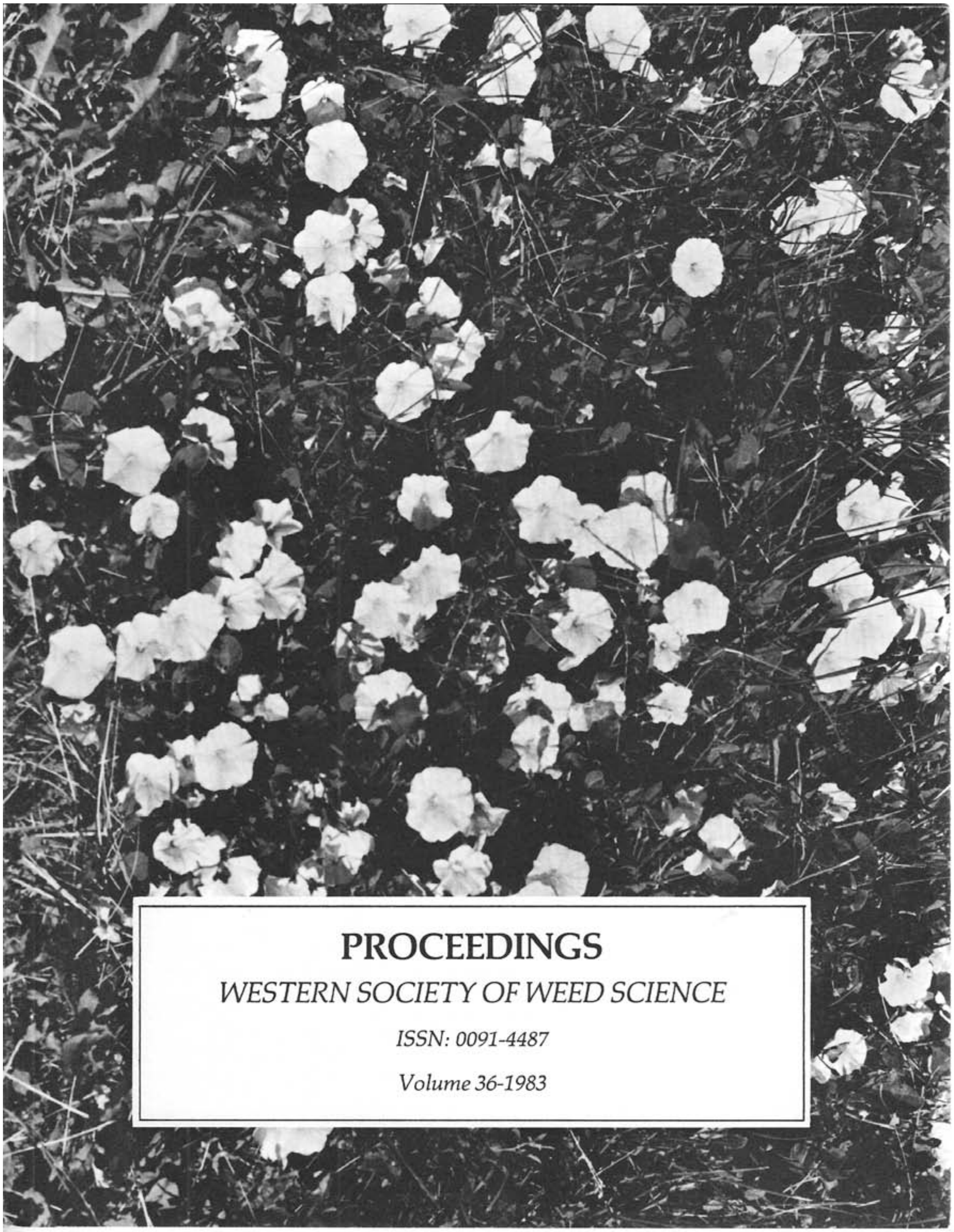

PROCEEDINGS

WESTERN SOCIETY OF WEED SCIENCE

ISSN: 0091-4487

Volume 36-1983

1983

PROCEEDINGS

OF

THE WESTERN SOCIETY OF WEED SCIENCE

ISSN: 0091-4487

VOLUME 36

PAPERS PRESENTED AT THE ANNUAL MEETING

MARCH 8, 9, 10, 1983

MGM GRAND

LAS VEGAS, NEVADA

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LOOKING FORWARD, THINKING BACK

J. Wayne Whitworth[1]

PRESIDENTIAL ADDRESS

Looking back may bring to mind pleasant memories of good times past, but it will not be very helpful in solving future problems or even those of today. We have spent our inheritance and must now suffer the consequences. Our planning must be based on the fact that cheap energy and reasonable interest rates are no more, and that we are currently associated with a business that produces such a surplus that we must beg people to buy our products at a price that will yield a profit.

Herbicides are one of the few cheap sources of energy still available to the farmer. This fact is underlined by the rapid growth of minimum till practices of land preparation and weed control. In pursuing this practice, we should not forget the lessons of the past. Selective pressure always creates new problems. Shifts in weed populations must be anticipated and provisions made to deal with them. Energy savings must also be developed in more efficient application and use of irrigation water.

A farmer can no longer stay in business with pump water costing $200 an acre unless more efficient methods of irrigation are developed. When such methods reduce the amount of water applied, herbicide efficiency will also be affected. We need more information on how to effectively use herbicides in conjunction with irrigation systems involving trickle or drip tubes, low pressure sprinklers, furrow checks, and alternate row irrigation.

As weed specialists you are a member of one of the closest knit fraternities in the world. Appreciate this association you have one with another. You younger members may think you are just a "kid" in the society right now, but tomorrow is just around the corner when you will be the "old man", so make haste slowly.

Ours is a field of endeavor with rapid developments involving increasingly sophisticated herbicides and methods of application. Computers must be recognized and utilized, but they will never replace common sense or honesty. They can tell more lies in a short time than the winner of the "liar of the year" award, and create a paper shortage in the process. Let us make the computer our slave, not our master.

Please see that both as students and teachers in Weed Science we do not become narrow vision specialists. It is important to become an expert in certain areas, but we must broaden our scope to appreciate that the solution to many problems is not possible without the input of a generalist, be he an Ecologist or an Agronomist. No solution to a weed problem that ignores the importance of crop and soil management will, in the long run, ever be adequate or economic.

Now a word to women in the field of Weed Science. Your presence complicates the business for us men, but it also enriches and makes more pleasant our environment, depending on your attitude and conduct. The presence of a good woman will bring out the best in most men. The only time you should stoop to the level of a man is when you help him lift a heavy sprayer. You can be a good worker who is unafraid of difficult or dirty jobs without compromising your femininity. Don't degrade it by crude language or profanity, or by wearing slovenly clothes as a badge.

Perhaps the most important idea for all of us to remember was expressed in a Christmas story by J. Edgar Park: "To love people, to be indispensible somewhere, that is the purpose of life. That is the secret of happiness."

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HAVE WE WON THE WAR AND LOST THE BATTLE?

Gerald W. Thomas[1]

I am honored to be invited to address the Western Society of Weed Scientists. I have had periodic interaction with your group and with a number of your members during my 30 years of experience in higher education. I have always been impressed by the quality of your scientific work and the excellent interaction that weed scientists have, through the Society, with representatives from business and industry who are an essential part of any program for progress in weed and brush control.

I will explain the title of my presentation, "Have We Won the War and Lost the Battle?" as I get into the text. In spite of the somewhat negative aspects of the title, my presentation will deal primarily with some positive aspects of the business of agriculture, and I will touch briefly on your role as weed scientists concerned with the future.

We have heard too much of the negative - the bad side - the pessimistic. Perhaps my farm background does not make me a good choice to talk about the positive side. After all, my family went broke on a farm in Medicine Lodge Creek in Idaho - partly because we had 1894 water rights and every year when we needed water the creek was too low to service the late rights. We were so short on water on the farm that when I had the opportunity I joined the Navy. There were times while I served as a torpedo pilot during World War II that I felt like some of today's farmers and ranchers. The war was important, the battle only a part of a larger objective, and those of us that were torpedo pilots were considered as just another weapon - expendable today for the sake of winning the war tomorrow.

In agriculture, our challenge has been to produce food. Well, in America we have done just that. Perhaps we have won the "war on hunger" but lost the battle to maintain the farm enterprise in the process. That's why the title of my talk is, "Have We Won the War But Lost the Battle?" Let us examine that question as we look to the troubles of today while trying to project a more positive future.

Sometimes on Sunday morning I listen to the Rev. Schuller on TV. He has frequently made the statement, "Tough Times Never Last - Tough People Do!" Perhaps this is a good approach. Let's look at some facts which are positive in today's setting.

Inflation is down. Federal Reserve Board Chairman Paul Volcker stated recently that he expects to keep inflation below the 5% level in 1983. I have the privilege of serving on the Dallas Federal Reserve Bank Board (El Paso Branch) and have enjoyed my interaction with the Board of Governors of the Federal Reserve, and I have great confidence in what they are doing.

The stock market has experienced the best rally in half a century which indicates confidence that we are on the road to recovery. Interest rates are down, and they may go down more, especially if the Federal Reserve cuts the discount rate by another one-half point. Interest rates generally follow the downward movement of inflation, but the correlation is not exact.

With interest rates down, our money will go further. The farmer's cost of operation will be down. One side of the formula is positive. Now we need to concentrate on the other side, i.e., marketing and production control. Our farmers and ranchers need to be "price makers" rather than "price takers."

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With the drop in interest rates, farmers will be paying lower rates for their loans. In 1950 interest amounted to only 3% of the total farm production expenses. This has grown to over 13% at present. Further interest declines are projected. This decline should help farmers, ranchers, and agribusiness operations both on their loans and on their costs of farm inputs.

Monetary policy appears under control. However, fiscal policy needs more attention. The national debt projected at over $200 billion will adversely affect interest rates. Too much government borrowing will compete with the financing of private industry.

One major effect of the Federal Reserve's tight monetary policy over the last three years has been a much stronger dollar in the foreign exchange markets. This is both good and bad. The stronger dollar makes it much harder for foreign governments to purchase U.S. products. It has reduced our competitive edge in terms of agricultural exports. Also, the stronger dollar has helped competitive industry abroad and has contributed to our losses in the "high technology shootout."

There is increasing concern about the size of our external debt to many nations - not only Mexico and Brazil, but to many LDC's and Middle-Income countries. Many foreign governments are in financial trouble. 26 economists from 14 nations gathered recently in Washington to conclude: "The global economy that boomed in the 60's, growing at an average rate of 5.5 percent a year and 4.3 percent in the 70's, simply stopped growing in 1981-82." They are looking to us for leadership in facing the financial crises. Mexico may finally be on the upward swing. The new President de la Madrid's leadership appears to be positive. Mexico, as you know, is of vital importance to us not only because it's our neighbor but because of our large volume of trade with that country. The LDC's are also important to us since one-third of our exports go to the less-developed countries. As we demonstrate fiscal responsibility, other governments will follow.

The international situation will prevent a more robust recovery here at home. However, the Federal Reserve Bank is projecting some leveling or depreciation of the dollar for 1983 which should help U.S. exports.

The export market for crops and livestock is critical to U.S. agriculture at a time when we have huge food stockpiles at home. We export the equivalent of the production of 1 out of every 3 acres on U.S. farms. Farmers, as well as the general public, now understand we cannot operate in isolation from other nations. Economically, American agriculture is at the lowest ebb since the Great Depression due to the depressed prices for farm products. Our farmers, as they see some of their neighbors declaring bankruptcy, are asking serious questions about our trade policy and our economic aid to foreign countries. They fear that U.S. agricultural policy is set by the State Department more than by the Department of Agriculture.

The European Economic Community is subsidizing programs to get agricultural products to markets where we cannot compete. The impact of the Soviet grain embargo still persists. China recently placed a retaliatory ban on cotton and soybean imports, and Japan has limited U.S. beef imports. Everywhere, we see problems with U.S. agriculture because we overproduce, while much of the world faces food deficiencies. Have we won the war on hunger and lost the battle on our farms?

The world food situation has improved in the past few years, i.e., it has improved if one examines the world grain supply as a measure of food availability. However, this improvement was not universally shared.

FAD reports that in 69 countries per capita grain production fell by 3% last year. Sub-Saharan Africa is still in serious trouble. The most quoted figure on people facing starvation of 500 million has been questioned. In spite of this question, there is no doubt that 500 million is a conservative figure if one considers the number of people in the world facing severe malnutrition or lack of balance in the diet.

A recent study by Wheeler of the Winrock Foundation pointed out that by 1985, 80% of all of the grain moving in the export market will come from the U.S. and Canada. Furthermore, he stated that in spite of the statements by some authorities that more grain should be diverted directly to humans from farm animals, the trends have been opposite. He states, "By 1985, worldwide use of grain for livestock feed will surpass that for human use by about 10 million metric tons." This statement reflects, in part, the importance of the world's vast uncultivated land base where the ruminant animal remains the best converter of forage to a human food product. Here again, weed and brush control are an important tool in raising the productivity of range and pasture lands.

I believe the move toward large corporate farms has slowed. Fewer industries are seeking tax write-offs in agriculture because they have found that the write-offs are so great that they may more appropriately be called bankruptcy.

Eighty-five percent of our farms and ranches in New Mexico are operated as family farm units. Our average farm size is 3,389 acres compared to the U.S. average of 4.5 acres. The average farm and ranch family in New Mexico had a net worth in 1981 of just over a million dollars. That's big business for a family farm!

Changes in the Estate Tax Laws now make it possible to pass agricultural holdings on to other family members with proper estate planning. This may help to hold some of the enterprises at an adequate size to constitute an "economic unit."

In New Mexico, 59% of our farmers and ranchers own the land they operate; 31% are part-owners - not counting the banks. The average age of our farmers is 51.4 years - a little older than the U.S. average. That means, again, maturity on our farms and perhaps the statement, "Tough times never last but tough people do," applies more to the agricultural sector than to other sectors of our economy.

We are experiencing a more balanced approach to environmental issues looking more toward management rather than protection per se - looking more toward reason than emotion. We see more responsible attitudes on the part of the Federal land managers. We see some relaxation in EPA standards for chemical use in brush and weed control and in predator control. This has provided some optimism for the agri-business sector and promising new products are in the development stage.

Some new and exciting management tools are now available to the agricultural sector. The micro-computer is the best example. With the use of the computer, we can provide a data base for decision making. Good business managers will survive these tough times. Good salesmen with a sound product to promote will also survive these tough times.

Several new scientific developments will help in the agricultural sector. Genetic engineering and tissue culture techniques are an example of this. We will be able to shortcut our research and testing processes in the field.

Water is perhaps the most important limiting factor in agricultural production for the long-term future. As energy prices ease up we will see more attention to water conservation and the development of new crops and weed control methods which will provide more effective use of the water resource.

There are new opportunities for intensification in farming. We see more attention to high-value crops. For example: The grape-wine industry is expanding into New Mexico and other parts of the southwest. The fastest growing ethnic food in the U.S. is presently Mexican food, and this means, for some areas in the southwest, more demand for chile and for ground beef.

We now have a better understanding of IPM (Integrated Pest Management) and all that IPM implies. We are taking a closer look at mechanization because of energy costs and looking at alternative or "appropriate technologies."

We see more emphasis on the Farming Systems Approach to research, i.e., examining the total system with the farmer as a part of the process. National attention is being focused on "no tillage" approaches to farming to reduce costs and conserve soil. As we look at these new techniques, we see new opportunities for the input of weed scientists and related industries interested in weed and brush control.

In the animal sector there is room for some optimism. The hog industry had a good 1982 and the price outlook is favorable for this next year. Feedlots and dairies should do better with cheap grain and lower interest rates. The horse industry is expanding in many western states in spite of the recession. Race tracks did well in 1982. Perhaps some of the farmers shifted their attention from gambling on the farm to betting on the horses!

In the near future, we will see more use of the new techniques for embryo transplants, controlled breeding, and computerized management. One of our scientists recently developed a heat-sensing device to detect ovulation in the female. This new device has received great interest from the dairy, swine and race horse industries since it is important to shorten the breeding time and increase the productivity over time. The 1982 reduction in the numbers of beef cows and heifers on American farms and ranches should reduce the likelihood of an over-supply of beef in the near future.

Major attention must now be placed on marketing. Most universities are strengthening their research in this area but the industry will have to commit more resources to finding new markets and to the study of market trends. For example: We do not completely understand all of the ramifications of changes in the fast-food industry.

Along with marketing, we now see more emphasis placed on production controls. President Reagan's PIK or Crop-Swap program may help but, as you know, it is controversial. Most of us believe that the first 15-20% of the reduced acreage will only yield about 5% in reduced crops because the farmers will lay aside the less productive acreage and concentrate more on the area planted. Also, large operators may not participate due to the dollar limit in the proposed program. Agribusiness - certain aspects of supply and off-farm activities may resist the new PIK program. The reduced acreage will mean less volume of business for suppliers, processors, and distributors of farm and ranch products.

I should add that the world food situation could change dramatically with a series of drought years. It doesn't take too much imagination to visualize what might happen if U.S. farmers decided not to plant at the same time the world weather changed to a pattern similar to that in the early '70's. At that time, starvation reappeared in several parts of the world simultaneously.

In this presentation, I have tried to list some of the positive aspects of the agricultural situation today. I have pointed to several opportunities for cost reductions and increased efficiency. I have emphasized the importance of marketing. All of these factors fit into a complex which I call a "Formula for Progress." This formula recognizes that, if we are to win the world-wide war on hunger and yet maintain a healthy farm enterprise, we must have (1) responsible government programs and policies; (2) adequate recognition of education and research, including the application of genetic engineering, proper use of chemicals, appropriate technologies for energy conservation, (3) attention to the off-farm sectors of supply, storage, processing and distribution, and (4) probably most important, we must provide an environment on the farm and ranch which stimulates both the "incentive to produce" and the "incentive to conserve" our important resource base. Your Society has an important role to play in both today's battle and the longer-term war.

AGROMEDICAL PRACTICES FOR PESTICIDE MANAGEMENT IN THIRD WORLD COUNTRIES

Virgil H. Freed[1]

Background

Disease and hunger, two of the dread horses of the apocalypse, are rampant among the poor of the less developed countries. Millions are afflicted with vector borne diseases or suffer malnutrition with little relief in sight. The populations of these countries lacking a technology capable of meeting the needs of their numbers, are unable to protect themselves from either disease or hunger.

The causes of this tragic situation are many. To ascribe it to any one cause is dangerously simplistic. Inadequate knowledge, the lack of a complex infrastructure to make resources and information available, the constraints imposed by economics, politics, and culture, all contribute to exacerbate the problem.

One may, however, single out pests -- weeds, insects, fungi, birds, rodents, and others, as significant, important causes of disease and food shortages in many of the countries of the world. To this must be added the caprice of climate, improper resource management, and a number of other factors that also exact their toll. Thus, WHO (World Health Organization) points out that schistosomiasis is second only to malaria as a principle of morbidity and mortality in the tropics. The maintenance and spread of this disease was linked closely, both with the extremes of lifestyle of the population, and the impact of the agro-ecosystem managment, particularly irrigations systems.

It is, however, the pest organisms that year after year wreak their havoc on the health and food supply of man. These organisms, whether native or introduced, are adapted to the environment, and persist in such numbers as to pose a continuing threat.

There are a number of insect vectors of such diseases as malaria, filariasis, and a variety of trypanosome diseases. Yet, other insects attack and destroy crops, transmit diseases, or consume the crop in storage. Weeds,

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a world-wide problem, seriously reduce crop production with some estimates ranging up to 30 percent or more. The result of the losses to these pests is malnutrition and starvation through food shortages and disease and death caused by the vector borne pathogens. It has been estimated that as many as 200 million persons in the world are afflicted with malaria, 300 million with filariasis, and altogether, about one in six of mankind has some insect vector borne disease. With respect to malaria, the greatest impact is on children less than four years old. Statistics on food losses are equally grim. Twenty to 40 percent of a crop on an average may be lost to weeds, insects, and diseases, and another 20 to 30 percent lost in storage. On an individual farm basis, the loss may be complete with ensuing disaster for the family.

The consequence of perennial disease/hunger syndrome is debilitation, if not death, limiting any effort that the afflicted countries may make to overcome the problems. Inanition and disease reduce productivity leading to an even greater problem of malnutrition and disease.

The question is whether there is any solution, even partial, to this pressing human problem. The consensus of expert opinion is that the fundamental first step is to bring the crop and human pest problem under control. Eradication is not feasible, but the application of technical knowledge and management capabilities to the problem of reducing the populations of disease vectors and crop pests to tolerable levels is possible. Tools to accomplish this include agro-ecosystem management, biological controls, crop rotation, resistant varieties, and very importantly, the judicious use of chemicals.

The long-term control of pest problems involve all of the foregoing techniques, used as appropriate, in a balanced program. However, not all teachniques are ready for immediate application, and indeed, are not even suitable to some of the problems. An integrated pest management program requires some time for research and development before ultimate application. This should not be a deterrent from pressing on to the development and ultimate use of IPM. Neither should misplaced confidence in biological control or integrated pest management to ultimately provide control measures for all pests, lead to a cavalier disregard for the need for immediate action. In many instances around the world, disease and hunger caused by pests are life-threatening and demand immediate, effective action. In almost every instance this means the use of an appropriate pesticide to provide assured, rapid, and effective control.

Concerns Over Pesticides

Some of the problems occasioned through use of pesticides in Third World countries has aroused considerable concern. The developed countries, who are the primary manufacturers of pesticides, have been accused of exporting poisons (12). Alarm is expressed not only for the impact of the pesticides on the people and environment of the Third World countires, but also that the residues of these materials may be exported to us in the food crops.

The fears expressed by some in the developed countries have had their influence in the Third World. In some instances, it has stimulated more intelligent awareness of problems, both real and potential, and led to efforts to ameliorate these problems. In other instances, it has created a fear and overreaction.

The concern expressed in some developed western countries does not always recognize that the situation in the developing countries is quite different. In most of the developed countries of the west, life-threatening vector borne diseases are almost unknown, and an adequate food supply is available the year round. The advanced health and agricultural technology, including the use of pesticides, goes far in assuring this happy situation. Under these circumstances, evaluation of the use of pesticides can be more concerned with possible effects from long term, low level residues, than with human survival.

Environmental conditions in most of the temperate zone developed countries also is substantially different. For example, the climate of the countries in the humid tropics fosters a multiplication of ectoparasites and vectors of human and animal diseases, and advances the biological clock of crop pests. Multiple generations, therefore, constitute a year-round threat. From 50 to 90 percent of the economy of many of these countries is agriculturally based, much of which is directed toward production of export crops in a plantation system.

In both rural and urban areas, pesticides are relied upon as an immediate and effective way to control pests and diseases in health and agriculture. This is reflected in the large increase of the amount of pesticides being imported, and sometimes manufactured in tropical countries. For example, since about 1965, the use of pesticides in Africa has increased almost five fold, similar increases are reported for other areas of the world.

It is true that even the safest of pesticides are often used in a manner that threatens the continued safety of the user and the environment. For example, in 1976 in the malaria control program in Pakistan, 2,900 people experienced intoxication from malathion. Five of these people died (1). In some areas, persistent pesticides, notably the organohalogens, continued to be used in agriculture.

It should be noted that in the tropical countries, environmental conditions are substantially different than those in the temperate region. The higher temperature, and in many instances, higher moisture level, plus a more intense irradiation, causes more rapid loss of chemicals through degradation and volatilization (9, 11).

Another factor in the Third World Countries is that they are often short on technically trained people. That is not to say they do not have people who are well trained, but the number is small. Moreover, in many instances, the populace has not been exposed to the level of technology taken for granted in the west. As a consequence, they are less familiar with the safe use of pesticides as technical tools in agriculture and health. But, it must be remembered that the area treated, or extent of use, is usually small in proportion to the land area. Heavy use through frequent application on a limited area is common, but would not involve as high a proportion of the cultivated acreage as might be found in the developed countries.

Agromedical Problems

The foregoing background illustrates the importance of various pests and their impact on food production, health, and economic welfare of the less developed countries. That nutrition and health are inseparable is unquestioned. Usually, this is thought of in terms of the ability of the well nourished to resist infectious diseases. But, this inseparability is equally true in the case of vector borne diseases. There is, hence, a confluence of the interest of medicine and agriculture in the health and welfare of society. A further factor weighs to drive this confluence in Third World countries. Since the economy of these countries is highly dependent on agriculture, the health and well-being of people is a vital element in productivity. This consideration gave rise to the concept of "agro-medicine" which is the practical blending of the arts and practices of medicine and agriculture for the benefit of man and his environment. In view of the limited number of trained people in Third World countries, it is essential that the health or agricultural practitioner have some knowledge and skills in the other science. For example, the agriculturalist is often the primary professional contact with a rural community. If the agriculturalist, in addition to providing assistance in agriculture can impart some health information such as proper use of pesticides in and around homes, something on public sanitation, and a bit on nutrition, he thereby multiplies the benefit to the community. Likewise, the public health worker must have an appreciation for the role and importance of agriculture in the rural community and be able to share some knowledge, at least of appropriate food crops that might be grown.

A number of years ago, US/AID funded a project on "Pest Management and Related Environmental Protection." This project supported teams of people going to Third World countries to provide assistance on pest control and proper use of pesticides. These teams, as others before them, discovered the existence of four specific problems in pesticide management. These are: (1) human and animal poisoning, (2) residues in food and the environment, (3) the development of resistence, particularly on the part of insects, and (4) the problem of safe disposal of waste pesticides and pesticide containers. Among these problems are equally those of health and agriculture. Improper use of chemicals in either instance impinges on the other area. The agromedical problems listed may be described briefly as follows:

Human and Animal Poisoning

As agriculture and public health switched from organochlorine to the organophosphate and carbamate insecticides, human and animal pesticide poisoning increased on a world-wide basis. This isn't to say that there were not human poisonings with the organochlorine compounds, but the organophosphates, being particularly more toxic to the mammal, greatly exacerbated the problem. It is evident, also, from the paucity of statistics on poisoning, that this is a problem whose magnitude is still not fully known, because in many areas of the world, acute pesticide related incidents are often unrecognized and universally under reported.

In a review of global pesticide safety, Copplestone (4) discusses this problem and reviewed the WHO estimates of the magnitude of the problem. The WHO expert committee (13) on safe use of pesticides, in 1972 concluded on the basis of a mathematical model based on the statistics of accidental poisoning for 19 countries, concluded that there were 500,000 pesticide poisoning cases annually. The mortality rate was estimated to be about one percent in those countries where medical treatment and antidotes were readily available. In a subsequent survey, it was found from a series of different countries that there was a poisoning rate of 2.9 to 4.8 per hundred thousand persons. The mortality, based on the number of poisoning cases, was about 5-1/2 percent, in other words, one out of about every 18 cases of poisoning resulted in a fatality. In many instances, the poisoning was the result of contamination of food or clothing, as well as careless use of the material.

Residues and Environmental Pollution

Persistence of chemicals, of course, contributes to residues in either food or the environment. The problem has been especially acute with the organochlorine pesticides, many of which continue to be used in tropical agriculture. However, even the organophosphates, where applied too near to harvest or at too high a rate, constitutes a problem.

An illustration of the problem of residues in food and the environment is illustrated from a case in Central America. In the production of cotton a pre-harvest application of organochlorine was a common practice. After harvest, beef cattle were turned in to graze on the cotton stalks before being taken to fattening pens. In the fattening pen they were fed on cottonseed meal and corn which had also been treated with an organochlorine insecticide for ear worm control. Needless to say, the residue levels were significantly high.

Development of Resistance

The speed of the biological clock in tropical areas means that there will be more generations of a given organism than would be found in temperate regions. It is not surprising, therefore, to find that because multiple application of pesticides is needed to control pests, resistance has developed, again primarily in the insects, but also is becoming evident in some of the weeds of the tropics. In the case of insects, often the resistance is fostered by use of pesticides in agriculture. Thus, for example, the extensive use of organochlorine and organophosphate pesticides on cotton, vectors of human disease, also indigenous to the area, develop resistance. Resistance, however, is not always confined to the chemical used, but may show cross resistance. This is the case with the carbamate insecticides where mosquitos that have developed resistance to organophosphates are also resistant to carbamates.

Disposal of Chemicals and Containers

This is a problem of some magnitude in many of the tropical countries. The high temperature and humidity, for example, will accelerate the decomposition of pesticides in open containers. Thus, often there will be distressed stock that must be disposed of. Not infrequently in the case of government programs, the amount of chemical ordered will far exceed the requirements. This then is just left, more often than not, in poor storage with deterioration of both chemical and container. All together too frequently, disposal consists of dumping the material into a nearby stream or putting it on a garbage dump. It takes but a little imagination to envision the problem that ensues.

Agromedical Practices Being Adopted

There is general recognition in the Third World countries that the well being of their people and the economy is dependent on a good agriculture. If too much of the national income has to be spent on importing food stuffs, little is left over for some of the essentials. To develop and maintain a good agricultural base, they are cognizant of the need to employ modern technology. This includes the use of pesticides in a safe and effective manner. Though integrated pest management for both insects and weeds is receiving attention, it is recognized that IPM is not developed to the state where it is applicable to all crop and pest problems. Therefore, there is strong interest in development of pesticide management practices consonant with the welfare of the country.

Agromedical practices in pesticide management had some of their initial development in Indonesia where one of the officials in the Ministry of Health acting on the agromedical concept set up pesticide management teams. These teams were composed of agriculturalists and public health people that had gone through a training program giving them a common core of knowledge on pesticide management and the role of pesticides in both agriculture and health.

Subsequently, the Agromedical Training Program, funded by US/AID, was carried to a number of other countries in Africa, Central and South America, the Philippines, other southeast Asian countries, and the Caribbean. In the Philippines, there are a number of physicians now that carry the specialty of agromedicine, and of course, agriculturalists that work closely in the public health area.

Many countries, following the training program, or on their own initiative, established an infrastructure within government and inclusive of industry in some cases, to carry out the agromedical practices. One of the notable examples that involves both a professional organization as well as governmental infrastructure, is found in Jamaica. There they have organized the Jamaican Agromedical Association to further training and implementation of agromedical practices for management of pesticides in both health and agriculture. In that case it is gratifying to see the public health worker expounding on cultural techniques to prevent erosion of contaminated soil into water ways, or an agriculturalist giving advice on control of vectors.

The practices that the health and agricultural workers trained in agromedicine try to promote include the use of protective clothing during application, correct storage, transport, and disposal methods, safe applications, and preventing environmental pollution with pesticides. These practices are having impacts as seen in a drop in poisonings in some countries, reduction of problems of pollution and more responsible handling of pesticides in general. But, it is not just government and university alone that is adopting the agromedical practices in pesticide management in the Third World. Many responsible multi-national firms are likewise promoting this and encouraging their local representatives and commercial outlets to observe these procedures.

Although there still remains many problems, it is encouraging to see that progress is being made. There is little question but what the welfare of many of these nations is dependent on developing a good agricultural base and getting control of vector borne diseases. Despite the criticism and concern of some over the use of chemicals in these countries, the control of pests, weeds, insects, and other organisms, is essential to this agricultural base. If we can help them utilize these chemicals more responsibly through introduction of agromedical practices, both they and we will have been the gainers.

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LATIN AMERICA: THE WEED SCIENCE CHALLENGE

L. C. Burrill, A. D. Deutsch and M. D. Schenk[1]

Abstract: Weeds in Latin America reduce crop production through direct competition and by limiting the amount of land a family can farm. The problem is complicated by an extremely diverse climatic, geographical, and governmental environment. Control measures commonly employed run the gamut from the most advanced to the most primitive. The few trained weed control specialists are often limited by factors beyond their control to the point of accepting better opportunities in private enterprise. Yet there is a nucleus of people and professional societies working hard to find acceptable weed control systems. Specialists in the United States can find personal and professional rewards be being alert for opportunities to assist colleagues in Latin America.

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Overview

From virtually any perspective -- geophysical, agricultural, or socio economic -- the challenge, conduct, and potential of weed science in Latin America are monumental. Dedicated nationals in nearly every Latin American nation are striving to translate weed science principles into effective and practical weed control efforts. But they face a set of circumstances that, in many situations, vastly complicate their chore.

Some aspects of the challenge parallel conditions found in the WSWS sphere, but many don't. Yet, there are opportunities, albeit selected, for western North American weed science expertise to assist in the implementation of research, training, and extension weed science activities in Latin America.

The status of weed science in Latin America should not be generalized, other than to say that the extent of knowledge and array of methods employed correspond to the prevailing range of agricultural sophistication. Small farm, slash-and-burn, subsistence agriculture frequently exists only a stone's throw from large farming operations, or multinational corporate plantations utilizing applicable modern agricultural technology. Frequently, a laborer who works with this modern technology returns home to practice traditional technology on his own property. The weak link in otherwise highly productive farming enterprises, as pointed out by Doll (8), quite often is weed control.

In 1975, Agundis spoke to WSWS on the "Status of Weed Science in Mexico" (1). He could have been speaking for any Latin American state when he observed that, "the weed problem in Mexico is quite variable due to the great differences in the ecological and edaphic conditions and the cultural practices prevailing in the farming areas." He also cited the wide diversity of crops grown in zones ranging from tropical to semiarid.

Diversity Problems

Geophysical. Latin America comprises a fair chunk of the world's real estate and includes, within its approximately 202 million square kilometers (78 million square miles) land mass, a number of extremes that have implications for weed science. Not only do altitudes, temperatures, and precipitation rates vary widely (Table 1), there is the element of rainfall unpredictability.

Where the climate favors cropping (and not infrequently, where it doesn't) small, subsistence farming often is relegated to steep, erosion-prone, rocky, or otherwise less farmable land. Fields that a farmer "can fall off of" present yet another hurdle for weeding.

Table 1. Latin America: Geophysical and Climatic Extremes

Element	high	low
precipitation, per year - mm (in.)	>2540 (100)	<254 (10)
temperature, ave. - F(C)		
- January:	72 (25)	23 (-5)
- July:	72 (25)	23 (-5)
elevation - m (ft)	>4000 (13,100)	-55 (-181)

Demographics. Educated estimates project nearly 350 million people in Latin America for 1982 and, at a 2.4% average annual population growth rate, the pressures on the land can only accelerate (Table 2). Coupled with more people is the fact that, on average, a third of the labor force is engaged in agriculture.

The vast numbers belong to a two tier agricultural system comprising a) the large, resource endowed enterprises, and b) the miniscule holdings of single land owners, often tradition and culture bound. Not only are the natures of the two farming levels opposite, so are the goals and guiding constraints.

In terms of crops, the gamut of food and fiber produced in Latin America is second to none. In fact, Latin America may be the indisputable center of germplasm for major crops: maize (*Zea mays* L.), potatoes (*Solanum tuberosum* L.), and tomatoes (*Lycopersicon esculentum* mill.), to cite three. Vegetables, fruit, cereals, beverage crops, sugar crops and fiber crops span the cropping spectrum.

Socio Economics. The subsistence-survival tier of farming embodies well-tested, if crude, techniques. The farmers are risk averse, and, while not unconscious of yield, are quick to opt for lower but assured yield levels. Access to capital and consequently to capital-requiring inputs is severly limited. Labor mainly derives from the family unit.

The opposite pole, the corporate plantation or commercial farm, can more easily gamble by relying on technology aimed at maximizing yield. Labor is but another cost, though an ever more scarce resource. Management attention focuses on profit and how to increase it.

Weeds impact farming at both tiers, but with different results. Many small farmers recognize the need to control unwanted vegetation. In high rainfall tropical areas, the battle against intrusive vegetation never ends. Voraciously growing grasses and other species must be restrained (or removed) before a crop can be planted. And the farmer, as he moves through his field, better not look back to see how fast regrowth occurs. Often, even on small holdings, the area a farm family can keep weeded is the area they farm; the rest of their land is left in fallow.

At the large farm level, weeds are no less of a drain on resources, but the extent of resources and weapons to throw into the battle is far greater than for subsistence farms. Thus, to the extent inputs are available, plantation managers -- with the advice of resident specialists in some cases -- can devise and conduct an active weed control program.

Governmental Presence. While governmental operating policies and imperatives may seem distant from the front lines of the weed war, their impact often is direct. Subsidies of certain crops deemed important to the national welfare, such as sugarcane (*Saccharam officinarum* L.) destined for gasohol distillation in Brazil, encourage greater efforts at overall crop protection. Incentives to utilize more labor, or restrictions on the import of agrichemicals (related to either foreign currency drain or environmental concerns) obviously affect the nature and extent of weed control. Some governments are intrusive, others adopt a laissez-faire stance.

Compared to a single EPA in the U.S., with a state by state overlay, the situation in Latin America with 21 national governments plus a host of provincial and local public administrations, vastly complicates the regulatory aspect of agrichemical sales and usage.

Table 2. LATIN AMERICA: DEMOGRAPHICS

country	est. 1982 population (millions)	annual population increase (%)	labor forces engaged in agriculture (%)	1980 per capita GNP (US$)
Argentina	28.6	1.6	13	2,390
Belize	0.2	1.8	29	1,080
Bolivia	5.6	2.7	46	570
Brazil	127.7	2.4	39	2,050
Chile	11.5	1.5	16	2,260
Colombia	25.6	2.0	28	1,180
Costa Rica	2.3	2.5	36	1,730
Ecuador	8.5	3.1	45	1,220
El Salvador	5.0	2.7	41	590
French Guiana	0.7	3.2	-	2,580
Guatemala	7.7	3.2	57	1,110
Guyana	0.9	2.1	22	690
Honduras	4.0	3.5	61	560
Mexico	71.3	2.5	40	2,130
Nicaragua	2.6	3.4	42	720
Panama	1.9	2.1	51	1,730
Paraguay	3.3	2.6	44	1,340
Peru	18.6	2.8	40	930
Suriname	0.4	2.0	18	2,840
Uruguay	3.0	0.8	16	2,820
Venezuela	18.4	2.9	19	3,630
Total	347.8	-	-	-
Weighted ave.	-	2.4	35	-
U.S.	232.0	0.7	3	11,360
United Arab Emirates	1.2	2.3	5	30,070

Publicly supported activities, such as research extension and teaching also enter the weed control equation. The lack of administrative coordination between agencies charged with research, extension, and teaching remains a problem often cited for anemic agricultural development. All teaching takes place within universities, while ministries of agriculture conduct the bulk of research. Though usually within the ministry, extension services tend to be organizationally separate. Communication and coordination become difficult at best, and often simply succumb to arbitrary bureaucratic blockages and rivalries.

Resources and Roles

Weed Research in Latin America.

Country level. Based on a survey he conducted in 1981, Doll (8) concluded that, "most countries in Latin America have a nucleus of trained, highly motivated weed science researchers." Earlier, Doll (7) had noted that deficiencies of equipment, trained support personnel, and financing result in rapid turnover of researchers, thus thwarting attempts to build a stable research presence. Low salaries, poor facilities and little opportunity for advancement are other common reasons for leaving public institutions.

Various Latin American countries have built up excellent weed research teams and programs in the past 15 years, only to see them dissolve as personnel grew discouraged and sought (and found) less frustrating and more rewarding opportunities.

Attractive opportunities for researchers traditionally have occurred in two areas. Probably the largest number of individuals have left national or local programs to join the agrichemical industry; others have been promoted to administrative positions within their parent organizations. Thus, the experience and training of these researchers has not been lost entirely; their relocation is a normal process to be anticipated, and an event that should not halt a well organized research effort.

On the plantations. Many of the larger plantations and farms in Latin America maintain a professional agronomist on the technical staff. Usually this position carries responsibility for advising on weed control programs. Agronomists often conduct some applied research, generally with chemical weed control methods, in search of more effective weed control tactics. Often this will be done collaboratively with aggressive chemical company representatives.

Weed Science Societies. Nine national weed science societies and one regional international group have formed and are active, to differing degrees, in Latin America. These are:

Sociedad Ecuadoriana de Malezas (SEM)
(Ecuadorian Weed Society)

Sociedade Brasileira de Herbicidas e Ervas Daninhas (SBHED)
(Brazilian Herbicide and Weed Science Society)

Sociedad Mexicana de la Ciecia de la Maleza
(Mexican Weed Science Society)

Sociedad Venezolana para el Control de Malezas (SOVEM?)
(Venezuelan Weed Control Society)

Associacion Argentina para el Control de Malezas (ASAM)
(Argentine Weed Control Society)

Sociedad Colombiana de Controle de Malezas y Fisilogia Vegetal (COMALFI) (Colombian Weed Control & Plant Physiology Society)

Sociedad Peruviana de Control de Malezas
(Peruvian Weed Control Society)

Sociedad Boliviana de Control de Malezas
(Bolivian Weed Control Society)

Sociedad Chilena de Control Malezas
(Chilean Weed Control Society)

and,

Associacion Latinoamericana de Malezas (ALAM)
(Latin American Weed Society)

A few exist in name only while others have maintained their momentum for over a decade.

One of the more noticeable limitations facing researchers in Latin America is the current lack of communication with colleagues regarding common problems and research results. Research results, whether arising from work conducted by public or private entities (perhaps with the exception of the agrichemical industry) are rarely shared and only infrequently published.

The professional society, notes Burrill (5), stands as an effective communication method for weed science research and information. A group can be organized with relatively little expense and no need for outside assistance. A newly formed society usually placed an initial conference high on its agenda. When members (and interested others) gather, communication occurs. A logical second step involved publishing information and attempting to distribute it to members and others for whom it may have value.

The Latin American national groups and international society have not been utilized to their full potential for this purpose. Currently only the international and two national societies regularly publish a journal. Aside from the occasional conference proceedings, few attempts are being made to publish results of ongoing research.

Agricultural Research Centers.

A discussion of agricultural research in Latin America would be incomplete without reference to the activities and contributions of the four international agricultural research centers (IARC's) in Latin America.

Centro Internacional de Mejoramiento de Maize y Trigo (CIMMYT). The oldest of the group, CIMMYT was established in Mexico during 1966. It focuses its resources on research and training related to improving production of wheat (*Triticum* spp.), maize, barley (*Hordeum* spp.), and triticale (*Triticale* spp.). The core staff does not (and never has) include a weed scientist, although production agronomists have conducted limited weed control research. Work has emphasized identifying chemical control for *Avena fatua* and *Phalaris minor* and preventing weeds from interfering with other research at CIMMYT's various experiment stations (6).

Centro Internacional de Agricultura Tropical (CIAT). CIAT, established at Cali, Colombia in 1967, now conducts research work in beans (Phaseolus spp.), cassava (Manihot esculenta Crantz.), beef and forages, maize, rice (Oryza sativa L.), and swine. CIAT once had an active and productive weed science research and training program, but discontinued it in 1977. Presently, a general agronomist in each of the three major programs (cassava, beans, and beef) carries responsibility for weed research (6).

Centro Internacional de la Papa (CIP). Devoted exclusively to improving production of (the "Irish") potato, CIP opened in 1971 at Lima, Peru, close to the origin of edible Solanum spp. The Center has operated without a staff weed scientist. Weed control activities have been limited primarily to cultural practices including hilling procedures, intercropping, mulching, and manual labor (6).

Centro Agronomico Tropical de Investigacion y Ensenanze (CATIE). This center was organized in 1973 at Turrialba, Costa Rica (based on a long-established agricultural research station) to concentrate on improved cropping systems for small farms, livestock, and forestry. Between 1976 and 1982, a weed science presence and program was conducted by a team from the International Plant Protection Center (IPPC) at Oregon State University. Research was directed toward developing both biologically and economically acceptable weed control systems. The status of a continuing weed science effort at CATIE is unsure, though IPPC continues to provide periodic assistance.

The Herbicide Industry. Does Latin America represent a significant opportunity for industry? Consider that, of US $9.8 billion in worldwide pesticide sales at the user level in 1979, the region accounted for 10%, approximately (2).

Many international agrichemical companies conduct field research in Latin America either operating their own experiment stations, or cooperating with governmental agencies or larger farmers to perform the necessary work. Types of research most commonly carried out by industry representatives in developing countries are: late stage herbicide screening; herbicide testing under prevalent local environments and cropping systems to determine appropriate rates and times of application; and various efficacy and environmental impact studies as part of national registration requirements.

Agrichemical companies must, because of their nature, have limited objectives (3). In general, these involve discovering, developing, and marketing new materials which have sufficient sales potential to make a profit. Until a product is put on the market and utilized by farmers, an agrichemical company has little impact on local agriculture.

Herbicides are still a novelty in many areas where small farm agriculture predominates. Quite obviously the agrichemical industry cannot meet all of the research needs of small farmers; equally obvious, they cannot serve all commodities. Only the relatively extensive crops will receive much agrichemical company attention. For example, in the United States corn and soybeans have been estimated to account for 69% of the herbicide use in 1981. The figure was 41% on a worldwide scale (2).

Company representatives, however, can have a broad and positive impact at the local level because they generally travel more often and more widely than public researchers with whom they associate. They also can contribute to the orderly growth of the science by being active in national and regional weed science societies.

One Program's Experience

Fifteen Years in Latin America. Under a contract with the U.S. Agency for International Development, the International Plant Protection Center (IPPC) has operated an on-site weed control-weed science program in Latin America since 1966. A senior staff weed scientist was first assigned to Colombia, followed a year later by another staff member posted in El Salvador. In 1969, a third specialist began a program in Ecuador with added responsibility in Panama.

These three programs had as objectives the development of weed control research and training programs in the respective country or region. Activities included training counterpart specialists, conducting field research to find solutions to pressing weed problems, conducting training programs, and preparing publications on training, weed control recommendations, and weed identification.

In 1973, the IPPC effort changed emphasis to focus increased attention on weed problems as they affected small farms. That year a team of two weed control specialists and an agricultural economist began work in the semi-arid, less developed Brazilian Northeast Agreste region, collaborating with governmental counterparts and agencies. Economic data were gathered - including an extensive on-site survey of small farm operators - as well as agronomic.

The IPPC team investigated two starkly differing forms of agriculture: (1) the sugarcane, hired-labor, plantation economy of relatively wet coastal Pernambuco State, and (2) the diversified, small "family" farm agriculture of the same state's dry interior Agreste region. The dual approach was justified by both sectors' regional importance and the fact that it reflected the multi-tier characteristic of agriculture in many developing countries.

Research and investigation suggested the prospects for technology change - in weed control or nearly any other aspect - for the small farm segment studied were extremely limited. Under the physical and economic environment of the area, the commonly practiced one or two hand-weedings by small farmers emerged as the least cost, least risk weed control method with yields equal to the best chemical control.

In contrast, sugarcane estate operators had a clear incentive to adopt herbicides as governmental policies and market forces increased the monetary attractiveness in comparison to traditional weed control. Data indicated that the relative costs of manual and chemical weed control systems were largely determined by labor wage rates and prevailing price of herbicides. Both were distorted from "free market" levels by governmental policy. Payroll taxes increased the cost of labor to employers by 40%. Herbicides, on the other hand, were favored indirectly by subsidized credit, exemption from domestic taxes and import tariffs, and importation at overvalued exchange rates. The combination of factors tilted sugarcane farming toward the use of herbicides.

From 1976 to 1982, IPPC's activities in Latin America primarily focused on Central America. Project agronomists and economists worked jointly with specialists at the Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE) in Costa Rica to develop weed control systems suitable for small farmers of the region.

Small Farms and High Rainfall. Initial surveys of Costa Rica led to the conclusion that extremely vigorous weed growth in the high-rainfall Atlantic zone was a major crop yield depressant and cause of high labor costs. IPPC and CATIE launched a research effort and series of experiments in an attempt to improve weed management systems for small farms.

Results suggested that modifications of current practices could produce definite advantages for small farmers. Some form of minumum or zero-tillage appeared to be the best answer for weed control in both maize and bean production. The systems devised were flexible; depending on the predominance of annual or perennial weeds, growers could use either paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) or glyphosate [n-(phosphonomethyl)-glycine] to kill vegetation prior to seeding. The resulting mulch helped prevent weed regrowth after crop emergence. Farmers also had the option to supplement the mulch by using herbicides between the crop rows or hand-weeding as needed.

Perhaps the most useful spin-off of the small farmer project in Costa Rica was design and development of a locally fabricated, inexpensive spray shield for use with knapsack sprayers. Some farmers had used paraquat to control between-row weeds in maize. Application was made with a knapsack sprayer, but only after the maize plants had gained sufficient size to allow the spray to be directed under the plant's lower leaves. By using the spray shield, spray droplets were controlled, the plants and leaves protected, and most importantly, application now could occur much earlier when both maize and weed plants were small and before serious competition had taken its toll.

Weed Science Needs in Latin America Research, Extension, and Teaching

In 1981, Doll (8) conducted a survey of weed scientists working in Latin America. Based on responses and his own experience, he suggested the following needs in research, extension, and teaching.

A. Research

1. More trained personnel especially in Central America, Paraguay, and Bolivia
2. Further research on weed management is needed in these areas:
   a. minimum and no-tillage systems,
   b. perennial weeds,
   c. mixed cropping systems,
   d. upland rice, beans, maize, cassava and other "subsistence" crops,
   e. pastures and ranges.
3. Greater attention to integrated control measures and balanced research programs which do not over-emphasize herbicides.
4. More on-farm research trials, especially on small farms.
5. Studies on the long-term effects of weed management systems in various cropping patterns.
6. Better documentation of the losses due to weeds at various levels of control.
7. Integration of weed management into overall pest management programs and research to study the interactions between various pests.
8. Increased attention to weed biology and physiology.
9. Studies on herbicide application technologies, especially those suited for small farmers.

B. Extension

1. Commitment by governments to create extension weed scientist positions in most countries.

2. Most countries would benefit from reorganization within the Ministry of Agriculture to more closely integrate research and extension programs.
3. More on-farm demonstrations of weed management methods.
4. Intensive weed science short courses and training opportunities for extension workers.
5. More farmer-level publications on topics such as:
   a. competition and losses due to weeds,
   b. weed control recommendations,
   c. weed identification,
   d. sprayer selection, calibration and maintenance,
   e. factors affecting herbicide performance.
6. Development of non-written media to use with illiterate audiences.
7. More attention on preventative and cultural weed control practices by extension workers.

C. Teaching

1. Additional trained professors of weed science are essential.
2. Better field, laboratory and controlled environment facilities to conduct research at most Latin American universities are needed.
3. More universities need to make weed science a required course for agronomy students.
4. Improved availability of weed science texts, especially in Spanish, is necessary.
5. Increased opportunities for students to obtain "hands on" experience in weed management would be beneficial.
6. Development of integrated pest management courses which include weed science should be done at most universities.
7. Closer involvement of university instructors with weed science researchers and extension workers in each country is desirable.

Publications. A critical need facing professionals attempting weed science research or training in Latin America involves up-to-date, relevant printed materials. Ideally, publications would be produced in Spanish or Portuguese to have maximum impact. Availability is but part of the problem; the dearth of materials is compounded by the communication gap. Dedicated workers in Latin America often aren't aware of existing, potentially useful publications. Table 3 lists various types of publications that might be useful to weed science efforts in Latin America (4).

Table 3. Partial List of Weed Science Publications for Latin America.

Anon. 1977. Herbicidas em florestas - apostilas (2 vol.) (Forest herbicides - mimeograph.) Piracicaba - SP, Instituto de Pesquisas e Estudos Florestais. 358 pp.

Anon. Malezas de Chile. Boletin Tecnico No. 15 del Institute de Investigaciones Agropecuarios-Estacion Experimental La Platina. Casillo 5427 - Santiago, Chile.

Anon. Principios de Control de Malezas en Colombia Instituto Colombiano Agropecuario (ICA) 45 p. Spanish

Bristow, J., J. Cardenas, T. Fullerton and J. Sierra. 1972. Malezas acuaticas (Aquatic weeds). Published jointly by the Instituto Colombiano Agropecuario, Director do Commun. A. A. 7984, Bogota; and by Oregon State University, International Plant Protection Center, Corvallis. 115 pp. Spanish and English.

Burrill, L. C., J. Cardenas and E. Locatelli. 1976. Field manual for control research. International Plant Protection Center, Oregon State University, Corvallis. 60 pp. English and Spanish.

Camargo, P. (ed.). 1970. Texto basico de control quimico de plantas daninhas. University of Sao Paulo, Escola Superior de Agricultura Luiz de Queiroz, Peracicaba, Sao Paulo. 257 pp. Portuguese. Five hundred weed species occurring in Brazil are listed.

Cardenas, J. 1969. Manual de terminologia de control de malezas y fisiologia vegetal. Sociedad Colombiana de Control de Malezas y Fisiologia Vegetal, Bogota. 74 pp.

Cardenas, J., O. Franco, C. Romero and D. Vargas. 1970. Malezas de clima frio. International Plant Protection Center, Oregon State University, Corvallis / USA. 127 pp. Spanish.

Cardenas, J., C. Reyes, J. Doll and F. Pardo (eds.). 1972. Malezas tropicales (Tropical Weeds). Vol. 1. Instituto Colombiano Agropecuario, Bogota; and Oregon State University, International Plant Protection Center, Corvallis / USA. 341 pp. English and Spanish.

Detroux, L. and J. Gostinchar. 1966. Los herbicidas y su empleo (Herbicides and their use). Oikos-tau, s.a. - Ediciones Vilassar De Mar - Barcelona, Spain.

Doll, J. 1977. Manejo y control de malezas en el tropico. CIAT, Apartado Aereo 67-13, Cali, Colombia. 114 pp.

Ferreyra, R. 1970. Flora invasora de los cultivos de Pucallpa y Tingo Maria. Botanica Sistematica de la Universidad Nacional Mayer de San Marcos, Lima. 263 pp. Spanish.

Freitas, L. F., C. Aranha and O. Bacchi. 1972. Plantas invasoras de culturas no estado de Sao Paulo (Crop weeds of the state of Sao Paulo). 2 Vol. Editora Humanismo, Ciencia e Tecnologia "HUCITEC" Ltda. Sao Paulo.

Garcia, J. G. L. et al. 1975. Malezas prevalentes de America Central (Prevalent weed of Central America). International Plant Protection Center, Oregon State University, Corvallis, OR. 162 pp. English and Spanish.

Garcia, J. V. and J. M. Gonzalez. 1973. Manual de malezas en el Peru-Communes en cana de Azucar. Publicado bajo el Patrocinio y Auspicio do i Mag and Baker Ltd. Dagenham, Inglaterra. 224 pp. Spanish.

Jurgens, G. 1975. Curso basico sabre control de malezas en la Republica Dominicana (Basic course in weed control). German Agency for Technical Cooperation Ltd. (GTZ), 6236 Eschborn, West Germany. 173 pp.

Klingman, G. C. and F. M. Ashton. 1980. Estudio do las plantas nocivas - principios y practicas. Editorial Limusa, S. A. Balderas 95, Primer piso, Mexico 1, D. F. 449 pp. Translation of 1975 book in English.

Kogan, M., R. Lazen and C. Fernandez. 1973. Principios de control quimico de malezas en huertos frutales (Principles of chemical weed control in fruit orchards). Fac de Agronomia. Univ. de Chile. 74 pp.

Leitao, H., C. Aranha and O. Bacchi. 1972. Plantas invasoras de culturas no estado de Sao Paulo (Crop weeds in the state of Sao Paulo). Empresa Grafica da Revista dos Tribunais S.A., Sao Paulo. 291 pp. Portuguese.

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Lorenzi, H. 1982. Plantas Daninhas Do Brasil. Available from the author at Avenida Brasil, 800, 13.460 - Nova Odessa - Sao Paulo, Brazil.

Lorenzi, H. J. 1976. Principais ervas daninhas do estado do parana (Principle weeds of the state of Parana). Bulletin No. 2, Instituto Agronomico do Parana. IAPAR, C. P. 1331, Londrina 86100 Parana. 208 pp. Portuguese.

Morales, I. A. et al. 1974. Algunas malezas de potreros tropicales. ICA (Instituto Colombiano Agropecuario) CIAT (Centro Internacional de Agricultura Tropical), Universidad Nacional de Colombia. 274 pp. Spanish.

National Academy of Sciences, USA. 1976. Making aquatic weeds useful: some perspectives for developing countries. National Academy of Sciences, Washington DC / USA. 175 pp. English with summaries in French and Spanish.

Perez, E. 1965. Plantas utiles de Colombia. Libereria Colombiana, Bogota, Colombia. 831 pp. Spanish.

Programma Cooperativo de Experimentacion Agropecuaria. 1954. Diccionario de plantas cultivadas, hierbas silvestres y malas hierbas en el Peru. 56 pp. English and Spanish.

Conclusion

The scope of weed management in Latin America stretches the imagination, second only to the urgent need for innovative approaches to establishing control programs. In many regions, the alternatives for control programs tend to be far more limited than is generally the case in North America. Climatic vagaries, economic limitation, and burdens of tradition, all overlaid by national policies that often neglect crop protection for all but the major foreign-exchange generating export crops, deepen the challenge.

There are dedicated professionals in nearly every Latin American nation who have accepted the challenge despite the limited resources available to them. But the talent pales in the shadow of the problem, thus creating an opportunity for collaboration with colleagues in North America.

Agronomist-weed scientists in this Society could well consider the possibility of involvement and, in fact, several have engaged in extensive international weed control activity. There are several avenues to consider. Individually, Society members can become more familiar with the problem set in specific regions, or crops, of Latin America. Willingness to accept consulting assignments could be mutually beneficial. Those closer to the point where they no longer need current weed science publications (or even extensive collections of periodicals) might consider donating them to the library of an educational institution in Latin America (a program being worked out and coordinated through the International Affairs Committee of the Weed Science Society of America).

As a whole, WSWS might investigate establishing some sort of collegial relationship with a selected counterpart professional group in Latin America. Sponsorship of exchange visits, sharing of information, and generally fostering and furthering weed science could be of mutual benefit for all involved.

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CHLORSULFURON EUP REVIEW

G. E. Cook, L. F. Taylor, J. R. Wix and N. D. McKinley[1]

During 1981 and 1982, chlorsulfuron (2-chloro-*N*-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide), sold under the trade name "Glean" Weed Killer, was evaluated under a federal Experimental Use Permit. Tests were conducted in 16 states, primarily in the Central Great Plains and the Pacific Northwest. Over 4,200 cereal growers participated in this program. This presentation will discuss the objectives and results of this successful program.

[1]E. I. Du Pont de Nemours and Co., Wilmington, Delaware 19898.

The five main objectives were: 1) Correlate data from small plots to large scale commercial applications, 2) refine use rates, 3) measure performance under a wide range of soil and climatic conditions, 4) monitor recropping results, 5) evaluate grower acceptance of handling characteristics.

Based on the data accumulated, Du Pont received in September, 1982, a federal label for chlorsulfuron use in wheat, barley and fallow on soils of pH 7.5 or lower, with rotational crops restricted to cereals.

Results obtained on more than 50 weed species, primarily broadleaf weeds have been good to excellent within the rate range of 0.125 - 0.375 oz. ai/A. Chlorsulfuron possesses both preemergence and postemergence activity. For optimal postemergence activity, susceptible weeds should be sprayed from emergence to two inches tall or two inches in diameter. A surfactant should be included at 0.25% V/V rate (1 qt. per 100 gallons). Liquid fertilizer can replace the need for surfactant. Canada thistle, kochia, Russian thistle, catchweed bedstraw, wild buckwheat, and certain grasses may only be suppressed by chlorsulfuron. Suppression is defined as a visual reduction in size, vigor or population density when compared to untreated areas.

In the Pacific Northwest, fall applications of chlorsulfuron have provided good control of kochia, mustards, Russian thistle, wild buckwheat and very small corn gromwell. In the winter wheat areas of Kansas, Oklahoma and Texas, where fall crop fertilization is practiced, chlorsulfuron efficacy was maintained when combined with liquid fertilizer.

In fallow, use of various tillage practices did not significantly reduce the activity of chlorsulfuron if sufficient moisture was available to move it into the soil prior to tillage. Good weed control was usually due to: 1) adequate rainfall following treatment, 2) treating weeds which were 0-2" tall or across, 3) treating weeds which were not hardened off due to cold temperatures or drought stress, and 4) thorough coverage with fan nozzles.

Some examples of weed species not adequately controlled by chlorsulfuron at recommended use rates include nightshade species; buffalobur; groundcherry and horsenettle; field bindweed; skeleton-weed; toothed spurge; cheat and downy brome grasses; common rye; wild oats; jointed goatgrass and knapweed.

A major benefit of the use of chlorsulfuron is the extended period of weed control that can be obtained. Applications made in fall or spring can provide weed control through to harvest and, in certain instances, post-harvest control has been noted. The length of control is dependent on weed sensitivity, use rate, soil pH, rainfall and temperature. As soil pH increases and rainfall and temperature decrease, duration of control will generally increase.

Weed control efficacy in fallow is most consistent when chlorsulfuron is applied post-harvest in fall or in early spring (February-March). This application timing allows rainfall to distribute chlorsulfuron within the top 2-4 inches of soil. By obtaining this herbicidal profile in the soil, root uptake is maximized.

Chlorsulfuron was found to be physically and biologically compatible with commonly used cereal and fallow herbicides. These include: bromoxynil (3,5-dibromo-4-hydroxybenzonitrile), metribuzin (4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one), diuron (3-(3,4-dichlorophenyl)-1,1-dimethylurea), 2,4-D ([2,4-dichlorophenoxy]acetic acid), dicamba

(3,6-dichloro-*o*-anisic acid), glyphosate (*N*-(phosphonomethyl)glycine), paraquat (1,1'-dimethyl-4,4'-bipyridinium ion), chlorpropham (isopropyl *m*-chlorocarbanilate), difenzoquat (1,2-dimethyl-3,5-diphenyl-1*H*-pyrazolium), triallate (S-(2,3,3-trichloroallyl)diisopropylthiocarbamate), barban (4-chloro-2-butynyl*m*-chlorocarbanilate), diclofop methyl (2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid), and pronamide (3,5-dichloro(*N*-1,1-dimethyl-2-propynyl)benzamide).

Spray volumes of one gallon per acre with fixed wing or rotary aircraft and 3 to 40 gallons per acre with ground equipment are recommended. With ground equipment, flat fan nozzle tips provided the most consistent results.

Growers responded favorably to the handling characteristics of the dry flowable formulation. The small container and graduated measuring cylinder permitted rapid and accurate measuring.

Chlorsulfuron can be used on many varieties of barley, spring wheat (including durum) and winter wheat with good to excellent crop safety. On wheat, chlorsulfuron may be used as either a pre or postemergence treatment. Barley should be treated only postemergence. Test work will continue on additional cereal varieties.

Many broadleaf crops are extremely sensitive to low concentrations of chlorsulfuron in soil. Consequently, chlorsulfuron should only be used on land dedicated to continuous wheat, barley, fallow rotations. A field bioassay must be performed before rotating to a crop other than wheat or barley.

Chlorsulfuron is chemically degraded to biologically inactive compounds. As with other chemical reactions, environmental factors such as soil temperature, moisture and soil pH, each influence the rate of degradation. In general, low pH, high rainfall and long periods of warm soil temperatures accelerate degradation, while high pH, low rainfall and low soil temperatures slow the degradation process.

Extensive recropping studies are in progress utilizing EUP sites from 1981 and 1982. In addition, experiments conducted by university investigators are providing data from plots established as long as three to four years ago. As this data base increases, the recropping provisions on the current federal label are likely to be shortened for certain crops.

Summary

As a result of the EUP program, we made label changes in these areas: 1) increased surfactant rate, 2) flat fan nozzles/spray volumes, 3) crop rotation guidelines, 4) soil pH restriction, 5) weed spectrum, and 6) effect of rainfall.

We believe that current label guidelines and instructions allow growers the opportunity to make a prudent judgement as to whether or not chlorsulfuron fits their cropping practice.

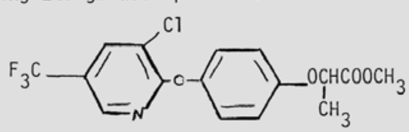
Accurate use rates along with recommendations on timing and application techniques give the grower a high probability of getting excellent weed control for an extended period of time with a very low risk of crop injury.

DOWCO 453 ME, A NEW POST SELECTIVE HERBICIDE FOR ANNUAL AND PERENNIAL GRASS CONTROL IN COTTON AND SOYBEANS

L. E. Warren[1]

Abstract: DOWCO 453 ME (Methyl-2-(4-((3-chloro-5-(trifluoromethyl)-2-pyridinyl)oxy)phenoxy)propanoate), is a new postemergence herbicide for control of annual and perennial grasses in broadleaf crops. To date, no activity has been observed on broadleaf crops, broadleaf weeds or sedges when the herbicide is applied at suggested use rates. While DOWCO 453 ME is selective to all broadleaf crops, initial registration efforts in the United States will be directed towards cotton and soybeans.

DOWCO 453 ME is formulated as XRM-4570, an emulsifiable concentrate containing 240 gm a.e. per liter.



DOWCO 453 ME has exhibited excellent herbicidal activity when applied as a foliar spray to a wide range of annual and perennial grass species. In areas of adequate rainfall, most annual grasses are controlled at 0.14 Kg/ha and perennial grasses at 0.14 to 0.28 Kg/ha, provided adequate crop competition is present. However, under conditions of high temperature and low humidity, slightly higher rates may be required.

Effective preemergence control of annual grasses can also be achieved, but rates 2 to 4 times those needed for foliar applications are required. Soil residual from postemergence applications is sufficient to provide extended control of later germinating grasses. The length of such control depends on the dosage applied, extent of crop competition, soil and environmental conditions.

The use of crop oil concentrate, crop oil or a nonionic surfactant is recommended for consistent control with DOWCO 453 ME. Suggested adjuvant rates are 2.5 L/ha for crop oil concentrate or crop oil and 3/4 L/ha for nonionic surfactants. Information to date indicates that the addition of crop oil concentrate provides the most consistent control of larger sized annual and perennial grasses. A spray volume of 190 L/ha is suggested.

Suggested Use Rates

Grasses	Kg/ha	Growth Stage
Annual Grasses	0.07 - 0.28	up to 20 cm
Rhizome Johnsongrass (*Sorghum halepense*)	0.07 - 0.56	38 to 51 cm
Bermudagrass (*Cynodon dactylon*)	0.14 - 0.56	7.5 to 30 cm
Quackgrass (*Agropyron repens*)	0.07 - 0.28	10 to 30 cm

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[1] Field Development Specialist, Dow Chemical, USA.

SETHOXYDIM, SOPHISTICATED BUT SIMPLE

Ron Kukas[1]

Abstract: Sethoxydim (2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one) is a selective broad-spectrum postemergence herbicide being developed by BASF Wyandotte Corporation for the control of grasses in broadleaf crops. Sethoxydim is a true gramicide in that almost all grass species (annual and perennial) are susceptable and all broadleaf species are highly tolerant. A list of labeled grass species is as follows:

barnyardgrass	- Echinochloa crus-galli
broadleaf signalgrass	- Brachiaria platyphylla
fall panicum	- Panicum dichotomiflorum
giant foxtail	- Setaria faberi
green foxtail	- Setaria viridis
yellow foxtail	- Setaria lutescens
junglerice	- Echinochloa colonum
sprangletop	- Leptochloa filiformis
Texas panicum	- Panicum texanum
witchgrass	- Panicum capillare
goosegrass	- Eleusine indica
large crabgrass	- Digitaria sanguinalis
smooth crabgrass	- Digitaria ischaemum
shattercane	- Sorghum bicolor
johnsongrass	- Sorghum halepense
bermudagrass	- Cynodon dactylon
barley	- Hordeum vulgare
oats	- Avena sativa
rye	- Secale cereale
wheat	- Triticum aestivum

In addition to soybeans and cotton, a partial listing of tolerant agronomic and vegetable crops is: alfalfa, asparagus, beans (dry, navy, red kidney, lima, fava, snap, mung, wax), beets (sugar, red), broccoli, brussel sprouts, cabbage (green, red, chinese), carrots, cauliflower, celery, chard (Swiss), clovers, collards, cucumbers, eggplant, flax, kale, kohlrabi, lentils, lespedeza, lettuce, melons (cantelope, water, honeydew, musk), mint, mustard, okra, parsley, parsnips, peanuts, peas (english, southern blackeye), peppers, potatoes, pumpkins, radish, rape, safflower, spinach, squash (summer and winter), strawberries, sunflower, sweet potatoes, tobacco, trefoil, turnips and vetch.

As a result of true physiological crop tolerance, sethoxydim can be applied as a postemergence spray at all stages of crop growth. It is not necessary to post-direct to avoid spray hitting the crop leaves. However, it is necessary to obtain thorough spray coverage of grass foliage.

To achieve optimum control, grasses must be actively growing free of stress due to lack of moisture or herbicide injury. The addition of one quart of oil concentrate per acre is required for consistent results at minimum rates. A timely cultivation no sooner than seven days after sethoxydim application may aid in providing season-long control.

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[1]BASF Wyandotte Corporation, Modesto, CA.

For control of most annual grasses in the arid west (CA, AZ, NM), the optimum rate of application is 0.3 lb ai/A applied when grasses are a maximum of eight inches tall. Data shows that volunteer cereals will require 0.4 lb ai/A applied at a maximum of six inches tall.

The optimum application rate for rhizome johnsongrass control in cotton is 0.5 lb ai/A when grass is 6-10 inches tall followed by sequential applications of 0.3 lb ai/A when regrowth is 4-8 inches tall. The necessity for sequential applications will be determined by environmental conditions, rapidity of crop canopy formation and cultivation practices.

Maximum rate needed to control bermudagrass in cotton is 0.5 lb ai/A applied before plant diameter exceeds six inches with a second application of 0.3 lb ai/A 21 days after the first application. If regrowth occurs or new plants emerge a third application of 0.3 lb ai/A should be applied when new plants or regrowth are 1-4 inches long.

With selective over-the-top postemergence grass control possible in a multitude of broadleaf crops, sethoxydim offers a new dimension in weed control. It gives the grower a new management tool to help him conserve and optimize his limited time, energy and manpower resources. Sethoxydim can be used over a wide range of crop production situations and will fit into new programs such as conservation tillage and solid seeded plantings.

Full tolerance and registration for use in soybeans and cotton is expected in time for commercial sales in 1983.

PREDISPOSITION OF WEEDS FOR IMPROVED SELECTIVE POSTEMERGENCE WEED CONTROL

A. H. Lange and J. T. Schlesselman[1]

Abstract: Most selective postemergence herbicides used today cause some degree of crop injury even under optimum conditions. Under adverse conditions they often produce economic injury. Routinely, a one time application is used to kill or stunt the weed seedling without materially affecting crop yield. One of the best examples is the use of 2,4-D ((2,4-dichlorophenoxy)acetic acid), or bromoxynil (3,5-dibromo-4-hydroxybenzonitrile) in small grains, i.e., successfully used on millions of acres each year.

In the cole crops, umbilifers and onions, nitrofen (2,4-dichlorophenyl *p*-nitrophenyl ether) was used commercially as an early postemergence treatment. Related chemicals such as oxyfluorfen, acifluorfen and bifenox have shown a degree of selectivity but the safety has not been adequate for commercial use. A large number of other herbicides such as metribuzin and glyphosate have also shown some degree of selectivity in tomatoes, but have not been adequately safe except when used at very low rates.

If a low enough rate is found that will not effect the crop, but will effect newly germinated weed seedlings sufficient to stop their growth or predispose them to a second application without affecting the crop plant, it is possible to increase the margin of safety and produce commercial selectivity.

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[1]University of California, Parlier and Rohm and Haas Company, Reedley, CA.

Acifluorfen (5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoic acid) applied at 1/32 to 1/16 of a pound per acre followed one weed later resulted in excellent selective control of black nightshade (Solanum nigrum L.) in tomatoes.

Repeated oxyfluorfen (2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene) at 1/16 and 1/8 pound per acre in California onion work and lower rates in other states have resulted in excellent selective weed control without increased phytotoxicity to young onions and no loss of yield.

Additional study with low rates of herbicides followed with these same low rates or with higher rates at short intervals should be researched especially where postemergence herbicides with some degree of selectivity has been observed.

INFLUENCE OF MEFLUIDIDE ON THE ACTIVITY OF OTHER HERBICIDES

D. W. Gates[1]

Abstract: Mefluidide, N-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl]amino]-phenyl]acetamide, is a plant growth regulator that has been commercially developed to suppress turfgrass and woody ornamentals and as a herbicide to control weeds in soybeans.

Mefluidide, 0.07-0.14 kg/ha, applied two times, one to five days apart, has been more effective than a single application of 0.28 kg/ha. Tank mixtures of mefluidide, 0.14-0.28, and bentazon, 3-isopropyl-1*H*-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide, 0.56 kg/ha, have additively and on some weed species synergistically controlled a broader spectrum of grass and broadleaf weeds in soybeans. Red rice, (Oryza sativa L.), and hemp sesbania (Sesbania exaltata (Raf.) Cory), are examples of weeds synergistically controlled with this mixture. Two applications of mefluidide, 0.14, plus bentazon, 0.42 kg/ha, applied one to five days apart have controlled sicklepod (Cassia obtusifolia L.), as well as a wide range of broadleaf and grass weeds. The lower rates applied twice have controlled more species and larger weeds than a single application of equivalent chemical.

Mefluidide, 0.14-0.22 kg/ha, "preconditions" many grass and broadleaf weeds to greater sensitivity to acifluorfen. When mefluidide was applied one to five days before acifluorfen, more species and larger grass and broadleaf weeds were controlled with lower rates of acifluorfen. Greater susceptibility of weeds has been observed when mefluidide has been applied in sequence to bentazon, chloroxuron (3-[*p*-(*p*-chlorophenoxy)phenyl]-1,1-dimethylurea), naptalam (*N*-1-naphthylphthalamic acid), dinoseb (2-*sec*-butyl-4,6-dinitrophenol), or mixtures of naptalam and dinoseb.

Recent reports of three herbicide mixtures of mefluidide, 0.06, molinate (*S*-ethyl hexahydro-1*H*-azepine-1-carbothioate), 1.12, and propanil (3',4'-dichloropropionanilide), 2.24 kg/ha, have shown promise for controlling a wider range of grass and broadleaf weeds in rice. Preliminary observations have shown improved weed control and turfgrass supression when mefluidide, 0.068, was combined with chlorsulfuron, 0.034 kg/ha.

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[1]3M, Agricultural Products, St. Paul, MN.

HOE 33171 (HOE 00581) - A NEW GRASS HERBICIDE

Phillip D. Olson and Charles A. Hanson[1]

Abstract: HOE 33171 is a selective herbicide for the control of annual and perennial grasses in broadleaf crops. HOE 33171 acts primarily through the foliage and therefore is most active on grasses which are emerged at time of application. The proposed trade name for HOE 33171 is Whip™. The chemical and physical properties of HOE 33171 are to be released later. Optimum results for biological activity of HOE 33171 are when soil moisture is good and grassy weeds are actively growing. It is not a contact herbicide and effects on grass weeds are a general chlorosis or blackened stem tissues that do not become evident until seven to fourteen (7-14) days after application. A redish-purple tint of the foliage occurs in Johnsongrass (Sorghum halepense). The use rates of HOE 33171 will range between one-tenth to two tenths (0.10 - 0.20) pounds of active ingredient per acre. The use rate of 0.25 pounds of active ingredient should be used in the semi-arid areas from West Texas to California. A second application is sometimes necessary for adequate Johnsongrass control. Major attention to date has been evaluating HOE 33171 in agronomic crops such as soybeans and cotton. HOE 33171 appears to be weak on volunteer grains and quackgrass (Agropyron repens).

[1]American Hoechst Corp., Post Falls, ID.

PPG 1013, A NOVEL HERBICIDE FOR BROAD-SPECTRUM SELECTIVE WEED CONTROL AT VERY LOW RATES.

Fred R. Taylor[1]

Field tests conducted with PPG 1013 have shown it to be a broad-spectrum broadleaf herbicide at very low dosage levels. Crops which show good tolerance to both preemergence and postemergence applications are soybean, dry beans, peanuts, rice, wheat and barley. Corn and sorgum also show good tolerance to preemergence applications. Rates being evaluated for preemergence applications are from 0.1 to 0.3 kg/ha. Postemergence rates are from 0.01 to 0.04 kg/ha.

Some of the more susceptible weed species are pigweeds (Amaranthus sp.), nightshades (Solanum sp.), hemp sesbania (Sesbania exaltata), wild mustard (Brassica kaber), common ragweed (Ambrosia artemisiifolia), jimsonweed (Datura stramonium), common purslane (Portulaca oleracea), carpetweed (Mollugo verticillata), groundcherry (Physalis wrightii). Other weeds which are controlled at slightly higher rates are common cocklebur (Xanthium pensylvanicum), velvetleaf (Abutilon theophrasti), morning-glories (Ipomea sp.), Teaweed (Sida spinosa), and wild sunflower (Helianthus annus).

PPG 1013 is a relatively short soil residual herbicide. There is no herbicide carry-over from the treated crop to succeeding crops. Herbicidal

[1]PPG Industries Inc., Northglenn, CO.

symptoms occur rapidly on susceptible weeds. Within one day wilting, bronzing and marginal necrosis begin to show. Within 7 days necrosis is complete.

There are two areas of primary interest in evaluating PPG 1013 in the Western States. One is preemergence and postemergence applications to cereal grains. The other is for use as a cotton defoliant. Both uses appear to very efficacious.

GRADUATE PREPARATION FOR INDUSTRY

Richard Gibson, Moderator[1]

The Education and Regulatory Section of the Western Society of Weed Science considered graduate preparation for industry employment as part of its 1983 annual meeting. Jon Arvik, Monsanto Agricultural Products Co., Randy Nelson, CIBA-GEIGY Corporation, Larry Thompson, Elanco Products Co., John Evans, Utah State University, and Peter Fay, Montana State University participated in a panel discussion.

Graduate students themselves must take an active role in developing and carrying out their own preparation. They should plan to make a contribution to the University as part of a program but at the same time define their goals and plan their activities to make themselves attractive to industry.

Industry employment requires simultaneous experience in statistics, plant sciences, plant pathology, weeds, entomology and other agricultural disciplines. Some educational institutions provide multidisciplined degrees such as the Plant Protection Program of the University of Arizona. Several firms offer summer internships which can provide needed experience. The potential industry representative can expect further on-the-job training before assuming full responsibilities.

Since much of an industry representative's work is carried out in the field without direct supervision, it is essential that the prospective employee have the presence of mind, skills, and experience to function in such an environment. Employers place heavy emphasis on this factor and students expecting industry employment should prepare themselves with this in mind.

[1] Univ. of Arizona Extension Service, Casa Grande, AZ.

GRADUATE PREPARATION FOR INDUSTRY
WHO, WHAT AND WHY

Jon H. Arvik[1]

The initiation of discussions of the needs of industry, the University, and the graduate student, relative to the kinds and depth of training that a student needs is a strong positive move that certainly will benefit all parties.

[1] Monsanto Agricultural Products Co., Arlington, TX.

For the purposes of this discussion, we will consider only a product development field position, and not be concerned with sales, marketing or research. Though each of these represent excellent career opportunities, their requirements for student training are somewhat different than for field development, and would dilute today's discussion.

When once asked about the job description for product development, I gave the following: to plan, organize, direct, coordinate, and control all aspects of the business in the territory for which the representative is responsible. Though at first glance this definition seems very general, it is quite specific. In fact, it is at once both general enough to include nearly all jobs, and specific enough to detail the responsibility of the holder of the jobs.

However, since today we will discuss product development (PD) as a position which required training, it is necessary to further describe the functions of that position. A product development representative must do the following:

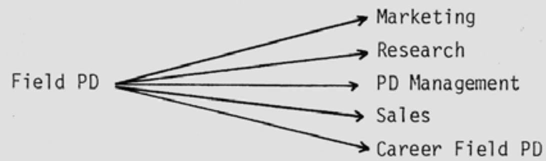
-Conduct, interpret, and report field research. Much of the information used by industry must come from "hands-on" experience and experiments performed by the PD field man. He must become acquainted with the new materials (and old commercial products) that are candidates for commercialization. The first "real-world" tests will be done by PD, and the interpretation of those tests will determine whether the material continues to be developed or is abandoned.

-Coordinate research with cooperators. When a material is released to University cooperators, and later to farmer/government/other industry/other cooperators, it is the PD representative's responsibility to insure that the transition is smooth; that is, that samples are available at the right time at the right place, that technical information such as toxicology and preliminary efficacy data are available, and to provide whatever help he can to insure the proper use of the new material.

-Provide technical expertise to the company marketing group. Most of the marketing staff of a company will have little technical training, yet the programs of sales promotion and advertising they design depend upon the technical characteristics and performance of the products. Thus, it is necessary that precise information be made available from local sources to insure that the programs fit the intended market. The PD staff provides that information.

-Provide training to the sales group. As new products are introduced or new sales representatives join the company, it is imperative that training be accomplished to insure that the characteristics and performance of the products are well understood. The sales rep is the "front line" for the company, and the stronger his background in product knowledge, the more effective he can be in finding the fit of the product in the customer's operation. The PD rep will teach the product to the salesman, demonstrate its use, point out advantages over competitors (and disadvantages, where appropriate), and prepare the salesman for the many questions he will have to handle.

From a field PD position, a representative has several options, as shown below:



He may move from one area into another, as his ability and desires permit.

Let's discuss the needs of the three groups.

Industry needs trained, talented product development people for performance and management of field research. Note the key words "trained", "talented", and "field research".

The University needs acceptance of their product (students), whose work will enhance the reputation of the University and of the professor.

The student needs meaningful employment, with the ability to contribute positively to his company, his society, and his personal quality of life.

A discussion of the need of industry for trained and talented people is almost jejune; it goes without saying that the performance of a company is based on the ability of the staff to perform the tasks at hand, without extensive additional training and with a good deal of competence. That need constitutes a market for the product of the University: the student who has been selected and provided the capability to perform selected tasks with a high degree of competence. The performance of the student will reflect upon the process by which he was selected to continue in advanced education, upon the university which allowed him to advance, and upon the professor who led him through the advancement process.

Within industry, and within the University system, there is sufficient word-of-mouth advertising that we know beforehand about how a student will perform, just by knowing where he went to school and who his major professor was. That is a large part of his interview/screening. On the other hand, the same type of system allows a professor to recommend or discourage a student from consideration of a particular company, or of industry in general. We are all concerned with out personal and organizational reputations, and work very hard to keep them positive. To a large degree, it is our products that determine those reputations, as a reflection of our individual and collective work.

In an employee selection process, we examine a candidate's resume' and credentials. What are we looking for? Certainly performance as indicated by grades, but we are also concerned with the degree granted and the scope of the curriculum taken. For example, a poll of five major companies shows the following, where an "X" indicates the minimum degree required, and a "0" shows the level of most recent hires (remember, these are field PD jobs only):

Minimum Degree Required	Company				
	A	B	C	D	E
None	X				
BS		XO			
MS	0		X	XO	X
Ph.D.			0		0

Only two companies actually hired at their minimum level. This is indicative of two things; (1) the availability of higher degree candidates, and more importantly (2) the higher the degree, the more attractive the candidate is to industry. That same poll of companies provided a concensus of course work we would recommend as a minimum:

--Chemistry through basic biochemistry.
--Math through basic statistics.
--Basic soil science.
--Equipment design and operation (sprayers, basic farm equipment).
--Plot design and evaluation skills (hands-on, in the field, their own plots and reports).
--Basic ecological relationships (what happens when you select for or against a population? What impacts the environmental fate of pesticides? What can pesticides impact? How?)
--Basic microbiology.
--Strong communications program (note that this is the only item on the list that is not limited to the basic level). The PD representative must be able to communicate verbally and in written form at all levels. Require participation in seminars, speech classes, anything that will force the student to speak in front of a group; teach the art of visual aids and their use. Make the student be comfortable in public speaking.
--Basic crop production (no matter where he is trained, his field assignment will probably be somewhere else, so great detail in specific systems is not adviseable).
--Basic weed science (also include pathology and entomology, since many companies have programs in more than one field).
--Basic business training (remember the job description: plan, organize, direct, coordinate, and control... these are all management functions). The PD representative will have to manage a territory, a budget, equipment, perhaps a small staff of technicians. Train him to do these things with introductory business management courses.

Those courses we believe to be nice to have but not essential include:

--Advanced plant sciences.
--Basic conversational Spanish.
--Computer literary (understand what a computer can do in terms of time-saving; be able to use computers to operate more efficiently).
--Psychology of motivation (how do you motivate others, how do you stay self-motivated).
--Political science (how do you operate in a political environment).
--Advanced management skills (as the representative advances in responsibility, personnel management, economics, and marketing skills become more important. These can be strong items on a resume' as well as contributing to performance).

Those courses we believe to be of no value include:

--Foreign languages (other than basic Spanish).
--Computer programming.
--Volatile/high-tech training (that not oriented towards field research or which is easily made obsolete by advances in technology or the lack of sophisticated equipment).
--Advanced anything not listed previously.

The two areas that drew most comments in our informal poll were foreign languages and computers. A recent business magazine summed it up nicely when discussing requirements for general business training: "The student must be fluent in English, Spanish, and computer". That is not to say that the employee will not need a foreign language at any time in his career, only that we cannot predict which one he will need. When the time comes for an international assignment, the representative will be trained in the language and customs of his new location. Most companies have excellent programs for this training. Use the time for practical experience and broadening the background of the student. Nor is this to say that the student needs to know the exact path of the electrons in a computer; he only needs to know how they can serve him and how to use that service. Several universities have excellent programs in applications of computer services; if you do not have one, I encourage you to start one. The programs at Utah State University and at Ricks College (Rexburg, ID), are superb and I urge you to examine them for content and style.

With all of this, we can now list what we think would be an ideal candidate: one with a strong technical Ph.D., extensive field training and experience, strong communications skills, and with some business training.

In addition to the course work, it is important that we consider what kind of person this should be. The University cannot teach these characteristics, but must consciously select for them. They include: Aggressive, assertive, smart, clever, motivated, mature, ethical, personable, confident, flexible, common sense, positive attitude and philosophy of science.

The responsibilities of each of us to fulfill the needs listed earlier are heavy, as failure to satisfy those needs will reduce us all in performance of our tasks. These responsibilities include at the least the following:

Industry, to the Student - provide a stable work environment based on the needs of the industry and of the employee.

Industry, to the University - provide long-range guidance to allow lead time for training students to fill the needs of industry, and to allow the evaluation of the "fit" of the student to the job.

The University, to Industry - to provide trained, hard-working, talented people to do the work that needs doing.

The University, to the Student - train, motivate, and inform the student so that proper career decisions can be made, appropriate opportunities can be made available, and the student can perform to the level required for his and his employer's satisfaction.

The Student, to Industry - to give more than asked, to provide smart work, to lead the industry into greater accomplishments. It is from you that our growth will come.

The Student, to the University - to conduct yourself proudly, to reflect praise by performance, and to bring honor to the system that created you.

How do we meet these responsibilties?

Industry - grow, and let the employee grow with us in personal and professional accomplishments.

University - be selective; set high standards and accept nothing less; train, test, retrain, challenge, recommend, and support your students. You are all they have to assist in the transition to the work force.

Students - define your goals, work, question, challenge, understand, and apply. Know what you want, know what you need, know where you want to go, and use this system to go there.

EDUCATION OF A CONCERNED PUBLIC

PESTICIDES AND PEOPLE: AN INTRODUCTION

Richard Gibson[1]

The subject of pesticide controversy is not new. For more than a decade, America has been rocked with acrimonious exchanges reaching from the highest levels of the federal government down through the microcosm of the local neighborhood. Conflict has been the norm, rhetoric on both sides of the issue has been abundant. The time for evaluation has come. All citizens need to ask: "What have we gained and what have we lost?" We need a fresh breath of air in a world choking on emotions. We need rational thinking, and decisions based on proven fact.

Unfortunately, the pesticide controversy is embedded in fear, the worst kind of fear, the fear of the unknown. The average American is unfamiliar with the scientific processes of food production, the environmental relationships of the agricultural ecosystem, and the fates of agricultural chemicals in the field. His training and experience is in business, construction, or mining. Nevertheless, the march of urbanization into America's farmland has produced an interface that places the average, untrained citizen face to face in his own backyard with the unknown. Emotional, and often unfounded reports enter his home through the newspaper or the telelvision. Half-truths, suppositions, or over blown reports breed concern that perhaps he is facing the same problem. Agriculture, in his mind, has become a threat to the home and the family.

The editorial page of the January 1983 issue of Agrichemical Age reports the results of a national consumer study. Designed to evaluate public perception of agricultural chemicals, the study underscores the very trends that are now being addressed.

First, farm pesticides were rated among the seven most serious national concerns, right behind nuclear power. Pesticides were considered a problem by 66% of those interviewed. Nuclear power was 69%. Second, 61% reported that they believed that farm pesticides today tend to alter the ecological balance.

Other studies have been just as alarming. In 1976 and 1977, the Environmental Protection Agency conducted the National Household Pesticide Usage Study. Approximately 10,000 households randomly selected from throughout the country were personally visited to assess the pesticide usage patterns by region. In every area of the country, the vast majority of households used pesticide products either in the home, the yard, or the garden. In itself, this is, of course, not bad. Couple those figures however, with the results of the following study.

In 1980, all pesticide - related calls to the Intermountain Regional Poison Control Center in Salt Lake City, Utah were evaluated for effect and outcome. Only 10.1% were related to exposures actually resulting in verifiable symptoms. The remainder, 89.9%, resulted from symptoms unrelated to

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[1]Arizona Cooperative Extension Service

to the exposures, asymptomatic exposures, and questions about the hypothetical effects (What if . . .?) of specific chemicals.

The results of the EPA study clearly indicate a significant potential for the public to experience real or imagined poisonings and other adverse effects. The Utah study indicates that a majority of public concerns about pesticides result from minor, exaggerated, assumed, or unverifiable exposures. Together they mean that a concerned public is being formed in an emotional atmosphere fed largely by unfounded fears, suppositions, hear-say and half-truths.

This is not to say that real and verifiable exposures do not exist. Applicators are human. Mistakes are made. Equipment breaks down. On occasion, misjudgements occur. Unfortunately, the relatively rare occasion when public concern is justified lends credence to the paranoia resulting from the far more numerous incidents where exposure cannot be substantiated.

The final decision on the continued use of agricultural chemicals will occur not in the legislature, in the courts, or by bureaucrats. It will be made in the minds of the public; by those who are even now forming opinions. Agriculture must make up its mind whether it intends to let its existence go by default, or whether it will recognize the role of the general public and the need to communicate straight forward fact no matter where the chips fall. If the latter is chosen, several requirements will become necessary. First, fact will need to be generated on every level of agricultural research. Second, those facts must be effectively communicated in a form that will be acceptable to the majority of the public. They must be believable. Third, we must learn to use the media effectively. If we don't work with them, they will work against us. Finally, emotionalism must be curtailed, avoided, banned.

It will not be easy, but it is essential. A person wrapped in anger, fear, or a combination of both becomes immune to reason. He cannot be taught, he will not learn. Resolution of the problem will never come through emotionalism. It is a lesson for us all.

HOW ONE COUNTY WEED DISTRICT FACED A TORDON WELL CONTAMINATION AND WON

John L. Baker[1]

Ladies and gentlemen, I'm glad to be here today to share with you some of my experiences of the last three years regarding a contaminated aquifer and the interactions of those involved. I'd like to start with a little history and geography of the Lander area, followed by our recognition of the problem. Then, I'll describe our efforts with others to mitigate the damage, determine the source of the contamination, and lastly, some conclusions that I reached that may have universal application in similar situations.

Lander is located in the foothills of the Wind River Mountains and its many small valleys and streams provide agricultural opportunities for irrigated pasture and hay among the rangelands. Many ranches headquarter in the area and the Squaw Creek valley has become desireable for subdivision due to its nearness to the town and beautiful rock formations. The rocks are red sandstone of the Chugwater formation and separate the small valleys creating natural boundaries to the land. Many fine homes are found nestled against the cliffs.

[1]Supervisor, Fremont County Weed and Pest Control District, Lander, WY.

Leafy spurge was first identified in the 1950's on the Amigo Ranch and, as you can see, was well developed in 1952 when these photos were taken of some herbicide research in the area. Fremont County Weed and Pest maintained a program in the area with technical assistance and cost sharing to encourage control. When Wyoming passed the Leafy Spurge Act of 1978, we had most of the infestation mapped and much of it was already being treated.

Three elements came together in the Squaw Creek Valley to make this well contamination possible: 1) Leafy spurge and Tordon used in its control, 2) people with wells and houses, and 3) the permeable sandstone of the Chugwater formation. With the use of Tordon for the control of leafy spurge over the past fifteen years, many complaints have come to our office regarding vegetation injury. All of these problems could be traced to the use of Tordon and the resultant contamination of soils or manure that we used in the gardens, or the planting of susceptible species on land previously treated with Tordon. In 1979, when Bill Wilson called, we examined his concerns from our past experience. In this case, his wife's houseplants were injured and they blamed their well water. I couldn't argue with the obvious damage but just couldn't believe the well water was the cause. I took water samples and when they turned out negative, even Wilsons were sure the problem was elsewhere. In 1980, the symptoms returned with vigor and another resident of the area also complained about his garden. Ken Richardson's garden showed some injury in poatoes, peas, beans, and tomatoes, but much of the injury was due to drought and fertilizer deficiency. We fought the idea of a contaminated aquifer but took water and soil samples again. As weeks passed, more damage was reported by an increasingly large list of Squaw Creek residents. Much of it was not at all related to herbicides, but we took water samples from each affected house.

After a month and no samples returned, the area people became anxious for something and I called the State Lab. I discovered that they were not able to process the samples when they were received due to a power shut down on the campus at Laramie and we could expect at least two more weeks before they could run them. In an effort to get some results, one way or the other, I sent some samples to a private lab in Powell, Wyoming, but they predicted a delay of 8 weeks. I just couldn't wait that long and called Ken McMartin with Dow Chemical to see if he could help. He got us an address for water samples and he and Emmett Roche came out to see what the situation looked like. The Squaw Creek people were not excited about Dow doing the water samples at all and feared falisification of the results if they found Tordon in the water. We split the samples and sent duplicates to the State Lab on all the samples we took. Ken Richardson had sent his own sample into a lab in Washington and called our office in late July to report that they had found .006 ppm Picloram in that sample. Once this was confirmed, I felt I needed to notify the State Department of Environmental Quality. I found Robin Collins, area director, to be aware of the problem but not concerned, due to the low concentrations. He had contacted the EPA and they recommended expanded sampling activity to determine the extent of the contamination and to identify the source, if possible.

Once proof of the contamination was obtained, a group of Squaw Creek residents met to talk about the situation. They called a meeting of all interested people and a few days later they met again and formally organized. They called themselves Squaw Creekers Against Tordon, SCAT for short, and elected Ken Richardson President. They also had a Vice President, a Secretary and a Calling Committee. They drafted a list of questions and sent them to the DEQ, University of Wyoming, Wyoming Department of Agriculture, EPA, and the Weed and Pest District. The questions mostly about who would be responsible for the damage, human health concerns, and what was going to be done about the contamination. There was an attorney present and litigation was discussed. Also present were representation from the Sierra Club and Wyoming Outdoor Council, both of which are active in the area.

I contacted the State Engineer's office in hope of getting some help in locating wells in the area, and hydrologist Craig Cooper got involved right away. We began work to map the aquifers and Craig had several ideas about the source. He felt leaching could not be possible and really suspected an abandoned well had been used as a disposal site for unwanted herbicide. We also examined the irrigation ditches and streams and found them to feed the aquifer in many places where they crossed the red sandstone. We launched a water sampling program that approaches 500 samples to date, and covers 6 sections of land.

Robin Collins of the DEQ suggested a public meeting to discuss the problem. I really opposed that idea and felt that we should keep it quiet and play it down. I wanted to keep working on a one-to-one basis with those involved and avoid publicity. Robin scheduled the meeting anyway, and I'm glad he did. He really knew best. We assembled a panel from the Weed and Pest District, Dow Chemical Company, the University of Wyoming, the Wyoming Department of Agriculture and the State Engineer's Office. We showed Dow's toxicology data and outlined our plans for mapping the aquifer and locating the source. Nothing new, but the public forum somehow made it sound different. We also had data on water samples and the really low levels were obvious. Dow found Tordon where the State Lab couldn't and that established their reliability. All in all the meeting was very positive and answered all the questions but one. Who was going to pay for all the damage? Who was responsible?

The press covered the meeting and the local radio station really jumped on it. According to the radio, Fremont County Weed and Pest Control District had destroyed half of the County and had driven people from their homes. I called the station to complain about their reporting and was given equal time, but they still ran their story. I'm sure they also fed the wire service. In contrast, Bill Sniffin, the Editor of the Lander paper, gave the story little space and treated the problem with fairness. Since he was directly affected with Tordon in his own well, he could have used his paper to apply a lot of pressure. Instead, he became a voice of reason at the SCAT meetings and helped to calm others.

As the data began to come in from all that water sampling and well surveying, it became obvious that no immediate solution would be found and yet SCAT pressed for a solution. The Weed and Pest District Board was concerned about the injury but were angry about SCAT's approach. As we saw this situation, the effect of the Tordon was limited to a few people who wanted to raise peas and beans in their little gardens. All the damage at that time wouldn't have amounted to $100 worth of groceries. Johnny Wunder, a local rancher, spent $1,000 every year to control spurge on his own land and by comparison, the spurge seemed to be the overriding concern. Yet no one who was involved in the spurge program wished hardship on others. In an effort to find middle ground, we experimented with charcoal filters and discovered how to remove the Tordon. We offered to supply filters at $800 a copy to anyone who, on the advise of our attorney, would sign a release of liability from past actions of the Weed and Pest Control District. This was very unpopular. We finally placed the filters on 12 wells where the Tordon was greatest, in time for the next year's watering. An interesting note is that many of the wells we tested were not suitable for drinking, or watering gardens anyway, due to high salts. After three years of collecting data some definite trends can be seen. There are 4 wells that show a jump in the Tordon concentration 6 weeks after significant precipitation. One of these wells is artesian and its flow is affected by water in an irrigation ditch in the area.

Craig Cooper, the State Hydrologist, solved the problem with this information. He was able to relate the changes in flow of the artesian well to irrigation water running across exposed areas of Alcova limestone. The Alcova limestone separates layers of the Chugwater sandstone. The sandstone is permeable but the Alcova is not, trapping the water underneath. In 1980 we treated 5 acres of spurge growing among the exposed Alcova on the hillsides. These areas had never been treated before and we are confident they lead directly to the contaminated aquifer.

This information will allow us to resume our treatment program without fear of recontamination of the aquifer. We are introducing biocontrol organisms as they become available in hopes of obtaining some measure of control in those areas where herbicides can't be used.

In conclusion, I feel there are some concepts that we all can apply in dealing with a concerned public in similar situations. 1) When someone complains, it's because he really believes he knows what's wrong. It's better to investigate his position with an open mind. If we had done so in 1979, the 1980 contamination may not have occurred at all; 2) There are many people who can help if you can find them. Call for assistance from local agencies; 3) Go public early and beat any opposition. Have a plan of action ready and establish yourself as concerned and in control of the situation; and 4) Since absolute responsibility many never be determined, it is better to work for a solution than trying to identify the responsible parties.

I really hope that no one else ever gets the same opportunity for growth and learning that I have received, but if you are even a little prepared, the outcome will be favorable.

THE MEDIA AND PUBLIC OPINION

Gary A. Lee[1]

I get a little nervous about an assignment with an abstract title such as The Media and Public Opinion. For I am not an authority in journalism or sociology, nor am I a pollster with my finger on the pulse of the American public. Perhaps my only credentials are that I have been "misquoted" a sufficient number of times in the newspaper to qualify as a speaker today.

Permit me to reverse the topics of the title and address "public opinion" first. Webster defines public opinion as "opinion of the people in a country, community, etc." It is an intangible force that, once focused on an issue or theme, can cause the most confident, secure politician to shake with fear. Public opinion can literally move mountains. If we analyze this powerful monster, we find that it is neutral and indefinite about any topic until influenced by some outside stimuli. The most influential force on public opinion today is the newspaper, television and radio -- the public media.

[1]University of Idaho, Moscow, ID.

We in agriculture did not know or even care what public opinion was 20 years ago. We were perceived as honest, hard working "tillers-of-the-soil" dedicated to the production of high quality food, feed and fiber to keep America strong. No one had to justify their actions because no one in the public sector questioned our motives or credibility.

The fiasco that occurred when amino triazol residual was found in cranberries started to shape and polarize public opinion. Then like a bolt of lightning from a clear blue sky came Silent Spring. Agriculture as an industry was ill-prepared to effectively mount a public relations campaign to salvage our image. As "environmental issues" became more popular, young people armed with skills and experience in shaping public opinion began to work against pesticides in general. They knew how to manipulate the media and politicians responsible for legislation. Agriculture, on the other hand, has been slow to recognize the power of public opinion and to mount an effective program to sway the force in our direction.

In addressing the California Weed Conference, Mary Ann Ford stated "The 60's attitudes are now held by over 60% of the American public. They are an American way of thinking. A New York Times Gallup Poll issued last fall pointed to this new trend. Of the sample surveyed, 65% favored legislation which would impose strict environmental standards of all industry. And so much for the old pocket book argument. That same 65% were willing to shoulder the economic price for such environmental control." She further posed that "public opinion change is not the monster it too often appears to be. A small swing in opinion change, no more than 5 to 7 percent, can affect a group attitudinal change. That percentage is out there for you."

I personally feel that Mrs. Ford has properly assessed the situation and that we can influence the public with some organized effort. As a society and as individuals we must take a lesson from those who oppose pesticides and adapt their techniques.

In searching for resources and material for this presentation, I had the opportunity to interact with several individuals from industry and the media. K. W. Dunster, Past-President of the Society and an able member of the agriculture chemical industry, suggested that we should develop two primary goals related to public opinion. First, we must initiate a program to build a positive image, and secondly, we must have the wherewithal to prevent a negative image. With these major objectives in mind, we can start to recapture the essential "5 to 7 percent" of the public opinion poll referred to by Mrs. Ford.

The first objective does not necessarily include the media but it can certainly be influenced by the coverage we receive. Building a positive image should be a long-range program which starts with small groups of people in the community. If I might ask a rhetorical question, how many of you have presented a program to the Chamber of Commerce, Lions International, Kiwanis, Rotary or other civic groups in the last year? Community leaders belong to these organizations and can be exposed to the positive aspects of agriculture chemicals in a non-confrontation atmosphere. Often times, the press does cover these meetings and will provide a synopsis of the meetings in the newspaper. You don't have to hold a Ph.D. in toxicology in order to be a spokesman for weed science and a proponent of proper use of pesticides. Each of you are an authority in your field by virtue of your position. As a guest speaker, you have the opportunity to address the problems associated with weeds and the benefit derived from effective control programs. I caution you to utilize terminology which is meaningful to the layman to whom you are addressing. Technical terms such as "mg/kg",

"LD_{50}", "parts per trillion", "teratogenic" should be reduced to examples that non-technical people understand. Explanation of how tolerances are established and the built-in safety factor for residual products can go a long way in developing credibility. The more exposure we have with community groups other than those with agricultural interests will strengthen our image over time.

The second and perhaps most important objective is to prevent a negative image. This situation will most likely come into play when the media is seeking information related to some incident that has occurred which is "news worthy". How should you deal with the media? I wish that there were specific procedures that could be printed in the handbook for agricultural chemicals personnel but each incident is different and must be handled in a different manner.

You can better deal with the media if you know where they are coming from. When I enrolled in an undergraduate journalism class, the first lecture was dedicated to the Cardinal Rule of Journalism -- strict adherence to objective reporting of factual information. I was naive and took the comments literally. However, I have since learned that commercial reports select an "angle" to each story and emphasize the human interest side in order to sell more papers or attract a larger viewing audience. The American public is responsive to tragic, sensational or spectacular stories and we must be aware of this influence on how stories are approached. For instance, two scenarios can be developed around broken beer bottles. You tell me which story will be printed or be aired on the 5 o'clock news, i.e. "last night a maniac wielding a broken beer bottle slashed eight patrons of Joe's Tavern; or local Boy Scout troup picked up 300 broken beer bottles along the interstate highway as a civic project during Environmental Week." The scouts might get mentioned if they picked up three tons of bottles, not because of the good deed, but because of the sensational number of bottles.

Discussions with media representatives, specifically newspaper editors, revealed a disturbing, but not shocking, philosophy related to reporters developing a news story. Timeliness of the article is of first priority with the appropriate human interest slant being second consideration. The reporter has license to "piece together" the information in a sequence which has the greatest impact. Accuracy, in the purest sense, was not a priority to those individuals I contacted. In expressing consternation about having an expert's statement being used out of context which might give the wrong impression or totally misrepresent the facts, these editors were unanimous in their lack of concern. I was not consoled by their willingness to print a retraction or correction statement to clarify the story. Such statements appear on the want ad page near the used car section and the impression and impact of the original article is not lessened. These are facts that you must be cognizant of when dealing with the press.

You cannot anticipate the direction or angle the media might be using, but several precautions can be taken to prevent a negative image. You and the personnel under your supervision must be thoroughly familiar with the products that are being used in a spray program. As a minimum, everyone should know what compounds are being used, safety precautions necessary for proper application, spectrum of target species, rate of application and the general purpose and scope of the program. Reporters can appear at any time and can either use your information in an authoritative manner or reverse the perception to make it look as though the program is being run by incompetents. How you present yourself will make a difference.

Before a "news worthy" story surfaces, we can do considerable to gain credibility with the local news media. You should make special effort to identify and contact reporters in your area. A positive approach in informing the media about the benefits of weed control programs, the impact of weeds on society from a health and economic aspect, and above all, stressing the fact that we are all concerned with the environment, natural resources, fish and wildlife, our family's health and future generations. By taking the initiative to become better acquainted with the media reporters, they will be less suspicious of your position when a crisis or controversial situation arises.

You have the responsibility to be familiar with the issues. Spend what ever time is necessary to search out the information that will answer the questions posed by the anti-pesticide groups. Knowing the motives and platform of your critics is essential in dealing with the media. If you don't know the answer, don't guess.

Some reporters like to use the element of surprise on the people they are interviewing. I suggest that you meet with the media representative face-to-face and discuss the topic before the television taping or disclosing information to a newspaper representative. Never give an interview over the telephone -- see who you are dealing with. Eye contact and the opportunity to illustrate your point are essential and cannot be done by phone.

I recently had the opportunity to view a telecast of a seminar held by Harvard University dealing with the credibility gap between the media and industry. Executives from television, newspapers and industry candidly discussed the topic. There was a mutual distrust between the two groups. The media intimated that industry would cover up nearly anything to protect a profitable product and that industry had no conscience. Industry representatives were extremely cautious about granting interviews to the media without first knowing what the topic or issue was to be discussed. Industry has been blind-sided so many times and statements taken out of context to develop a sensational story with a slanted view that the executive officers were reluctant to subject themselves to an interview.

There are several agricultural chemical companies that have specific policies that prohibit employees from interacting with the media. These companies have hired professionals in public relations to issue statements related to any and all questions by reporters. Misinterpretation of an issue results in a negative impact on a carefully guarded and important corporate image.

We cannot stand idly by while critics use the media to polarize public opinion. We must become proficient in public relations or rely on those who have the aptitude. It is evident that some positive actions must be initiated before we find ourselves in an irreversible position.

Those of us in the public sector should take a lesson from the commercial sector. We must carefully formulate statements that consider all facets of a situation. We must be willing and able to readily access sources of information from experts in the field. If our Society has a defined mission, it is to educate. It is conceivable that the Western Society of Weed Science can and should be a source of information for the weed science discipline through its collective expertise. A public relations committee could provide strong leadership and resources for critical issues that surface at the local, state or regional level. This, of course, must come from you, the membership.

THE CONTRIBUTION OF THE UNIVERSITY TO WEED SCIENCE

M. A. Massengale[1]

It is a pleasure for me to be with you this morning, both as a fellow scientist to share my thoughts about the work that you are doing, and as an administrator who is pround of the contributions universities have made to weed science.

Agriculture has been described previously as a controversy with weeds. You as weed scientists can be proud of your role on the winning side of that controversy.

Weed science stands today with a record of outstanding achievement. Virtually every weed encountered in the course of agricultural production has been controlled successfully through your efforts. You and your colleagues can be credited with helping to make agriculture this country's number one industry.

I'm particularly proud of the work that the weed scientists are doing today at the University of Nebraska's Institute of Agriculture and Natural Resources. They have been and continue to be leaders in the success story of Nebraska agriculture, and they represent an exemplary unit of research, teaching and extension at our University.

Improved weed control practices developed in the various states have had as much or more impact on modern crop production than any other technology. However, this achievement is not well recognized. Nonetheless, it has provided the foundation for sharp gains in the productivity of our important economic crops over the past quarter century. The impact of weed science on American agriculture is going to continue to grow in the future. We need only to look at the trends in weed science research to see that.

As applied research continues to solve today's problems, some exciting basic studies are underway at our universities which will solve the unknown problems of the future. Weed science, like other disciplines, is examining the basic physiology of weedy plants to better understand the most efficient ways of controlling them.

And, it is interesting to note that other scientific disciplines are being incorporated into weed science research, such as:

-Growth regulators which are used to alter growth of desirable crops, are being applied to weed species to make them more susceptible to herbicides.

-Genes from weeds which have developed resistance to atrazine have been implanted successfully into potatoes to protect that food crop from chemical damage.

-Tissue culture is being used in the study of weedy plants and how they react to herbicides.

Meanwhile, the huge success that the American farmer has realized in the production of food and fiber has placed us in a period of agricultural surpluses. As the country tries to alleviate this situation, research, and especially production-oriented research, has come under special scrutiny.

Much of the previous emphasis in agricultural research was on production efficiency. That's what we need to emphasize to others. Of course, production efficiency isn't a new concept to weed scientists.

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[1]Chancellor and Professor of Agronomy, University of Nebraska-Lincoln, Lincoln, Nebraska.

It's the work you have been doing all along: reducing competition between useful crops and weeds, finding ways to cut down on labor costs, making efficient use of energy, and conserving the soil by finding biological and chemical alternatives to tillage. Weed science research is an essential ingredient to the continued success of American agriculture.

Permit me to take a minute here to point out another important component of weed science in the universities and that is the Cooperative Extension Service. For research to be successful, results have to be put in the hands of the people who can use them. The Cooperative Extension Service of our land-grant universities is an important component and an integral part of the team.

Industry personnel are often prone to work directly with researchers. Extension specialists and county agents along with our communication network of publications and media relay research results to those farmers and ranchers engaged in production agriculture. Extension staff members working with farmers and ranchers must be considered in every way as an important part of the University's contribution to weed science.

Even though we often hear of the importance of research in our universities, in weed science and other areas, we are also in the business of teaching and training students. For some of you, training tomorrow's educators and agri-business men and women is a primary task. But I am bothered by some of the things I see happening here. We've been watching closely where our graduates in weed science have been taking employment. The best students used to stay at our universities, moving up the academic ladder through their Ph.D. programs, and later signing on as teachers and researchers. This is no longer typical.

About 80 per cent of the graduates in weed science from the University of Nebraska go to work in private industry. Attracting them to graduate work, and keeping them there, is becoming more difficult each year. The reason is money. It's that simple. The agricultural chemical companies are buying our best weed science students. Ph.D. graduates are wooed to off-campus professions with starting salaries that are higher than most of the faculty make at the University. A typical offer to a Ph.D. graduate last spring was some $35,000 in salary plus a bonus package worth $15,000 which included a car, a medical plan and other fringe benefits. Compare this to a starting salary at universities of approximately $25,000 to $26,000. It's easy to see why Monsanto, Dow, Dupont, Elanco and other industry leaders have become the professional homes of so many of our graduates.

I want to make the point here that we are proud of our graduate placement record. We are training the business and industrial leader of a multi-billion dollar industry. These young people will help American agriculture remain on top, and this is certainly consistent with our goals as a land-grant university. Nonetheless, the brain drain from the universities of this country has accelerated to a point where all partners in American agriculture are threatened.

The distribution of talent has become lopsided. We must keep more of our brightest and best students to fill the ranks of university teaching, research and extension staffs to help train those other bright young individuals who are coming along in the future and to further push back the frontiers of knowledge.

How can we accomplish this? Clearly the universities must become more competitive as professional employers. We need to expand our graduate programs. We need more assistantships and fellowships. And we need to find ways to boost starting salaries. It is in these areas that I believe agricultural chemical companies need to become more aware, concerned and involved. For years the universities have been helping these agri-businesses, training their professionals as well as studying and testing their products. Some people might even go so far as to say underwriting them in part. By and large, industry's return investment to the universities has been good but probably not enough for the future. Most companies have provided research grants and some have helped with equipment and construction of labs and greenhouses. But weed science efforts at our universities are still in need of major investments, big dollars if you will. Industry leaders need to be farsighted enough to see that their best interests, indeed their only source of future professionals, is being threatened. I feel confident that agri-business will help turn around this frightening circumstance.

Some 15 years ago this country's booming technical industries found themselves in a similar bind. Demand for graduate engineers by private companies was greater than the University could supply. We still are barely able to keep up with the growing demand in this field. Now, many of these firms are committing significant resources to our universities as their partners in alleviating these manpower problems. It will need to be that way in weed science.

Nebraska's weed scientists, a section within our Department of Agronomy, currently are working on a proposal that would coordinate their research and grant requests. Under broad guidelines, directed by a review committee, weed science faculty members would ask for annual grants-in-aid from leading chemical companies. These grants would come as unrestricted funds to be pooled and used to support graduate students in a variety of research efforts, some which do not even involve agricultural chemicals. The more usual practice of tying grants-in-aid closely with brand name products to be tested would also continue. The unrestricted funds would allow for the type of creative long-term projects that make university research unique.

When agricultural chemical companies decide to invest significantly in higher education, the universities will have no trouble finding good ways to spend the money effectively and in the best interest of the companies, the universities, agriculture and our society. At Nebraska it costs in excess of $10,000 a year to train a graduate student. For a Ph.D. that may add up to a total of $50,000 before they are finished. Most of that money now is supplied to the University by the state, but a significant sum of it comes from industry or government agency grants.

As you know, we call the latter "soft money," but it is no soft job trying to obtain it. A weed science section such as ours, supporting 20 or 30 graduate students, must constantly juggle funds and assign research requests to keep the students advancing toward their degrees. We are all too familiar with the time required to keep those monies coming to the universities.

Right now, the federal government, through its various agencies, probably furnishes as much or more money than any other single source. Of course, agricultural research receives only a small percent of total federal research dollars. Medicine and defense are far ahead, but agricultural research funding has not materially decreased; at least it seems to be holding its own. In fiscal 1981, total agricultural research funding reached some 2-1/2 billion dollars. USDA-ARS and Non-USDA Federal agencies contributed more than a third. The private sector contributed about 30 per cent. That's a percentage I would like to see go higher. Cooperative research services and state experiment stations contributed the remainder.

As you know, more and more of the federal government's formula funding is being replaced by competitive grants creating shorter term allotments for research priorities set by Congress. Although I don't agree with it, this type of funding seems to be the direction that federal allocations will be taking over the next several years. It would appear to me that unless you are willing to become involved in grant writing, you can expect to participate less in federally-funded research programs.

As a result of the direction that federal funding has taken, states have had to pick up a larger share of the investment in agricultural research, allocating it to the various research areas it supports. All university scientists, both internal and external to agriculture, are in keen competition for research dollars.

Your research programs in weed science, as well as other areas, need to be carefully targeted. You should strive for streamlining programs, with fewer projects focused on the highest priorities. Researchers with the best track record, those with the ability to get a project moving toward tangible results are the people who are going to continue to get their work funded. Nothing succeeds like success. One way you can be sure you are among that group is to ask if your research project measures up in relevance, quality and efficiency.

You need to be willing to sell your program to the University community. Make a real effort to share your ideas with scientists in other specialities down the hall and across the campus. Few people, even in the University but outside of weed science, know what you are doing or what you are trying to accomplish. Knowing fellow scientists in non-agricultural fields pays off in a number of ways. There are the obvious trade-offs of sharing new ideas and discovering shared goals, and serving each other's needs with equipment and technical facilities. But more important your standing as a scientist is at stake. Nothing will do more for your image as a researcher than letting other scientists know the extent and importance of your work. It makes for better relationships and higher morale within the whole scientific community at the University.

While we're talking about public relations, you can add taxpayers to the list of people who need to know how public money is being spent on agricultural research. They need to know how their state and community and their household will be affected by your research. Don't target your efforts just toward farmers, because city folks help pay your bills too.

Printing an article or two in the weed science journal no longer is enough. But if you don't want to do any more, then you need to have someone out selling for you. Television, newspapers, magazines and radio can tell your story. Make yourself available to advisory groups and industry leaders who will work on your behalf with legislators.
Elected officials at the state and federal level who are in a position to decide how funds are allocated need to know what happens to research money. They need to hear the word investment more often than costs when it comes to asking for research dollars.

All of us have to be prepared to take on the task of involving more fully both private industry and public agencies as investors in the University's weed science program. Your Department Heads, the Deans, Experiment Station Directors and yes, even Chancellors need to be making important contacts on behalf of weed science with legislators and industry leaders. But scientists need to make it a priority of theirs to join in the effort.

Together we can convince both the private and public sectors that investment in higher education, the universities to be sure, is in our mutual best interest.

In summary, I'd like to say that weed science has a bright future in this country. It is a field that holds great promise and is already attracting some of the best minds in agriculture today. You will undoubtedly encounter setbacks, but do not be discouraged. You have shown the tenacity and insight in the past to overcome obstacles. I know you can do it in the future. And you can count on the universities of this nation to be partners in your progress.

PROPER TIMING WITH OXYFLUORFEN FOR OPTIMUM WEED CONTROL

J. T. Schlesselman[1]

The work conducted in California in past years has centered around the use of oxyfluorfen [2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoro-methyl) benzene] in perennial crops for the control of a wide spectrum of broadleaf weeds. Oxyfluorfen has been registered in most treefruit, nut and vine crops for rates up to 2.0 lb ai/acre which will give excellent contact control of postemergence weeds as well as residual activity requiring only annual reapplications. Rohm and Haas Company has also recently registered oxyfluorfen for use in cotton as a fallowbed treatment (August 12, 1982), as well as for post-directed applications after the cotton has reached 8 inches tall (June 20, 1982). On December 12, 1982, a Section 18 was issued in California for oxyfluorfen to be used postemergence in dry-bulb onions. For the new registrations in these annual crops, the high rates of oxyfluorfen used in tree and vine crops would be prohibitive (especially in onions) in terms of crop response and possible herbicide carry-over in the next cropping cycle. A new set of use criteria had to be formulated to insure sufficient crop safety and still obtain maximum weed control.

Oxyfluorfen at rates as low as 0.125 to 0.25 lb ai/acre has shown to be very effective on a broad spectrum of weeds, assuming proper timing and application techniques are implemented. Understanding the relationship between weed stage at application and rate of oxyfluorfen is essential for optimum weed control at these low rates. For example, nettleleaf goosefoot (*Chenopodium murale* L.) has shown to be quite susceptible to oxyfluorfen. Figure 1 shows the results of a timing study conducted on goosefoot with oxyfluorfen at 0.125, 0.25 and 0.5 lb ai/acre. Even the 0.125 lb ai/acre rate of oxyfluorfen gave excellent preemergence control (96% after 3 months) and early postemergence control (91% of weeds less than 2 inches tall). When 2 to 4 inch tall goosefoot was treated with oxyfluorfen at 0.125 lb ai/acre, the control was still 87%. However, when the goosefoot was treated at the 4 to 8 inch stage, it required 0.5 lb ai/acre of oxyfluorfen to give satisfactory control (91%).

Oxyfluorfen is primarily a broadleaf herbicide. There are currently no grasses listed on the label. However, oxyfluorfen has considerable activity on certain grasses, but has a rather narrow treatment window relating to weed stage at application (Figure 2). Work conducted on

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[1]Rohm and Haas Company, Reedley, CA.

littleseed canarygrass (Phalaris minor Retz.) and rabbitsfootgrass (Polypogon monspeliensis (L.) Desf.) showed oxyfluorfen at rates as low as 0.125 lb ai/acre to give excellent preemergence control of these grasses (98% after 3 months). For postemergence control of these grasses, at least 0.25 lb ai/acre was necessary for good control (96%) when weeds were less than 2 inches tall. When grasses had reached the 2 to 4 inch stage, 0.5 lb ai/acre of oxyfluorfen was necessary for adequate control (89%). After the grasses were at the 4 to 6 inch stage, even the 0.5 lb ai/acre rate resulted in only 47% grass control.

Many weeds, which are either somewhat tolerant of oxyfluorfen or have reached the size of being little affected by low rates of oxyfluorfen, can be controlled with split applications. Studies have shown that split applications of oxyfluorfen at 0.25 + 0.25 lb ai/acre average 20% better weed control than a single 0.5 lb ai/acre application (Figure 3). If the initial oxyfluorfen application did not kill the weed, a second application about 2 weeks later did a much better job in controlling the weed than the total amount of herbicide applied at one time. This technique has also resulted in a greater tolerance by crops such as onions.

Although sequential applications of oxyfluorfen have shown increased weed control activity, proper timing in relation to weed stage is essential for a successful weed control program. Figure 4 shows the results of split applications of oxyfluorfen on 4 weed species, each at 2 distinct growth stages. Ratings showed an average 35% increase in control by applying oxyfluorfen when weeds were at the 2 to 3 inch stage (90%) as opposed to the 4 to 12 inch stage (55%).

Low rates of oxyfluorfen can result in considerable residual activity if the soil is left untilled (Table 1). The work conducted in transplant onions in 1982 showed oxyfluorfen as low as 0.25 lb ai/acre still giving an average 95% control of 6 weed species 6 months after application. Similar work in cotton has shown oxyfluorfen to give excellent residual activity when applications were made following the last cultivation.

From these data, it is apparent that oxyfluorfen can give excellent postemergence weed control and residual activity at relatively low rates. However, it is also necessary to understand the parameters under which oxyfluorfen can be used effectively and safely. Continuous research is the only way to broaden the use of any herbicide.

Figure 1. Activity of oxyfluorfen on nettleleaf goosefoot (Chenopodium murale).

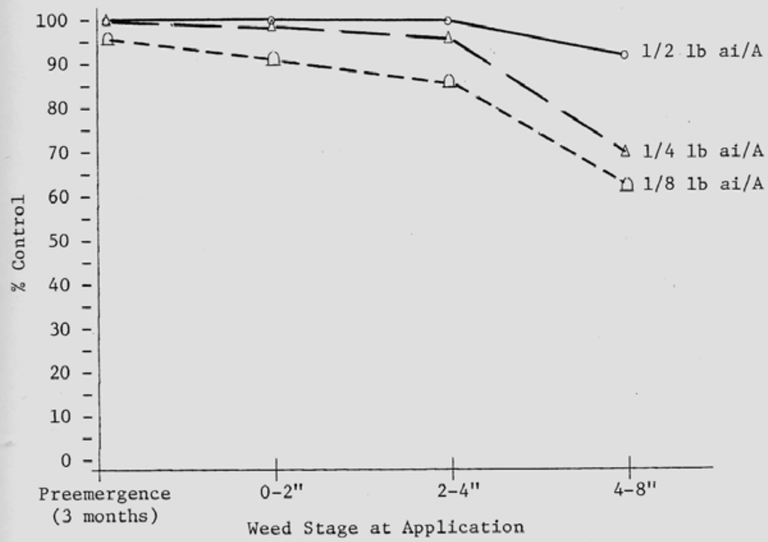

Figure 2. Activity of oxyfluorfen on canarygrass (Phalaris minor) and rabbitsfootgrass (Polypogon monspeliensis).

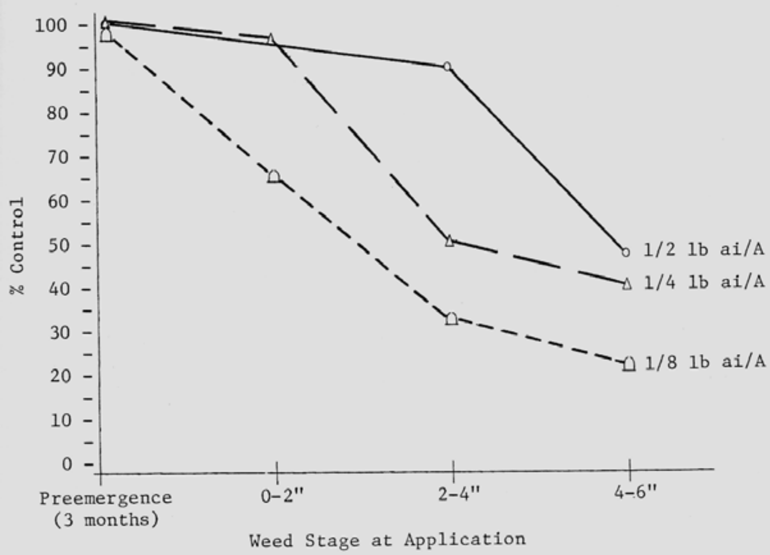

Figure 3. Postemergence weed control with oxyfluorfen in single vs. sequential applications (at 2 week interval).

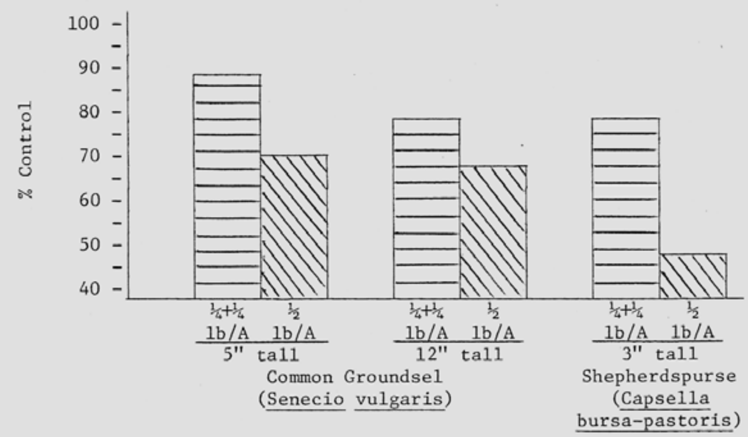

Figure 4. Timing of oxyfluorfen for effective postemergence weed control (sequential applications of ¼+¼ lb ai/A at 2 week interval).

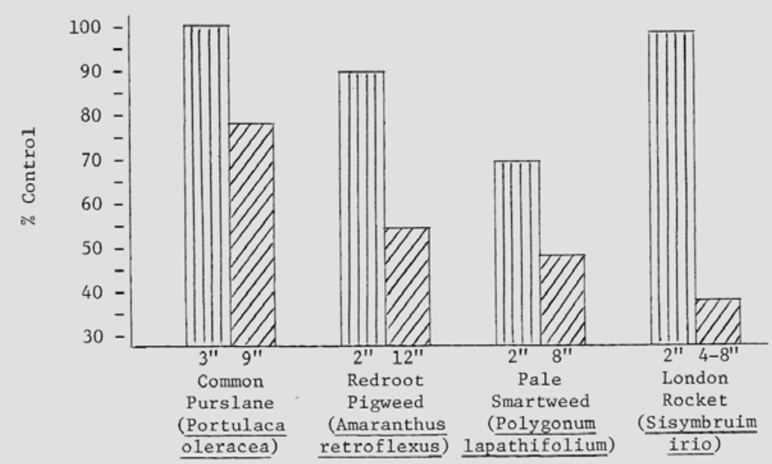

Table 1. Residual weed control activity in transplant onions 6 months after application.

Herbicide	Lb ai/A	Preemergence Weed Control (%) Chickweed (*Stellaria media*)	Sowthistle (*Sonchus oleraceus*)	Black Mustard (*Brassica nigra*)	Prickly Lettuce (*Lactuca serriola*)	California Burclover (*Medicago polymorpha* var. *vulgaris*)	Shepherds-purse (*Capsella bursa-pastoris*)	Average Weed Control
Oxyfluorfen	0.25	83	100	95	100	91	100	95
Oxyfluorfen	0.5	81	100	89	100	100	99	95
Oxyfluorfen	1.0	100	100	100	99	100	99	99
DCPA	10.5	85	60	69	56	68	68	68
Bensulide	6.0	61	93	-	90	61	66	75
Control	0	60	55	85	55	58	46	52

Table 1. Mean percent weed free condition evaluated in June, first year. Means of two replications by formulation and rate.

Hexazinone/rate		Glyphosate rate, kg/ha 0	0.62	
0 kg/ha	solid	30.0 percent	75.0	$\bar{X}$ = 41.2
	liquid	15.0	45.0	
1.11	solid	75.0	96.5	$\bar{X}$ = 86.2
	liquid	80.0	93.5	
1.68	solid	87.5	84.0	$\bar{X}$ = 86.6
	liquid	80.0	95.0	
2.23	solid	74.0	95.0	$\bar{X}$ = 90.5
	liquid	96.5	96.5	
		$\bar{X}$ = 67.25	$\bar{X}$ = 85.1	$\bar{\bar{X}}$ = 76.2

$\bar{X}$ solid = 85.3

$\bar{X}$ liquid = 90.25

Table 2. Mean tree height (centimeters), by treatment, four years after planting. Means of two replicates.

Hexazinone rate		Glyphosate rate 0	0.62 kg/ha	
0	solid	130.5	165.0	$\bar{X}$ = 149.5
	liquid	150.5	152.0	
1.11 kg/ha	solid	173.0	143.0	$\bar{X}$ = 158.0
	liquid	171.0	145.0	
1.68 kg/ha	solid	156.0	160.5	$\bar{X}$ = 157.4
	liquid	164.0	149.0	
2.23 kg/ha	solid	167.0	141.0	$\bar{X}$ = 160.1
	liquid	188.5	144.0	
		$\bar{X}$ = 162.6	149.9	$\bar{\bar{X}}$ = 156.3

$\bar{X}$ solid = 156.7

$\bar{X}$ liquid = 160.2

Table 3. Mean second year survival of Douglas-fir, percent. Rates expressed as kg/ha, herbicide active. Each observation is mean of two replications.

Hexazinone rate		Glyphosate rate 0 kg/ha	Glyphosate rate 0.62 kg/ha	
0 kg/ha	solid	45.0	50.0	$\bar{X}$ = 38.1
	liquid	27.5	30.0	
1.11 kg/ha	solid	90.0	50.0	$\bar{X}$ = 73.7
	liquid	85.0	70.0	
1.68 kg/ha	solid	90.0	85.0	$\bar{X}$ = 82.5
	liquid	85.0	70.0	
2.23 kg/ha	solid	87.5	65.0	$\bar{X}$ = 77.5
	liquid	67.5	90.0	
		$\bar{X}$ = 72.2	$\bar{X}$ = 63.7	$\bar{\bar{X}}$ = 67.95

$\bar{X}$ solid = 77.9

$\bar{X}$ liquid = 77.9

PREDICTION OF THE BIOMASS, LEAF AREA, AND CROWN AREA OF SPROUT CLUMPS OF TANOAK (LITHOCARPUS DENSIFLORUS) AND PACIFIC MADRONE (ARBUTUS MENZIESII): A TECHNIQUE FOR ASSESSING SITE OCCUPANCY BY THESE SPECIES

T. B. Harrington, J. C. Tappeiner II, and J. D. Walstad[1]

Abstract: Tanoak (*Lithocarpus densiflorus*) and Pacific madrone (*Arbutus menziesii*), evergreen hardwood trees that grow abundantly in southwestern Oregon and northern California, sprout vigorously after a disturbance, such as logging or fire. These sprouts form clumps that can hamper conifer regeneration on clearcuts and in shelterwoods.

In order to obtain a quantitative measure of the site occupancy by tanoak and madrone sprout clumps, aboveground biomass and leaf area were estimated for a range of sprout clump sizes of age 1 to 6 years. Both variables were linearly correlated with the diameter of the original parent tree at breast height (dbh). Equations were developed for predicting sprout clump biomass, leaf area, and crown area through age 6 from the dbh of the original parent tree. Thus, by knowing the diameters of tanoak and madrone trees prior to cutting, the biomass, leaf area, and crown area of the developing sprout clump stand can be predicted up to 6 years after cutting.

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[1]Oregon State University, School of Forestry, Corvallis, Oregon.

Biomass and leaf area were also linearly correlated with crown area for these two species. This permits the estimation of tanoak and madrone site occupancy (i.e., biomass/ha, leaf area index, and percent crown cover) in existing brushfields, based on measurements of clump size derived from aerial photographs or ground surveys.

INFLUENCE OF PHENOLOGICAL STAGE AND PHYSIOLOGICAL STRESS ON HERBICIDE TOLERANCE OF CONIFERS AND SHRUBS

S. M. Paley and S. R. Radosevich[1]

Abstract: Seasonal variation in conifer tolerance to herbicides is a major concern of foresters who wish to use herbicides for shrub suppression in conifer plantations. Present practices prescribe application in the fall when the trees are presumed to be dormant. However, actual correlations between herbicide tolerance and the physiological status of the trees have not been developed. This project investigates the possible influences of phenological stage and physiological status on herbicide tolerance for six coniferous species and a shrub species often associated with them. Parallel experiments consisting of three herbicides, 2,4-D [(2,4-Dichlorophenoxy)acetic acid], glyphosate [N-(phosphonomethyl)glycine], and triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid), applied to either tree plots or shrub plots were established in February of 1981 at the University of California, Blodgett Forest Research Station (1370 m elevation, in the Sierra Nevada mountains). An average of 5 five-year-old trees of each species (*Pinus ponderosa*, *P. jeffreyii*, *P. lambertiana*, *Pseudotsuga menziesii*, *Abies concolor*, and *A. magnifica*) were located in each of the 72 plots that contained trees. Each shrub plot contained an average of 15 *Arctostaphylos patula* plants. Treatments consisted of herbicide applications on seven dates at monthly intervals from April through October, 1981. Physiological stress, as revealed by xylem potential, was measured on and between the herbicide application dates. Phenological stages of development (budbreak, leader and leaf elongation, etc.) and climatic conditions were measured throughout the year and were continued through 1982. Final evaluations of herbicide injury (percent of tree damaged, percent of shrub volume dead, and type of damage) for all treatments were made in the fall of 1982.

Most species exhibited similar variations in herbicide injury among the application dates, though the degree of variation depended on the particular species and herbicide. Ponderosa pine exhibited maximum damage from 2,4-D as a result of May (averaging 94% of each tree damaged), June (92%), July (89%), and October (72%) applications. Least damage to that species occurred from applications made in late August (62%) and September (37%). The time periods in which the pines exhibited a high tolerance to the herbicide (late August and September) corresponded to periods exhibiting minimal growth activity and relatively high water stress. This was also true for most of the other species, including the shrubs. Growth (leader and needle elongation) ceased for the pines in August with some resumption of growth (lammas shoots) in the fall. Water stress gradually increased from April (-0.9 MPa at Predawn; -1.1 MPa at midday xylem potentials) through August (-0.8 MPa predawn; -1.7 MPa midday), reached a

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[1]Botany Department, University of California, Davis, CA.

maximum in September (-1.2 MPa predawn; -2.4 MPa midday), and decreased again in October (-0.9 MPa predawn; -1.5 MPa midday). Some species (the firs with 2,4-D treatments and all species except ponderosa pine with glyphosate treatments) also exhibited relatively low herbicide damages from spring applications. In this case the herbicide tolerance did not correspond to high levels of water stress since the xylem potentials were high at that time of year, but it may correspond to the pre-budbreak (minimum growth activity) period in the spring.

GROWTH OF DOUGLAS-FIR FOLLOWING RELEASE FROM SNOWBRUSH AND FORBS IN THE OREGON CASCADES

T. D. Petersen and M. Newton[1]

Abstract: Snowbrush (*Ceanothus velutinus*) and forbs such as fireweed (*Epilobium angustifolium*), trailing blackberry (*Rubus ursinus*), and bracken fern (*Pteridium aquilinum*) were found to suppress the growth of codominant Douglas-fir in plantations in the central Cascades of western Oregon. Increment in the stem volume of Douglas-fir after a four-year period was greatest when all competing vegetation was controlled for one growing season with herbicides. The four-year release of Douglas-fir from both snowbrush and forbs in five-year-old stands resulted in a mean stem volume that was almost four times greater than the mean volume of untreated trees. The relative growth response to release from snowbrush and forbs was much less in ten-year-old stands, but the absolute stem volume was still almost twice as great in released trees after four years. Treating snowbrush with herbicides without concurrent treatment of forbs led to a significant increase in the volume of five-year-old trees but not of ten-year-old trees. The increase in stem volume following control of just snowbrush in five-year-old stands, however, was less than one-half the increase obtained with control of both snowbrush and forbs. Releasing Douglas-fir in ten-year-old stands by cutting the snowbrush resulted in exposure shock that initially reduced the height growth of Douglas-fir but the trees have largely recovered from this injury after four years. However, there has not yet been a significant increase in the volume of Douglas-fir following release by cutting snowbrush.

Improved growth of Douglas-fir following control of snowbrush is probably due to alleviation of water stress caused by consumption of soil moisture by snowbrush. Snowbrush can deplete soil moisture to a depth of at least one meter which subsequently produces high water stress in conifers for much of the growing season. The mechanism by which forbs suppress the growth of Douglas-fir is less evident. Despite the better growth of Douglas-fir when forbs were controlled, in addition to snowbrush, water stress of Douglas-fir was found to be only slightly higher when only shrubs were controlled. Competition for nutrients or perhaps allelopathic inhibition of conifers, rather than competition for water, may account for the better growth of Douglas-fir when free from forbs.

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[1]Champion International Co., Missoula, MT and Oregon State University, Corvallis, OR.

The growth patterns observed in this study have several implications for weed management to improve the productivity by Douglas-fir. The time needed to grow Douglas-fir to a certain harvest volume has been reduced by four years in the first four years after the release of five-year-old Douglas-fir from snowbrush and forbs. These trees have obtained a volume by age nine that they would not have reached until age thirteen without any treatment. Rotation time will be further reduced if growth rates continue to be greater in released trees. This would appear to be a reasonable assumption given the growth trajectories that released trees are currently following. To achieve the maximum reduction in rotation time Douglas-fir should be released at an early age. The growth response will be substantially less for Douglas-fir that have grown in association with snowbrush and forbs for as long as ten years. Also, forbs can negate the potential benefits of release from shrubs regardless of the method of release. Forbs should be controlled concurrently with shrubs to promote the maximum growth of Douglas-fir.

EFFECT OF SALMONBERRY ON GROWTH OF PLANTED CONIFERS

M. Newton and D. E. White

Abstract: Salmonberry (*Rubus spectabilis*) is a common shrub on moist, low-elevation forest sites of the Douglas-fir region. It occurs as an understory to various hardwood and conifer forest types, and resprouts vigorously after disturbances that leave roots in place. Sprout growth is a serious reforestation problem in the Pacific coastal forests. Our objectives were to evaluate impact of the brush, and develop cultural and control strategies to minimize losses to this pest.

Performance of eleven types of conifer planting stock was evaluated for seven years after planting and release in salmonberry. Eighty seedlings of each type were planted immediately after brown-and-burn site preparation (completely blackened site), and similarly in recovered salmonberry four years after burning. A similar experiment was also established in salmonberry two years after fire, but with 160 each of six types of stock. Half of the planted blocks in the 0 and 4-year-old salmonberry were released in September, six months after planting with glyphosate [*N*-(phosphonomethyl)glycine] at .87 kg/ha. Trees planted in 2-year-old brush were released after similar delay with fosamine [ethyl hydrogen (aminocarbonyl)-phosphonate] at 3.3 kg/ha. Rainfall after application of the fosamine negated most of the effects, and differences therein were not apparent in brush or between released and unreleased trees. Effects of glyphosate on the 0 and 4-year-old salmonberry amounted to nearly 100 percent kill of tops and roots.

Differences in age of salmonberry at the time of planting had several effects on conifers. Each year of delay in planting beyond the second year increased mortality of all classes of stock, all species. Douglas-fir (*Pseudotsuga menziesii*) tolerated partial suppression better than western hemlock (*Tsuga heterophylla*), but not as well as Sitka spruce (*Picea sitchensis*). Larger trees tolerated suppression better than small trees

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[1]Oregon State University, School of Forestry, Corvallis, OR.

but even planting stock in the 90-cm height class (the tallest) sustained severe mortality when in 4-year-old brush, and suffered major growth losses when delayed two years.

Each year of delay in planting salmonberry-threat sites compounded losses from competition with those of vacant site. Competition added .4, 1.5 and 4.1 years to the time required to reach a height at which trees may be considered free-to-grow for those that survived planting in 0, 2 and 4-year-old salmonberry, respectively. Mortality added substantially to the years expected before stand closure; there will be many places in the 4-year-old salmonberry where mortality was so heavy that complete crown closure may not occur in this cycle.

Heavy damage was done to seedlings by four-year-old salmonberry in the six months between planting and release. Mortality continued after release for five years as the result of six months of suppression. Trees released at six months showed no measurable effect from newly sprouting salmonberry, but showed a prolonged lack of vigor after release from four-year-old brush, despite total control of competition within six months of planting. Hemlock, normally considered tolerant of such conditions, suffered more than any other species, and small hemlock seedlings sustained proportionally more loss than small seedlings of Douglas-fir or spruce.

All planting stock types performed very well when salmonberry was removed before seedlings were overtopped. All degrees of overtopping observed were detrimental. Regardless of whether released, there was a consistently higher growth rate from large seedlings than from small, and the differences were greater between large and small stock types with increasing competition from salmonberry. Benefits of very large stock in the absence of shrubs were probably economically marginal though measurable. Planting with the largest available Douglas-fir stock immediately after a broadcast burn is reasonably good insurance against total domination by salmonberry. A light application of glyphosate during the year of planting broadens the array of successful choices of stock, and provides a small growth bonus.

Table 1. 7th year survival of Douglas-fir and hemlock by height class when planted, release, and age of salmonberry.

		Salmonberry Age			
		0 years		4 years	
Species	Stock Height	REL	NR	REL	NR
		Survival %			
D-fir	>50 cm	88.5	83.5	46.0	39.5
	25-50	87.0	86.0	37.5	9.5
	<25	97.5	91.0	52.5	5.0
Hemlock	>50	36.0	27.0	15.0	10.0
	25-50	47.0	47.0	17.0	12.5
	<25	85.0	85.0	30.0	7.5

Table 2. 7th year height of Douglas-fir and hemlock by height class when planted, release, and age of salmonberry.

		Salmonberry Age			
		0 years		4 years	
Species	Stock Height	REL	NR	REL	NR
		Centimeters			
D-fir	>50 cm	555.5	504.5	272.0	190.5
	25-50	533.0	513.5	198.5	92.0
	<25	500.5	479.0	167.5	25.0
Hemlock	>50	592.5	521.0	358.5	195.5
	25-50	570.0	528.0	223.0	32.0
	<25	488.0	409.0	148.0	13.0

Table 3. Percentage survival of all stock types after planting in 0, 2 and 4 year old salmonberry during the next seven years.

Salmonberry age		Years after planting 1	2	3	4	5	6	7
SB=0	Released		76	76	76	76		75
	Not released		76	75	74	73		73
SB=2	Released	87	83	82		81		
	Not released	86	77	76		75		
SB=4	Released		49		38	38		38
	Not released		51		28	20		18

Table 4. Salmonberry growth impact - years lost from delayed planting, and failure to release 3520 trees.

	Planting delay - years		
	0	2	4
	Total growth delay - years		
Released	0	3.6	6.9+*
Not released	0.4	3.5	8.1+

*Plus sign signifies that later evaluation will show increased spread between delay and no delay, based on current trends, all classes of planting stock.

Table 5. 5-year growth and survival of various stock types in salmonberry (1) not released and (2) released at 6 months.

	SB=0				SB=2				SB=4			
	NOT REL		REL		NOT REL		REL		NOT REL		REL	
STOCK/HT	HT CM	SURV %	HT	SURV	HT	SURV	HT	SURV	HT	SURV	HT	SURV
DF 90 W*	328	82	357	82	286	96	297	99	151	52	194	52
DF 60 W	307	90	338	95	---	--	---	--	122	27	115	40
DF 40 N	319	85	344	87	---	--	---	--	84	25	107	45
DF 30 N	304	90	297	90	---	--	---	--	29	10	96	32
DF 20 N	321	98	330	100	169	77	145	84	83	5	90	27
DF 12 CN	269	40	294	47	---	--	---	--	18	2	90	27
SS 12 N	304	87	339	85	---	--	---	--	109	40	181	72
SS 60 N	---	--	---	--	237	90	201	96	---	--	---	--
WH 90 W	332	17	406	35	---	--	---	--	81	5	163	12
WH 60 W	344	37	371	40	278	54	226	70	150	12	184	17
WH 30 W	319	57	368	50	---	--	---	--	27	15	117	17
WHC 12 N	273	82	319	85	---	--	---	--	11	15	50	30
GF 45 N	---	--	---	--	138	56	122	60	---	--	---	--

*W = WILDLINGS, N = BARE-ROOT NURSERY, CN = CONTAINER, 65CC = CAVITY HEIGHT IN CENTIMETERS ± 5 CM GRADING STANDARD.

Table 6. 7th-year height and survival of 11 stock types in salmonberry.

STOCK/HT/ORIGIN	SB=0 years				SB=4 years			
	REL		NR		REL		NR	
	HT	SUR	HT	SUR	HT	SUR	HT	SUR
DF 90 W	569 cm	82%	517	77	337	52	213	47
DF 60 W	542	95	492	90	207	40	168	32
DF 40 N	559	87	524	85	197	45	151	17
DF 30 W	507	87	503	87	200	30	27	2
DF 20 N	521	100	528	97	171	50	---	0
DF 12 CN	480	95	430	85	164	55	25	10
SS 12 CN	505	85	463	87	294	75	179	37
WH 90 W	612	35	513	17	337	15	191	5
WH 60 W	573	37	529	37	380	15	200	15
WH 30 W	570	47	528	47	223	17	32	12
WH 12 CN	488	85	409	85	148	30	13	7

THE USE OF HERBICIDES AND/OR FIRE TO CONTROL SALTCEDAR (TAMARIX)

S. W. Howard, A. E. Dirar, J. O. Evans and F. D. Provenza[1]

Abstract: Experiments conducted over two years have indicated that managed burning during spring, fall, and winter are ineffective in controlling saltcedar. Burning and spraying in July was an effective means of controlling this species. Burning in late July prevented 64 percent of the plants from resprouting the year following treatment whereas spraying resprouts with 2,4-D [(2,4-dichlorophenoxy)acetic acid] 1 month after the July fire prevented 99 percent of the plants from resprouting. Triclopyr ([(3,5,6-trichloro-2-pyridinyl)oxyl] acetic acid) ester as a stump treatment or as a basal bark spray prevented resprouted 99 percent or better.

Introduction

Tamarisk, or saltcedar (*Tamarix* spp.) is a vigorous, competitive and important phreatophyte in the southwestern United States. Saltcedar is an exotic that has gained the reputation of being a wasteful water user and has extended its territory into semi-arid and arid regions of the southwestern United States creating ecological imbalances.

Saltcedar's remarkable root system enables it to exist under a wide range of conditions and replace the native vegetation. Extensive flood plains that are potentially suitable for grazing, farming, wildlife, and recreation are now occupied by saltcedar. In addition, the lush foliage is not acceptable as forage for cattle or big game (2).

In areas where the plant has become a pest there is a need for an effective control method. The herbicide silvex has been the most successful control method, however, there have been several restrictions placed on its use and the United States Department of Interior has totally prohibited its use on Interior Lands.

Objectives

The objectives of this study were:

1. To evaluate the effects of burning alone and burning and spraying 2,4-D in July, September, and October on regrowth of saltcedar the year following treatment.
2. To evaluate the efficacy of triclopyr as a stump or basal bark application.
3. To determine the effects of some experimental adjuvants on the efficacy of triclopyr.

Methods

The Ouray National Wildlife Refuge is located along the Green River in northeastern Utah, approximately 48 km southwest of Vernal. The refuge includes 19.2 km of the Green River and encompasses 4,647 ha of land. The annual precipitation is less than 180 mm.

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On 20 June 1981, three plots (351 m^2) within each of three saltcedar densities (blocks) were established. These plots, one from each block, were burned on July 23, September 9, and October 10. All burnings were into the wind. Half of each plot was subsequently sprayed with 2,4-D (0.48 kg acid equivalent/l as butoxy ethanol ester) 1 month after burning (i.e. September 3, October 7 and November 14) at a rate of 60 ml 2,4-D/l of water. The chemical was applied to individual plants and resprouts using a hand sprayer. Due to circumstances beyond control, the study site was inundated from 20 April to 13 July 1982; this is a common occurrence during spring. The response of saltcedar to burning and spraying was evaluated from 26 to 29 July 1982 by counting the number of dead and live plants.

Three categories of fuel were sampled before each burn. 1. Twenty, 1.0 m^2 quadrats were samples systematically on each plot to determine the amount of understory fuel. 2. The fuel provided by individual saltcedar plants was assessed by clipping the lower 0.6 m of stems from the ground. 3. The accumulated fine stems, leaves and flowers of individual plants were sampled.

Oven dry weights were obtained for the understory fuel and the accumulated litter within tamarix stems by drying at 73°C for 24 hrs and for tamarix stems at 73°C for 72 hrs. Air temperature, relative humidity, and wind speed were recorded during each burn.

At three locations within each plot the temperatures at the soil surface and 2 cm below the soil surface were recorded by Omega pellets that were glued to small asbestos boards. The temperature ratings of the pellets ranged from 37.8°C to 804.4°C. The first sign of melting indicated that the temperature rating of the pellets was reached.

The second experiment involved the use of three different application techniques including basal bark, cut stump, and modified cut stump to test the efficacy of the herbicide triclopyr as a control method for saltcedar.

Triclopyr is a selective herbicide which induces growth kinetics quite similar to that of IAA (1). Both the ester and amine formulations were included in the experiments.

The experiments were established in two different locations: Utah Lake and Moab, Utah. In both of these locations saltcedar was well established and abundant.

On the south shore of Utah Lake saltcedar is by far the most abundant woody species. In the test plot area it is the only woody species. The test site was an older saltcedar community which was ideal for the cut stump applications.

The soil at the Utah Lake site was a silty clay loam with a pH of 7.6, electrical conductivity of 32.0, and organic matter content of 3.79 percent.

The cut stump treatment was applied on July 13, 1981. The saltcedar plants averaged 2.7 m in height and had an average density of 1.2 trees/m^2. The plants and site were uniform enough to use a completely randomized design. There were five replications with one clump of stumps representing one replication.

This method of application involved cutting the tree 15 cm to 30 cm above the crown then applying the herbicide to the cut surface only. The actual height of the cut was a matter of practicality and convenience. Often the surrounding foliage and terrain dictate the height of the cut.

The herbicide was applied using a spray bottle. A total of 236 ml of spray solution was mixed and any remaining solution was measured to determine how much was used at each application. The spray solution was applied as soon as possible after cutting. This was necessary because suberization of the cut surface may reduce the amount of herbicide which actually enters the stump. The stumps ranged from 5 mm to 6 cm in diameter, with 7 to 12 stumps per replication. There was no measureable wind. Air and soil temperatures were 25°C and 22°C respectively.

The trial contained eleven treatments and included the use of both triclopyr formulations, silvex and picloram. Diesel was used as carrier in some of the treatments.

The modified cut stump treatments were applied on July 14, 1981. The saltcedar plants averaged 2.9 m in height and had an average density of 1.7 trees/m^2. The plants and site were uniform enough to use a completely randomized design. There were five replications with one clump of stumps representing one replication.

The same procedure was followed in this application method as was with the cut stump with one exception, the herbicide was applied to both the cut surface and all above ground bark. There was enough spray solution applied to the bark so that runoff occured at the ground level.

The trial included four experimental adjuvants, M4535, M4534, M4533, M4532 and one experimental surfactant, M4168, all made available by Dow Chemical. Diesel is usually the standard carrier in cut stump treatments, but the cost is becoming prohibitive. Presumeably these adjuvants would be less expensive than diesel and therefore make the treatments less costly.

There were eleven treatments, eight of which involved the use of triclopyr ester at 20 ml/l with two rates 25% and 50% (v/v) of each adjuvant. The experimental surfactant was used at 1% (v/v). The remaining three treatments were standard cut stump rates and carriers for both formulations of triclopyr and a control.

The following mixing procedure was followed: adjuvant, surfactant, herbicide, and water. A total of 472 ml of spray solution was mixed and any remaining solution was measured.

During the application there was no measureable wind, and air and soil temperatures were 22°C and 21°C respectively.

On a cooperators field north of Moab, Utah, a basal bark experiment was established. This field of 170 ha is adjacent to the Colorado River. The entire hectarage is covered with saltcedar. Three years previous to application of the treatment the entire field was mowed with a flail mower. Hence, all saltcedar plants were 3 years old.

The soil was a sandy loam with a pH of 8.1, and electrical conductivity of 57.5, and an organic matter content of 1.24 percent. Saltcedar was the predominant woody species although there were a few Russian olive and willow plants sparsely scattered throughout the field.

The basal bark applications were made on August 20, 1981. The average height of the plants was 3.05 m and the average density was 1.5 trees/m^2. A completely randomized design was used. There were four replications with each clump of stumps representing one replication.

In the basal bark treatment the lower 30 to 40 cm of bark was sprayed until runoff at the ground level occured. There was no cutting or removal of plant material involved. The experiment involved seven treatments and was essentially identical to the modified cut stump trial at Utah Lake. The only alteration was the deletion of the treatments with the low rates of the adjuvants.

The same mixing procedure was followed; adjuvant, surfactant, herbicide and water. A total spray solution of 472 ml was mixed and any remaining solution was measured. There was no measureable wind, air and soil temperatures were 23°C and 24.5°C respectively.

Results

Table 1 summarizes the effects of burning and burning and spraying on saltcedar. Analysis of variance indicated significant differences for time of burning, but differences due to spraying were not as significant. A significant interaction (spraying x July vs September and October) resulted because spraying in July prevented an additional 35 percent of the plants from resprouting the year following treatment, while spraying in September and October was ineffective.

Table 1. Percent of saltcedar plants that did not resprout the year following treatment.

	Date			
Treatment	July	September	October	Average[b]
Burned	64	9	4	26b
Burned and sprayed[a]	99	12	5	39b
Average	81a	11b	5b	

[a]Plants were sprayed approximately one month following burning.

[b]Means in the same row or column followed by a different letter are significantly different (LSD .05).

Spraying was effective following the July burn because the plants resprouted. Thus, the 2,4-D was translocated in sufficient amounts to the roots. Possible factors facilitating herbicide translocation following the July fire include good contact of the herbicide with the growing points on resprouts at the base of the plants, and good penetration of the herbicide through the thin leaf cuticle. This was not the case with plants treated following the September and October fires because the spray was applied to plants that had not resprouted.

The differential response of saltcedar to fire was probably due in part to the different degree of heat produced by each fire. Differences in heat yield were not attributed to fuel load, but were probably due to wind speed and the moisture content of the fuel (Table 2). The response of saltcedar to spraying was probably also related to differences in the morphological and physiological condition of the plants at the time of treatment. Spraying the resprouts following the July fire was detrimental to saltcedar because of effective penetration and translocation of the herbicide.

Table 2. Important parameters of the burn.

Parameter	Date July	September	October
Wind speed (m/sec)	0-1.3	0-3.1	3.6-4.9
Dry fuel weight (g)	2549	2330	3618
Moisture content (%)	44	50	59
Burn temperature (°C)	101-198	66-101	66-101

Due to an unusually high amount of rainfall, Utah Lake rose high enough to cover the entire plot area, therefore final evaluations could not be made. As of March 1, 1983 the plots are still under water. Table 3 shows the preliminary readings on the Utah Lake cut stump trial. Three treatments, triclopyr ester + diesel oil at 1:1, triclopyr ester + diesel oil at 1:2, and picloram (RTU), all provided complete control, where there was no resprouting in any stumps.

All of the treatments involving triclopyr amine provided poor control. Cut stump applications is one of the registrations for triclopyr amine and it appears, at least from this experiment, that it will be of little value in controlling saltcedar. Approximately 38 ml/stump of spray solution were needed to treat each clump of stumps.

Table 4 shows the results of the modified cut stump trial. Here, the most effective treatments were triclpyr ester at 20 ml + M4168 at 10 ml + M4533 at 250 ml, triclopyr ester at 20 ml + M4168 at 10 ml + M4533 at 500 ml, and triclopyr ester at 20 ml in a diesel oil carrier.

The adjuvant M4533 at both 250 ml/l and 500 ml/l was an ingredient in two of the most efficacious treatments. It is unfortunate that a treatment testing the phytotoxicity of this adjuvant was not included in the protocol. This would help determine whether the M4533 is acting as an adjuvant or a herbicide.

Again, as in the cut stump applications, triclopyr amine provided only fair injury as a stump treatment. An average of 80 ml/stump was used. This is a little more than double the amount used for the cut stump treatments.

As in the cut stump treatments there were no signs of phytotoxicity in any of the surrounding vegetation. This is the advantage to this application method. It is a very controlled application method so there is very little drift or injury to non-target species.

Table 5 shows that the most efficacious basal bark treatments were triclopyr ester at 20 ml/l in a diesel carrier and triclpyr ester at 20 ml/l + M4168 at 10 ml/l + M4532 at 500 ml/l providing control of 96% and 93% respectively.

Triclopyr amine at 27 ml/l provided extremely poor control, only approximately 95 ml of spray solution/stump was used. This is the most solution needed for any of the application techniques.

Table 3. Response of saltcedar to cut stump treatments at Utah Lake, Utah, September 23, 1981, three months after treatment.

Treatment	Dilution ratio	Control %
Triclopyr ester diesel oil	1:10	80
Triclopyr ester diesel oil	1:5	80
Triclopyr ester diesel oil	1:2	100
Triclopyr ester diesel oil	1:1	100
Triclopyr ester picloram	1:1	80
Triclopyr amine water	1:1	52
Triclopyr amine	undilute	46
Triclopyr amine picloram	1:1	46
Picloram (RTU)[a]	undilute	100
Silvex water	1:1	80
Control	---	0

[a]Ready to use.

Table 4. Response of saltcedar to modified cut stump treatments at Utah Lake, Sept. 23, 1981, three months after treatment.

Treatment	Rate (ml/l)	Control (%)
Triclopyr ester M4168 M4535	20 10 250	80
M4535	500	60
M4534	250	60
M4534	500	60
M4533	250	100
M4533	500	100
M4532	250	70
M4532	500	40
Triclopyr ester diesel[a]	20	100
Triclopyr amine	27	60
Control	---	0

[a]Sole carrier

Table 5. Response of saltcedar to basal bark treatments at Moab, Utah, June 15, 1982, one year after treatment.

Treatment	Rate (ml/l)	Control (%)
Triclopyr ester M4168 M4535	20 10 500	64
M4534	500	60
M4533	500	85
M4532	500	93
Triclopyr ester diesel[a]	20	96
Triclopyr amine	27	7
Control	---	0

[a]Sole carrier

Conclusions

From the research project designed to evaluate the effects of fire and 2,4-D for controlling saltcedar, the following can be concluded:

1. Fire in late July effectively controlled saltcedar the initial year following the burn. Burning in September and October did not control saltcedar.
2. Spraying one month after the July burn increased mortality from 64 to 99 percent.
3. Spraying after the September or October fire was ineffective.

For better understanding of the ecological effects of fire on saltcedar, the following are recommended:

1. Basic research on morphological and physiological features of the plant as they relate to burning and spraying.
2. An evaluation of early and mid-summer burning and spraying as means of controlling saltcedar.

Triclopyr ester shows promise as a basal and stump application. The adjuvants M4533 and M4532 should be tested further as an economical replacement for the costly diesel carrier.

Triclopyr amine was ineffective in controlling saltcedar for all three application techniques, especially the basal bark application. This probably indicates poor penetration and/or translocation of this formulation of triclopyr.

The basal bark application requires the most spray solution (95 ml/stump) when compared to the cut stump and modified cut stump applications (38 and 80 ml/stump respectively). The most expensive application, however, is the cut stump due to the high concentration of triclopyr included in the spray solution.

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INTRA- AND INTERSPECIFIC COMPETITION IN DOUGLAS-FIR PLANTATIONS IN THE OREGON COAST RANGE

E. C. Cole, M. Newton and S. M. Zedaker[1]

Abstract: An experiment was conducted to determine how Douglas-fir (*Pseudotsuga menziesii*) exploits site resources when growing in mixture with grasses or red alder (*Alnus rubra*) or with no competition apart from other Douglas-fir. The study was conducted in three zones of the Oregon Coast Range - the warm, dry climate of the Willamette Valley, the warm, moist environment of the valleys of the Coast Range, and the cool, moist situation in the fog-belt within a few miles of the Pacific Ocean.

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Douglas-fir 2-0 bare-root seedlings were planted in circular plots in a wagon-wheel configuration after the designs of Nelder. Twelve such plots were planted, four in each of the three zones. Within each plot, trees were planted in 18 concentric circles, 48 trees per circle for a total of 864 trees. Space per tree ranged from 300 cm^2 to 15,250 cm^2, in a roughly square spacing. Within each plot, the circle was divided into six "pie slices" of equal size. "Treatments" were randomly assigned to each pie so that no two adjacent "pie slices" could be of the same treatment (to avoid edge effect). Treatments included, 1) total weed control throughout the five years of the experiment, 2) complete weed control the first year, followed by grass seeding, and 3) planting alternate radii with Douglas-fir and red alder seedlings for a 50:50 mixture, with complete weed control for the life of the experiment. The three treatments occurred twice in each plot.

Fifth-year results indicate that the average height and diameter of Douglas-fir is strongly affected by density of Douglas-fir itself, and less strikingly by grass and by alder. There appears to be an important interaction between site, density and competitor. Effects of grass alone ranged from negligible, where some difficulty was encountered establishing grass, to 10.4 mm decrease in diameter at 15 cm above ground. Alder competition varied in its effects, with Douglas-fir diameter growth under alder ranging from 2.4 mm more than in pure conifers to 7.8 mm less, depending on stand density and locality. Both competitor types caused the greatest decreases at the lowest densities of Douglas-fir; high-density plantings had stressed the conifers so severely that the upper limits of growth were too constrained to reflect the potential of free-to-grow trees. The coastal site where grass failed was an exception.

Height growth was also decreased by both competitors about equally up to this time. Both grass and alder decreased height growth by 0 to 0.63 m during the five-year period. The two competitor regimes had different patterns of effect, however, in which grass inhibition occurred during the first 3 years, whereas alder suppression had its greatest effect later. Alder is beginning to decrease growth of Douglas-fir under all conditions in the fifth year. Effect of the alder is least at the perimeter of the plots where spacing of alder is widest. Long-term projections of current changes suggest that alder will be a far more serious competitor in years to come, and that the effect of grass is essentially past.

These plots suggest that alder growth habits are compatible with Douglas-fir for a few years in dense stands, but are incompatible in the long run. An association of species will lead to dominance by alder and negative growth impacts on Douglas-fir. Alder did not improve nitrogen status of conifers or soil, but soil nitrogen was not deficient. Alder created more severe moisture stresses in associated Douglas-fir than grass. Effect of grass after a year of total weed control was much less than would be anticipated for established grass, but growth impact is still measurable even under environments where moisture is generally not regarded as critical for established trees.

Table 1. Fifth-year height and diameter measurements for the warm, dry valley site. (High density 300 to 1110 cm^2/tree; Medium density 1441 to 4107 cm^2/tree; Low density 5339 to 15250 cm^2/tree.) Each figure is mean of 60 trees for Douglas-fir and grass, 30 trees with alder.

	Total Height (Meters)	Diameter @ 15 cm (mm)
Douglas-fir Only		
High Density	2.16	19.6
Medium Density	2.57	29.5
Low Density	2.76	43.9
Douglas-fir/Grass		
High Density	2.10	19.3
Medium Density	2.21	27.3
Low Density	2.13	33.5
Douglas-fir/Red Alder		
High Density	1.68	17.6
Medium Density	2.24	30.0
Low Density	2.78	43.6

Table 2. Fifth-year height and diameter measurements for the mid-range valley site. (Densities same as Table 1.)

	Total Height (meters)	Diameter @ 15 cm (mm)
Douglas-fir Only		
High Density	2.10	18.6
Medium Density	2.37	28.9
Low Density	2.40	39.9
Douglas-fir/Grass		
High Density	2.04	17.5
Medium Density	2.18	25.3
Low Density	2.11	31.6
Douglas-fir/Red Alder		
High Density	1.47	15.9
Medium Density	1.94	23.4
Low Density	2.65	38.7

Table 3. Fifth-year height and diameter measurements for the coastal site. (Densities same as Table 1.)

	Total Height (meters)	Diameter @ 15 cm (mm)
Douglas-fir Only		
High Density	2.14	21.0
Medium Density	2.65	29.1
Low Density	2.80	45.9
Douglas-fir/Grass*		
High Density	2.13	19.4
Medium Density	2.40	32.7
Low Density	2.88	49.3
Douglas-fir/Red Alder		
High Density	2.30	21.8
Medium Density	2.42	31.5
Low Density	2.29	38.1

*Grass establishment delayed until third year on coastal site.

THE RESPONSE OF CONIFERS TO THREE METHODS OF SITE PREPARATION

W. T. Lanini and S. R. Radosevich[1]

Both fire and the brushrake have been used extensively to prepare previously logged forest sites for conifer planting. Recently, rotary masticators also have been used to prepare planting sites. A four-year field study was initiated to determine the effects of these three methods of site preparation on the growth of three planted conifer species; ponderosa pine (*Pinus ponderosa* Dougl. ex P. & C. Lawson), sugar pine (*Pinus labertiana* Dougl.) and white fir (*Abies concolor* [Gord. & Gland.] Lindl.). The experiment was established in the summer of 1978 in Tahoe National Forest and conifer planting occurred the following spring. The plots were 20 m x 44 m and were replicated three times in a randomized complete block design. Conifer response to these treatments was monitored on a monthly basis during the field season.

Predawn and midday conifer water potential was measured using a portable pressure chamber. Regardless of species, water potentials were greatest on the brushrake treatment. Conifer height, stem diameter, and crown width also were greatest on the brushrake treatment. Of the three methods of site preparation studied, the brushrake generally resulted in the greatest decrease in shrub occupancy. Ponderosa pine growth was most responsive to the method of site preparation, while white fir was least responsive. The growth of conifers was related to shrub volume.

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COMPARISON OF RHIZOMES TO LATERAL ROOTS OF FIELD BINDWEED (CONVOLVULUS ARVENSIS L.) FOR SEASONAL VARIATION IN ESTABLISHMENT

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Abstract: Rhizomes and lateral roots of field bindweed (*Convolvulus arvensis* L.) were collected during the second week (approximately) of each calendar month for one year, beginning in March 1981. Roots and rhizomes, of 2 to 4 mm diameter, were cut into 6 cm segments. Twenty segments of each were planted in a sand, soil, and peat moss medium and grown in the greenhouse for 42 days. At the end of the 42 days, the segments were removed from the pots and evaluated for number of roots, number of shoots, and number of segments established. Establishment was defined as the presence of at least one newly formed root and one newly formed shoot per segment.

Forty-four percent of the root segments and 26% of the rhizome segments established over the entire year. Root segments attained a maximum of 85% establishment in January. Rhizome segment establishment reached a maximum of 45% in March and again in October. No growth occurred in June for either root or rhizome segments. Root segments generally produced greater numbers of roots and shoots than rhizome segments.

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Introduction

Field bindweed (Convolvulus arvensis L.) is a creeping weed of economic importance, in temperate regions worldwide. Holm et al. (3) list field bindweed as a problem weed in 44 countries and in over 43 world crops.

Field bindweed spreads by seed or vegetatively via a spreading root system. When undisturbed, the plant produces many lateral roots which radiate outward in all directions from the parent taproot. After lateral growth of 50 to 100 cm, the root turns downward and rhizomes develop from adventitious buds formed at the bend. Rhizome formation is not strictly limited to the bend region. They may form at any location along the lateral root. Once rhizomes are initiated they extend vertically until they reach the soil surface where they establish a new crown (6).

Bakke (1) excavated field bindweed roots from depths of over 6 meters and reported the production of lateral roots to approximately 45 cm. Timmons (9) found 70% (by weight) of all field bindweed roots in the upper 60 cm of soil profile. In a later study, Davison (2) reported 70% of all roots in the upper 15 cm of soil. This predominance of roots, and consequently rhizomes, in the upper portions of the soil profile leads to great amounts of fragmenting by commonly practiced cultivation techniques. Regeneration from root fragments in the field has been reported by Kiesselbach et al. (4) under very favorable moisture conditions. Research by Swan and Chancellor (7, 8) confirmed regeneration of root fragments, but due to a very low rate of root production, these researchers concluded that reinfestation from root fragments was probably of little practical importance. A finding of further interest reported in the studies (7, 8) was that the regenerative ability of the root fragments varied significantly with the time of year that the roots were collected in the field. The measure of regeneration used was the number and length of new shoots produced per fragment. To a lesser extent the number and length of new roots was also considered (7, 8).

Previous work on vegetative regeneration dealt with roots, both taproots and lateral roots. There have been no reports on the ability of the rhizomes to regenerate when separated from the parent plant. The research reported here was designed to compare lateral root segments to rhizome segments for seasonal differences in establishment and production of new roots and shoots. To be considered established, a segment needed to possess one newly formed healthy root and one newly formed healthy shoot at the time of removal from the pot.

Materials and Methods

Rhizomes and lateral roots of field bindweed were collected from an undisturbed natural infestation at Pullman, Washington. Collections were made from a 5 to 15 cm soil depth. These were obtained in the second week of each calendar month for 1 year beginning in March, 1981. Roots and rhizomes 2 to 4 mm in diameter were selected, washed in distilled water and cut into 6 cm long segments. Twenty root and 20 rhizome segments were chosen at random, all branch roots and stems were removed and the segments were planted into 2.6 liter black plastic pots. Rhizome pieces with fewer than 2 visible axillary buds were not used.

A total of 10 pots of roots and 10 pots of rhizomes were planted with 2 segments per pot. A mixture of coarse construction sand, Palouse silt loam soil, and horticultural grade peat moss, at a ratio of 1:1:1

was used for a growth medium. Root segments were placed horizontally at a distance of 4 cm below the surface. The rhizome segments were placed, apical end upward, 2.5 cm below the soil surface. All pots were thoroughly watered at the time of planting and maintained moist thereafter. The segments grew in the greenhouse for 42 days and then were removed from the pot for evaluation.

Results and Discussion

The percentage of rhizome segments established ranged from 0 in June to 45% for both March and October (Table 1). Establishment by rhizome segments was greatest in March and August. The poorest establishment was in June.

Table 1. Percentage and total number of field bindweed roots and rhizome segments established after 42 days of growth.

Month Collected	% Established* Rhizomes	Total Established /20 Root Segments	% Established* Roots	Total Established /20 Root Segments
March	45	9	50	10
April	15	3	10	2
May	20	4	50	10
June	0	0	0	0
July	15	3	30	6
August	30	6	75	15
September	35	7	15	3
October	45	9	80	16
November	25	5	30	6
December	35	7	40	8
January	25	5	85	17
February	30	6	65	13
mean	26.67%	5.82	44.17%	8.83

*% based on 20 segments per month.

In general, root segment establishment was greater than rhizome segment establishment. The establishment for roots ranged from 0 in June to 85% in January. Root segments produced a larger number of new shoots and new roots than the rhizome segments (Table 2). A total for the year of 293 shoots and 397 roots were developed by the lateral root segments. The rhizome segments produced only 185 shoots and 224 roots in the same time period.

When root and rhizome segments were statistically compared for establishment using a paired Student's t procedure (5) with an alpha error rate of 0.05, the roots established in significantly greater numbers in August, October, January and February. Although not statistically significant, the trend was for roots to establish in greater numbers in all months except April, June and September. Further comparisons of roots to rhizomes were made using the paired t statistic. Roots produced significantly more shoots than rhizomes produced in January, February, March, July and August, and more roots in May, August and October.

Table 2. Monthly production of shoots and roots by lateral root and rhizome segments of field bindweed.

Month Collected	Total number of shoots produced		Total number of roots produced	
	Lateral Root	Rhizome	Lateral Root	Rhizome
January	38	9	53	25
February	29	13	41	36
March	65	26	47	23
April	9	17	6	12
May	22	19	34	7
June	0	0	0	0
July	13	3	19	7
August	41	19	58	17
September	7	17	14	17
October	34	22	69	23
November	12	23	24	18
December	23	17	32	39
Total	293	185	397	224

Forty-two percent of the root segments established during the entire testing period. Of those collected during the Washington growing season, March through October, slightly over 38% established. Twenty-seven percent of the rhizome segments established for the year while 25.6% established for those collected in the growing season.

In this study, root and rhizome segments were capable of becoming established when separated from the parent plant. The root segments tended to establish more readily than the rhizome segments.

The rates of establishment were highest in the spring and again in the late summer or early fall. This corresponds to tillage time schedules for spring and winter crops. These are also times of greatest precipitation in this region. It appears from the results that if growing conditions are favorable, a substantial amount of reinfestation may occur from root and rhizome fragments. These data also suggest that early summer is the best time of year for cultivation to achieve the lowest rate of reinfestation.

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REGENERATION OF FIELD BINDWEED SEEDLINGS

Dean G. Swan[1]

Abstract: The regenerative ability of field bindweed (Convolvulus arvensis L.) grown from seed was studied in the greenhouse and field. Seedlings, grown a determined number of days following emergence, were cut off 1.3 cm below the soil surface. Regrowth occurred within one to four weeks after the plants were cut off. Seedling regenerative ability was correlated mostly with number of days after emergence and not with number of leaves. In the greenhouse, some plants cut off 20 days after emergence and all plants cut off 44 days after emergence regenerated. Seedlings grown at a 12 to 16C temperature range regenerated in fewer days after emergence than those grown at a 20 to 25C range. The number of leaves when the plants were cut off was correlated mostly with temperature and not age or regenerative ability. In one field study (temperature range 8 to 18C), some plants cut off 20 days after emergence and all plants cut off 38 days after emergence regenerated. In a second study (temperature range 9 to 22C), some plants cut off 15 days after emergence and all plants cut off 21 days after emergence regenerated.

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NITROGEN FERTILIZER SOLUTIONS AS CARRIER FOR GLYPHOSATE

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Abstract: Glyphosate [(*N*-(phosphonomethyl)glycine)] is a systemic, post-emergence herbicide used extensively throughout the United States to control

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annual weeds in small grain, reduced tillage systems. In such systems, substantial interest has been shown in using nitrogen fertilizer solutions as carrier for postemergence, glyphosate applications.

In the spring of 1982, three trials were initiated at Line, WA, Touchet, WA and Pendleton, OR to evaluate various concentrations of nitrogen fertilizer as carrier for glyphosate applications to volunteer wheat (Triticum aesticum L.) and downy brome (Bromus tectorum L.). Fertilizer used as carrier in the trials was 32%-Uran. 0.19 and 0.28 lb ai/A glyphosate, with and without additional surfactant at 0.5% (v/v), were applied with 0, 25, 50, 75 and 100% concentrations of nitrogen solution as carrier component. Five and 10 gpa spray volumes were also evaluated in these fertilizer carrier studies. Volunteer wheat was 4 to 5 inches tall and downy brome 2 to 3 inches tall when applications were made. At all locations, 10 ft by 20 ft plots were replicated three times in a randomized complete block design. All treatments were visually evaluated at approximately 30 days after treatment for percent weed control when compared to an untreated check plot.

Data indicate nitrogen fluid fertilizer solutions (32%-Uran) have potential to be successfully used as carrier for glyphosate in applications to troublesome annual weeds in small grain, reduced tillage systems (Table 1). It was demonstrated that fluid nitrogen solutions should not be used as a substitute for additional surfactant to enhance glyphosate efficacy. When contrasted to water alone, nitrogen fertilizer concentrations of 25 or 50%, respectively, had no effect on or slightly increased glyphosate efficacy on volunteer wheat and downy brome. When the nitrogen fertilizer composed greater than 50% of the carrier solution, a substantial decrease in glyphosate efficacy resulted, however, this efficacy reduction was overcome (masked) with the addition of surfactant at 0.5% (v/v). Maximum glyphosate efficacy enhancement was obtained when additional surfactant was combined with nitrogen fluid fertilizer composing up to 50% of total carrier volume. Both downy brome and volunteer wheat responded similarly in the trials, and 5 gpa spray volume was slightly superior to 10 gpa in improving glyphosate performance.

Table 1. Control of volunteer wheat and downy brome with glyphosate when using nitrogen fluid fertilizer as carrier

Carrier				Glyphosate Rate (lb ae/A)			
				0.19		0.28	
% Water	% N-Fertilizer	GPA	Additional Surfactant	Vol. Wheat	Downy Brome	Vol. Wheat	Downy Brome
				(% Control)[a]			
100	0	10	None	76	76	88	85
75	25	10	None	88	87	90	87
50	50	10	None	83	80	87	86
25	75	10	None	73	67	83	81
0	100	10	None	64	56	71	66
100	0	10	R-11 ½%(v/v)	82	80	92	92
75	25	10	R-11 ½%(v/v)	89	89	97	96
50	50	10	R-11 ½%(v/v)	90	91	93	93
25	75	10	R-11 ½%(v/v)	86	83	95	95
0	100	10	R-11 ½%(v/v)	86	82	91	91
100	0	5	None	82	84	89	86
100	0	5	R-11 ½%(v/v)	86	85	92	92
75	25	5	R-11 ½%(v/v)	89	90	93	92
50	50	5	R-11 ½%(v/v)	93	92	95	93

[a]Values are averages of nine replications over three locations.

FACTORS INFLUENCING GLYPHOSATE PERFORMANCE IN TANK MIXTURE WITH SOIL RESIDUAL HERBICIDES

Darlene M. Frye[1]

Abstract: Season long weed control (six to eight months) is desirable and often essential in many perennial cropping situations and in non-crop or industrial sites. A single application of one herbicide can rarely provide control of both emerged weeds and subsequent seedling weeds. For this reason, herbicides having postemergence activity and those having preemergence, soil residual activity are frequently combined to provide control of the emerged weeds and the seedlings that germinate during the six to eight-month growing season. When applied as a properly timed tank mixture, the single application can provide time and energy savings over multiple applications of singly applied herbicides.

Glyphosate [N-(phosphonomethyl) glycine] in the form of its isopropylamine salt is commonly utilized to control emerged annual and perennial weeds in these perennial crop and non-crop situations. Previously published data, however, cited instances where tank mixtures of glyphosate and selected soil residual herbicides resulted in antagonism such that the performance of glyphosate was negatively affected. Trials were established in Oregon and Washington from 1980 to 1982 in a variety of perennial crops and in roadside situations to evaluate, under commercial conditions, the relative performance of glyphosate tank mixtures with selected soil residual herbicides commonly utilized in the Pacific Northwest. Although diuron [3-(3,4-dichlorophenyl)-1,1-dimethylurea], oryzalin (3,5-dinitro N^4,N^4-dipropylsulfanilamide) and simazine [2-chloro-4,6-bis(ethylamino)-s-triazine] were evaluated most extensively, atrazine (2-chlor-4-ethylamino-6-isopropylamino-s-triazine), napropamide [2-(a-naphthoxyl)-N,N-diethylpropionamide], norflurazon [4-chloro-5-(methylamino)-2-(α,α,α-trifluoro-m-tolyl)-3-(2H)-pyridazinone] and a package mixture of diuron and bromacil (5-bromo-3sec-butyl-6-methyluracil) were also evaluated. Tank mixtures were compared to glyphosate applied alone or to sequential applications of the residual herbicide following application of the glyphosate. Where applicable, glyphosate rates as low as 0.75 lb ae/A were combined with soil residual herbicides rates as high as 10.0 lb ai/A. Herbicide combinations evaluated were based on the labeled rates for each herbicide according to crop and weed species.

Based on the data generated from these trials, the type of residual herbicide formualtion (wettable powder, flowable or water dispersable granule) did not differentially affect the performance of glyphosate. Although the length of time required to achieve weed burndown was affected when glyphosate was tank mixed with the soil residual herbicides, long term annual and perennial weed control was not reduced. In these trials, postemergence weed control was reduced by 0 to 39% at seven to ten days following treatment. These differences in weed control were no longer detectable by thirty days after treatment. Early differences were greatest when the rate of glyphosate was marginal for the control of a particular weed species, when the rate of soil residual herbicide was greater than 5 lb ai/A, when the carrier volume was greater than forty gallons per

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[1]Monsanto Company, Yakima, WA.

acre and/or when the weather was cool as would occur with late fall or early spring applications. In these trials, the addition of 0.5% v/v non-ionic surfactant to the tank mixture often increased the rate of initial burn-down such that it was equal to that of glyphosate applied alone. The timing of tank mixture application during the growing season did not affect the performance of glyphosate provided the emerged perennial weeds were in the proper stage of growth at the time of application.

These data indicate that glyphosate in the form of its isopropylamine salt can be tank mixed with selected soil residual herbicides under a variety of commercial use conditions without sacrificing long term perennial or annual weed control.

PRACTICAL APPLICATION OF HIGH CONCENTRATIONS OF EPTC IN CLOSE PROXIMITY TO ALFALFA SEED

J. H. Dawson[1]

Abstract: Alfalfa is not injured when seeded with massive quantities of EPTC (*S*-ethyl dipropylthiocarbamate) in the immediate vicinity of the seed. Alfalfa seedlings do not become susceptible to EPTC until they have emerged from the soil. By that time, the highly concentrated EPTC has diffused into the surrounding soil, so the susceptible alfalfa seedlings are not exposed to excessive rates of the herbicide. This situation makes possible the seeding of alfalfa and application of EPTC simultaneously in one field operation, rather than in several operations for spraying, mechanical incorporating, and seeding.

EPTC can be applied close to alfalfa seed by applying the herbicide directly to the seed before seeding, by mixing a granular formulation of EPTC (of the correct size and density) with the seed and sowing the mixture as a unit, or by carrying the herbicide and seed in separate containers on the seeder and placing them together in the soil.

In research at Prosser, weeds were controlled selectively in new seeding of alfalfa by practical methods that placed the seed and herbicide in close proximity in the soil. The alfalfa was seeded and the herbicide was applied in one trip over the field using certain combinations and minor modifications of commercially available implements.

For over-all selective control of annual grass weeds in alfalfa that was drill-seeded in rows spaced 18 cm apart, the following techniques were effective. Weeds in 13-cm bands between the drill rows were controlled by EPTC applied as sub-surface lines 5 cm deep, as either a granular or liquid formulation. Weeds in 5-cm bands within the rows were controlled by: a) seeding EPTC-treated seed; b) seeding untreated seed mixed with a granular formulation of EPTC, in which the granules were of approximately the same size and density as the seed, and c) depositing together in the rows untreated seed and a commercial granular formulation of EPTC, which were carried in separate boxes on the seeder.

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For complete selective control of annual grass weeds in alfalfa seeded broadcast with a seeder that dropped the seed between two corrugated rollers, the following procedures were effective: a) seeding EPTC-treated seed at excessive seeding rates (e.g., 50 kg/ha), b) seeding a mixture of EPTC-treated seed and a granular formulation of EPTC, wherein the clay granules were approximately the same size and density as the seed, c) seeding a mixture of untreated alfalfa seed and a granular formulation of EPTC, wherein the clay granules were approximately the same size and density as the seed, and d) seeding untreated alfalfa seed from the conventional seed box and concurrently applying a commercial granular formulation of EPTC from a granule spreader attached on the front of the seeder, so that the action of both corrugated rollers incorporated the herbicide at the same time that the rear roller covered the seed.

PARTITIONING OF HERBICIDES WITH DIFFERING TRANSLOCATION PATTERNS BETWEEN THE APOPLAST AND SYMPLAST OF INTACT SUNFLOWER LEAVES

J. J. Jachetta and A. P. Appleby[1]

Sap was expressed from intact sunflower leaves in a Scholander pressure chamber in 8 μl aliquots over 0.2 to 0.4 bar intervals from -1.7 to -5.0 bars. The volume of expressed sap was linear with applied pressure from 2.0 to 4.7 bars. The concentration of soluble solutes in each sample was measured with a Wescor vapor pressure osmometer. Three distinct pools were detected in the expressed sap volume, and were tentatively identified as midrib apoplastic sap, cell wall apoplastic sap, and a fraction containing cell wall apoplastic sap and plasmalemma filtered symplastic sap. This technique provided a method for the determination of midrib and cell wall concentrations of ^{14}C-atrazine (2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine), ^{14}C-glyphosate (*N*-(phosphonomethyl)glycine), and the known apoplastic dye, P.T.S. (trisodium 3-hydroxy-5,8,10-pyrenetrisulphonate). Water potential isotherm analysis was used to estimate the actual apoplastic and symplastic water volume of the leaves, and apoplastic/symplast partioning coefficients were calculated for atrazine and glyphosate.

A slightly higher concentration of atrazine was found in the midrib fraction than in the cell wall fraction. The third fraction, which included both cell wall apoplastic sap and plasmalemma filtered symplastic sap, showed an increase in atrazine concentration, with volume of sap expressed, above the cell wall concentration, indicating movement of atrazine out of the symplast. Glyphosate and P.T.S. were very similar to each other, with their midrib concentrations being comparable to atrazine. However, both glyphosate and P.T.S. showed a distinct accumulation in the cell walls, with ten times the midrib concentration present in the cell wall fraction. The concentration of both glyphosate and P.T.S. fell off sharply in the third fraction, indicating that the plasmalemma provides a significant barrier to the movement of these compounds. These results support the theory of Tyree, Peterson, and Edgington (Plant Physiol. 63:367-374, 1979), that compounds which display the apoplastic transport pattern are freely mobile between the apoplast and symplast. They suggested that the

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permeability of the plasmalemma to these compounds is so great that they cannot be retained in the symplast for long without being leached back into the apoplastic and carried away with the transpiration stream. Also, they concluded that the permeability of the plasmalemma to symplastically translocated compounds is low, thus allowing the molecules which do enter the symplast to be retained for long distance transport.

PHOTOSYNTHETIC STUDIES WITH FOUR WILD OAT (AVENA FATUA L.) ECOTYPES

D. R. Gealy and L. A. Morrow[1]

Abstract: Leaf photosynthetic characteristics of two North Dakota and two Pacific Northwest wild oat ecotypes were investigated. CO_2 compensation points (CCP) averaged 30 ppm, light compensation points (LCP) average 15 $\mu E\ m^{-2}\ s^{-1}$, and apparent photosynthesis (AP) averaged 40 mg $CO_2\ dm^{-2}\ h^{-1}$ for young fully expanded leaves over all ecotypes at 25°C and saturating light intensities. Light saturation occurred at an intensity of about 1700 $\mu E\ m^{-2}\ s^{-1}$ at 25°C. As leaves aged and plants approached maturity, AP declined, CCP increased, and LCP increased. AP of spikelets on newly emerged panicles was approximately 0.15 mg $CO_2\ h^{-1}$ per spikelet and declined as ripening occurred. No significant differences were detected in photosynthetic parameters among the four wild oat ecotypes studied.

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THE PRODUCTION POTENTIAL OF LEAFY SPURGE

B. D. Maxwell, P. K. Fay, S. M. Wiatr, and C. B. Veseth[1]

Abstract: It has been reported that some Euphorbia species produce adequate amounts of oil and hydrocarbon compounds to serve as economical alternatives to petrochemicals. This experiment was established to determine the agronomic potential of leafy spurge (Euphorbia esula L.) following applications of fertilizer and irrigation.

Plots were established in an area heavily infested with leafy spurge. Grasses were removed by applying .75 kg BAS90520H (2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexane-1-one) per ha on September 15, 1981 and April 3, 1982. Phosphorus fertilizer (80 kg P_2O_2 per ha) was applied on October 29, 1981 by banding in rows 18 cm apart. Ammonium nitrate fertilizer (80 kg per ha) was hand applied to individual plots on April 3, and July 22, 1982. Irrigation water (5 cm) was applied to individual plots once a week with a garden sprinkler starting on June 29, 1982 and extending through the summer. Leafy spurge production was measured by cutting plants at the soil surface with a one-meter wide sickle bar mower once or twice during the growing season. Cut plants were oven-dried and weighed. Oil, polyphenol, hydrocarbon and residual biomass yields were

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measured on dried material from fertilized and unfertilized treatments. Acid soluble protein was measured on dry harvested spurge material.

Highest yields of leafy spurge were obtained with two cuttings, however, the amount of regrowth following the first cutting was minimal. Leafy spurge is slow to resume growth and is nonvigorous. Highest production from a single cutting occurred when plant material was harvested in mid-July.

Leafy spurge was quite responsive to fertilizer in overall production. Yields increased nearly two-fold for each fertilized treatment compared to the unfertilized plots. There was no response to irrigation, possibly because the experimental area was subirrigated and water was not limiting. The highest yielding treatment produced nearly 9 metric tons of dry material per ha.

A peak oil production (9.7% of total biomass) was achieved in fertilized plots during mid-August. Oils in unfertilized treatments showed a similar pattern with peak production (7.6% total biomass) in mid-August. There was a continual increase in polyphenol production through the harvest season in both fertilized and unfertilized treatments. Hydrocarbon yields never exceeded 0.7% of total biomass and thus constitute a negligible plant resource.

The data from this study indicate the potential economic value of leafy spurge produced under optimized agronomic conditions is minimal.

A SUMMARY OF ORIGINAL AND THREE REPETITIVE HERBICIDE TREATMENTS FOR CONTROL OF LEAFY SPURGE (EUPHORBIA ESULA L.)

H. P. Alley, R. E. Vore and T. D. Whitson[1]

Leafy spurge (*Euphorbia esula* L.) is a competitive and aggressive perennial which is very difficult and expensive to control. Its deep, tenacious root system with the capacity to sprout from root segments and underground buds along with the potential of the seed remaining viable for up to eight years is indicative of its persistent nature.

The weed has spread in recent years from small isolated areas to where it is reported to infest 2.5 million acres in the United States and Canada. It is found from the best agriculture land to rocky slopes and hillsides of low productive rangeland sites. Infestations range from solid stands where all other vegetation is virtually eliminated to isolated infestations which serve as a source of seed for spread and subsequent infestation of additional areas.

An extensive repetitive herbicide treatment program for leafy spurge control was initiated in 1978 and the effects of original and retreatments on leafy spurge shoot and root control has been evaluated since the initiation of the study.

Initial herbicide treatments were made on May 25, 1978 in a randomized complete block design. Plots were 11 ft by 132 ft per treatment with two replications. The original treatments consisted of dicamba (3,6-dichloro-*o*-anisic acid) at 4.0 and 8.0 lb ai/A, picloram (4-amino-3,5,6 trichloropicolinic acid) at 0.5, 1.0 and 2.0 lb ai/A of the picloram K salt and 2% bead formulation, picloram/2,4-D amine (1.0 lb picolinic acid + 2 lb 2,4-D amine/gal) at 0.5 + 1.0, 1.0 + 2.0 and 2.0 + 4.0 lb ai/A and an untreated check.

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[1]Plant Science Department, University of Wyoming, Laramie, WY.

The soil at the experimental site was classified as a sandy loam (65.4% sand, 23.2% silt, 11.4% clay with 1.5% organic matter and a 7.7 pH).

Repetitive herbicide treatments have been applied in the years of 1979, 1980, 1981 and 1982. Plot size was 11 ft by 22 ft per repetitive treatment. Repetitive treatments were applied over the initial treatments creating a split block design. Each treatment was random and replicated twice. Retreatments were dicamba at 2.0 lb ai/A, dicamba/2,4-D amine at 1.0 + 2.0 lb ai/A, 2,4-D amine at 2.0 lb ai/A and picloram at 0.5 and 1.0 lb ai/A.

Four square foot quadrats were located at random within each original and retreatment plot. Live, aboveground leafy spurge shoots have been recorded each year over the life of the study. Percent shoot control was determined by using the formula:

$$\text{Percent control} = 1 - \frac{\text{Counts per ft}^2 \text{ in treatment}}{\text{Counts per ft}^2 \text{ in check}} \times 100$$

The percentage leafy spurge shoot control resulting from the original treatments are presented in Table 1 and Figure 1. The original treatment of picloram K salt and 2% beads applied at the rate of 2.0 lb ai/A in 1978 were maintaining 90 and 85% leafy spurge shoot control, respectively, four years following treatment. These percentages have decreased from 99% shoot control as evaluated one year following application. The 1.0 lb ai/A of picloram K salt was maintaining 78% shoot control in 1982, a decline from 97% in 1979. Lower rates of picloram, picloram/2,4-D and the dicamba treatments are maintaining from 0 to 61% shoot control.

The effectiveness of the various original treatments which received the different repetitive treatments are presented in Tables 2 through 7. The most effective original plus a repetitive treatment was where picloram was a component of each of the treatments. Picloram applied at 0.5 lb ai/A in 1978 and retreated with 0.5 lb ai/A in 1979, 1980, and 1981 gave 98% shoot control when evaluated in 1982. The higher rates resulted in 99 to 100% shoot control (Table 2).

Picloram as an original treatment and retreated for three successive years with dicamba, dicamba/2,4-DA or 2,4-DA were not as effective, especially at the lower application rates of picloram (Table 3).

Outstanding leafy spurge shoot control can be obtained with dicamba if the retreatment is picloram (Table 4). From 98 to 100% shoot control was obtained with the original dicamba treatment which was retreated for three successive years with picloram at 0.5 and 1.0 lb ai/A. The high rates of dicamba required for initial control are more damaging to the associated grass species than rates of picolinic acid that gives equivalent leafy spurge shoot control.

The retreatments of 2,4-D amine, dicamba/2,4-DA or dicamba were not as effective as retreatments as picolinic acid (Tables 3, 5, 7).

Data indicate that a maintenance or repetitive herbicide treatment would not have to be initiated for three years where the 2.0 lb ai/A of picolinic acid was utilized as a treatment. Where dicamba or the lower rates of picolinic acid were utilized retreatments would have to be ininitated earlier. With dicamba retreatments would have to be on a year to year basis to maintain shoot control.

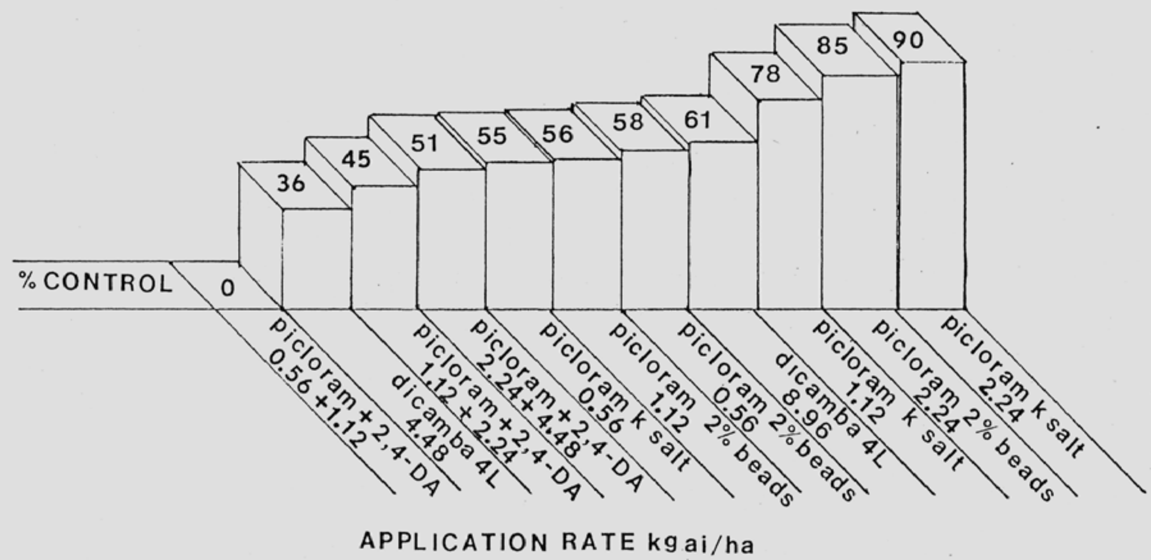

Figure 1. Longevity of leafy spurge shoot control resulting from treatments applied in 1978 and evaluated in 1982.

Table 1. Percentage leafy spurge shoot control resulting from the original and three successive herbicide retreatments.

Original Treatments[1] lb ai/A	Percent Shoot Control — Retreatment lb ai/A: 2,4-D amine 2.0			picloram (K salt) 0.5			picloram (K salt) 1.0			dicamba 4L 2.0			dicamba/2,4-D amine 1.0 + 2.0			Check			
	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982	1979	1980	1981	1982
picloram (K salt) 2.0	98	93	94	99	100	100	99	100	100	98	96	97	99	95	98	99	96	90	90
picloram (K salt) 1.0	76	84	83	96	99	99	99	100	100	96	90	96	99	89	98	97	94	84	78
picloram (K salt) 0.5	70	80	86	94	99	98	99	100	100	49	79	88	59	77	85	76	43	29	55
picloram (2% beads) 2.0	90	90	87	98	99	99	100	100	100	96	98	96	96	87	98	99	95	83	85
picloram (2% beads) 1.0	84	92	86	99	99	99	98	99	100	87	82	96	65	82	88	96	51	68	55
picloram (2% beads) 0.5	78	76	76	99	100	99	99	100	100	69	77	70	64	78	91	87	32	36	58
picloram/ 2,4-D amine 2.0 + 4.0	81	90	88	99	99	98	100	100	100	99	95	96	78	89	94	98	91	87	51
picloram/ 2,4-D amine 1.0 + 2.0	63	76	81	96	98	98	100	100	100	68	89	94	39	64	91	71	38	31	45
picloram/ 2,4-D amine 0.5 + 1.0	58	66	76	97	96	98	99	100	100	49	65	84	40	73	88	16	0	0	0
dicamba 4L 8.0	74	82	87	87	96	98	98	98	100	89	87	96	78	94	98	67	66	77	61
dicamba 4L 4.0	53	69	78	84	97	98	100	100	100	67	84	88	56	83	90	47	42	24	36
Check	9	58	62	96	99	97	93	100	100	72	85	92	11	63	84	11.6	11.1	11.4	13.9

[1]Original treatments May 25, 1978; retreatments June 21, 1979; May 13, 1980 and May 20, 1981; evaluated same dates in 1979 through 1982.

Table 2. Percentage leafy spurge shoot control resulting from picloram as the original treatment and picloram as a retreatment.

Original Treatment[1]	Retreatment[2] Rate lb ai/A picloram 0.5 1980	1981	1982	picloram 1.0 1980	1981	1982
picloram 0.5	94	99	98	99	100	100
picloram 1.0	96	99	99	99	100	100
picloram 2.0	99	100	100	99	100	100

[1]Original treatment: 1978.
[2]Retreatments: 1979, 1980, 1981.

Table 3. Percentage leafy spurge shoot control resulting from picloram as the original treatment and dicamba, dicamba/2,4-DA and 2,4-DA as a retreatment.

Original Treatment[1]	Retreatment Rate lb ai/A dicamba 2.0 1980	1981	1982	dicamba/2,4-DA 1.0 + 2.0 1980	1981	1982	2,4-DA 2.0 1980	1981	1982
picloram 0.5	49	79	88	59	77	85	70	80	86
picloram 1.0	96	90	96	99	89	98	76	84	83
picloram 2.0	98	96	97	99	95	98	98	98	94

[1]Original treatment: 1978.
[2]Retreatments: 1979, 1980, 1981.

Table 4. Percentage leafy spurge shoot control resulting from dicamba as the original treatment and picloram as a retreatment.

Original Treatment[1]	Retreatment Rate lb ai/A					
	picloram 0.5			picloram 1.0		
	1980	1981	1982	1980	1981	1982
dicamba 4.0	84	97	98	100	100	100
dicamba 8.0	87	96	98	98	98	100

[1]Original treatment: 1978.
[2]Retreatments: 1979, 1980, 1981.

Table 5. Percentage leafy spurge shoot control resulting from dicamba as the original treatment and dicamba, dicamba/2,4-DA and 2,4-DA as a retreatment.

Original Treatment[1]	Retreatment Rate lb ai/A								
	dicamba 2.0			dicamba/2,4-DA 1.0 + 2.0			2,4-DA 2.0		
	1980	1981	1982	1980	1981	1982	1980	1981	1982
dicamba 4.0	67	84	88	56	83	90	53	69	78
dicamba 8.0	87	87	96	78	94	98	74	82	87

[1]Original treatment: 1978.
[2]Retreatments: 1979, 1980, 1981.

Table 6. Percentage leafy spurge shoot control resulting from picloram/2,4-DA as the original treatment and picloram as a retreatment.

Original Treatment[1]	Retreatment[2] Rate lb ai/A picloram 0.5			picloram 1.0		
	1980	1981	1982	1980	1981	1982
picloram/2,4-D 0.5 + 1	97	96	98	99	100	100
picloram/2,4-D 1 + 2	96	98	98	100	100	100
picloram/2,4-D 2 + 4	99	99	98	100	100	100

[1]Original treatment: 1978.
[2]Retreatments: 1979, 1980, 1981.

Table 7. Percentage leafy spurge shoot control resulting from picloram/2,4-DA as the original treatment and dicamba, dicamba/2,4-DA and 2,4-DA as a retreatment.

Original Treatment[1]	Retreatment[2] Rate lb ai/A dicamba 2.0			dicamba/2,4-DA 1.0 + 2.0			2,4-DA 2.0		
	1980	1981	1982	1980	1981	1982	1980	1981	1982
picloram/2,4-DA 0.5 + 1.0	49	65	84	40	73	88	58	66	75
picloram/2,4-DA 1.0 + 2.0	68	89	94	39	64	91	63	76	81
picloram/2,4-DA 2.0 + 4.0	99	95	96	78	89	94	81	90	98

[1]Original treatment: 1978.
[2]Retreatments: 1979, 1980, 1981.

ECONOMICS OF LEAFY SPURGE (EUPHORBIA ESULA L.) IN PASTURE AND RANGELAND

R. G. Lym and C. G. Messersmith[1]

An experiment to evaluate long term leafy spurge management including forage production was established at four sites in North Dakota in 1980. The predominate grasses were bluegrass (Poa spp.) with occasional crested wheatgrass, smooth brome, but bluestem or other native grasses. All sites were established in early June except one site which was established in September 1980. The herbicides applied in 1980 (Year 1) included 2,4-D [(2,4-dichlorophenoxy)acetic acid], dicamba (3,6-dichloro-*o*-anisic acid), picloram (4-amino-3,5,6-trichloropicolinic acid) as liquid (2S) and granule (2%G) formulations, and picloram applied using the roller and wick applicators. The conventional broadcast treatments were applied using a tractor mounted sprayer delivering 8 gpa water at 35 psi. A granular applicator was used to apply the picloram 2%G treatments. The roller and wick applicator height was adjusted to treat the top one-half of the tallest leafy spurge stems. The additive in the roller and wick treatments was a 5% (v/v) oil concentrate (83% paraffin based petroleum oil plus 15% emulsifier). The plots were 15 by 150 ft and treatments were replicated twice at each site in a randomized complete block design. In June 1981 (Year 2) each plot was divided into six 7.5 by 50 ft subplots for retreatments of 2,4-D, picloram 2S, dicamba or no retreatment. Retreatments were applied again in June 1982 (Year 3). Forage yields were obtained from each plot by harvesting a 3 by 25 ft section with a flail mower in July 1981 and a 4 by 15 ft section with a rotary mower in July 1982. Sub-samples were taken by hand along each harvested strip so that leafy spurge and forage weight could be separated. The samples were oven dried and are reported with 12% moisture content. Economic return was estimated by converting forage production to hay sold for $48.00/T minus the cost of the herbicide and estimated application cost, i.e. 2,4-D + $2.17/lb ai, picloram 2S = $40/lb ai, picloram 2%G = $65/lb ai, dicamba = $20.60/lb ai, broadcast application = $2.05/A and roller or wick application = $4.10/A.

Picloram at 2 lb/A as the 2%G and 2S formulations provided the best leafy spurge control after 27 months averaging 43 and 48% control, respectively, without a retreatment and up to 90% with a retreatment of dicamba at 2.0 lb/A (Table). No original treatment provided satisfactory leafy spurge control by August 1982 without a retreatment. The best retreatments for leafy spurge control were dicamba at 2.0 lb/A, and picloram 2S at 0.25 lb/A alone or in combination with 2,4-D at 1.0 lb/A which provided 61, 59 and 53% control, respectively, when averaged across all initial treatments. Retreatments of 2,4-D at 1.0 lb/A did not improve control compared to no retreatment.

Forage yield increased for 42 of the 59 treatments compared to the control when averaged over 2 years (Table). The four treatments (Year 1 plus Years 2 and 3) which resulted in the highest yields were roller applied picloram at 1:7 (v/v) plus picloram at 0.25 lb/A, picloram 2S at 1.0 lb/A plus dicamba at 1.0 lg/A, control plus picloram at 0.25 lb/A, and control plus picloram + 2,4-D at 0.25 + 1.0 lb/A. The forage production averaged 5294 lb/A for the best four treatments compared to 3209 lb/A for the control. The best leafy spurge control was 91% with picloram 2S at 1.0 lb/A plus dicamba at 2.0 lb/A but the forage yield was intermediate at 4147 lb/A. Picloram roller applied at 1:7 (v/v) resulted in the highest forage production of the original treatments at 4635 lb/A when averaged across all retreatments. All retreatments increased forage production compared to the control.

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Seven of the 59 treatments resulted in a positive economic return. The four treatments (Year 1 plus Year 2 and 3) which resulted in the highest economic return were control plus picloram at 0.25 lb/A, control plus picloram + 2,4-D at 0.25 + 1.0 lb/A, control plus 2,4-D at 1 lb/A, and 2,4-D at 2.0 lb/A plus 2,4-D at 1.0 lb/A; the net return averaged $19/A for these four treatments. The most economical long term treatment was picloram 2S at 0.25 lb/A in years two and three without a year one treatment which resulted in 63% leafy spurge control and a return of $23/A. It is expected that this treatment will result in 80 to 90% leafy spurge control after annual applications for three to five years.

Leafy spurge control and forage production in North Dakota after 27 months. (Lym and Messersmith).

Year one			Years two and three herbicide and rate (lb/A)						
Treatment[a]	Rate (lb/A)	Soln conc[b]	2,4-D 1.0	Dicamba 1.0	Dicamba 2.0	Picloram 0.25	Picloram +2,4-D 0.25+1.0	Control 0	Mean
			(Percent control)						
2,4-D	2.0	1:15	4	33	48	56	48	12	33
Picloram 2%G	1.0	----	7	28	60	65	45	16	36
Picloram 2%G	2.0	----	33	52	65	66	63	43	53
Picloram 2S	1.0	1:15	52	43	91	47	56	34	54
Picloram 2S	2.0	1:7	72	77	90	67	69	48	71
Picloram(Roller)		1:7	5	30	51	50	41	3	30
Picloram+oil conc.(Roller)		1:7	26	47	63	62	63	29	50
Picloram(Wick)		1:3	12	11	48	52	35	4	30
Picloram+oil conc.(Wick)		1:3	2	49	42	67	75	15	41
Control	---	----	19	29	42	63	26	0	33
Mean			24	42	61	59	53	20	

LSD(0.05):Yr 1=12; Yr 2&3=9; Yr 1 x (Yr 2 & Yr 3)=29

			(1981 + 1982 yield lb/A)						
2,4-D	2.0	1:15	4431	3560	4815	5048	3578	3913	4224
Picloram 2%G	1.0	----	4196	3498	3814	4377	5043	4216	4191
Picloram 2%G	2.0	----	5014	5077	4060	4219	3325	3675	4228
Picloram 2S	1.0	1:15	3351	5346	4147	3451	5049	4106	4242
Picloram 2S	2.0	1:7	3745	3716	3870	3997	4384	3641	3892
Picloram(Roller)		1:7	4824	4588	4147	5490	4152	4606	4635
Picloram+oil conc.(Roller)		1:7	3574	3796	3665	3644	3136	4364	3697
Picloram(Wick)		1:3	5032	4016	4075	4618	3613	3350	4117
Picloram+oil conc.(Wick)		1:3	4047	4045	3817	3003	3392	3035	3557
Control	---	----	4312	4078	4583	5172	5168	3209	4420
Mean			4253	4172	4099	4302	4084	3812	

LSD(0.05):Yr 1=201; Yr 2&3=157; Yr 1 x (Yr 2 & Yr 3)=488

-cont.

Table cont.

			--------------(1980 + 1981 + 1982 net return $/A)------------					
2,4-D	2.0	1:15	15	-23	-13	14	-14	11
Picloram 2%G	1.0	----	-52	-85	-98	-63	-49	-43
Picloram 2%G	2.0	----	-97	-112	-157	-132	-158	-121
Picloram 2S	1.0	1:15	-47	-15	-64	-59	-26	-21
Picloram 2S	2.0	1:7	-78	-95	-111	-87	-82	-72
Picloram(Roller)		1:7	-14	-36	-50	-13	-50	-11
Picloram+oil conc.(Roller)		1:7	-50	-61	-85	-64	-81	-23
Picloram(Wick)		1:3	11	-29	-49	-15	-43	-21
Picloram+oil conc.(Wick)		1:3	-19	-35	-61	-59	-54	-35
Control	---	---	18	-4	-12	23	19	----

[a] Applied broadcast except the treatments identified as roller or wick applied.

[b] Picloram (Tordon 22K):water (v:v).

EFFECT OF FIVE HERBICIDES ON GERMINATION AND SEEDLING DEVELOPMENT OF FOUR GRASS SPECIES

F. L. Young, D. R. Gealy, and L. A. Morrow[1]

Abstract: Studies were conducted in the laboratory and greenhouse to determine the effect of glyphosate [*N*-(phosphonomethyl)glycine], metribuzin [4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one], paraquat (1,1'-dimethyl-4,4'-bypyridinium ion), pronamide [3,5-dichloro (*N*-1,1-dimethyl-2-propynyl)benzamide], and propham (isopropyl carbanilate) on seed germination and seedling growth of wheat (Triticum aestivum L.), common rye (Secale cereale L.), downy brome (Bromus tectorum L.) and jointed goatgrass (Aegilops cylindrica Host.).

In petri dish experiments conducted in the laboratory, all herbicides at concentrations of 50 and 5 mM decreased seed germination of all grass species compared with germination in distilled water. Within each species, either paraquat or pronamide were the most effective in reducing seed germination. Greatest reduction in seed germination of common rye and jointed goatgrass resulted from pronamide, whereas greatest reduction in wheat resulted from paraquat. Both herbicides effectively reduced seed germination in downy brome.

In the greenhouse, when treated seeds were placed on the surface of untreated, moist soil, seed germination of jointed goatgrass and downy brome was reduced by paraquat or pronamide applied at 0.6 kg ai/ha. Three weeks after treatment, dry weight of the seedlings of all species was reduced by paraquat, pronamide, or metribuzin at 0.6 kg ai/ha, or propham at 3.4 kg ai/ha. When untreated seeds were placed on the surface of treated, moist soil, germination was similar within each species regardless of treatment. For each species, shoot height and dry weight of the seedlings were greatly reduced by treatments of metribuzine, pronamide, or propham.

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THE GERMINATION AND DISSEMINATION OF COMMON CRUPINA (*CRUPINA VULGARIS* CASS.)

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Abstract: Studies were conducted under field and laboratory conditions to determine the influence of seed burial, temperature, moisture-temperature interactions, and the effects of high temperature afterripening on the viability, and percentage and rate of germination of common crupina. Experiments investigating the dissemination of common crupina were conducted using cattle, sheep, and upland game birds. Common crupina buried in the soil at 0 (surface), 2.5, 5.0, 10.2, 15.2 and 20.3 cm depths were recovered at predetermined dates over a two-year period. Throughout the study, cyclic germination patterns were apparent. After two years of burial, 60% of the achenes exhumed from the soil were either deteriorated (nonviable) or had previously germinated. Of the remaining achenes, 42% germinated. An aluminum temperature gradient plate was used to determine the optimum germination temperatures of achenes collected in 1981 and 1982. The 1981 seedlot, which was stored in the laboratory at 20 ± 1 C for one year, germinated over a wider range of temperatures and had greater rates of germination compared to freshly harvested achenes collected in 1982. Seeds of common crupina were germinated at osmotic potentials of 0, -2.5, -5.0, -5.0, -8.0, and -14.0 bars at 5, 15, and 25 C constant germination temperatures using polyethylene glycol solutions to simulate drought conditions. Studies indicated that common crupina germinates best at moisture potentials between 0 to -8 bars at 15 C incubation temperature. The percentage and rate of germination was reduced and delayed with increasing concentrations of polyethylene glycol solutions and by increasing temperature (25 C) or decreasing (5 C) temperature. In afterripening experiments, achenes stored at 20 C for 8 weeks had higher percentage germination when compared to achenes stored at -20 C. Accelerated afterripening at 50 C initially (16 weeks) increased germination, but prolonged exposure (32 weeks) to this high temperature decreased germination significantly. Cattle and chinese pheasant excreted viable seeds, while seeds did not pass the digestive system of sheep.

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THE EFFECT OF DEPTH AND DURATION OF BURIAL ON SEED OF *PANICUM MILIACEUM*

W. L. Stump and R. L. Zimdahl[1]

Eight cm square fine mesh nylon packets, each containing 200 *Panicum miliaceum* seeds were placed in a clay loam soil at depths of 5, 10 and 30 cm in October 1981. Seed packets were recovered at time intervals of 1, 4, 6, 8 and 12 months. Recovered seeds were counted and placed into one of four groups: a) germinated *in situ*, b) germinated using normal lab techniques, c) dormancy, and d) dead. After 12 months, seed loss was greatest at 5 cm with only 24% of the initial population viable. Seed depletion at 5 cm was

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due primarily to *in situ* germination. Seed persistence increased with depth with 77.3 and 80% viability at 10 and 30 cm depths, respectively. Depletion at those depths was due primarily to seed death. These data imply that conventional tillage will result in a more persistent *Panicum miliaceum* seed population than a more shallow or nontillage system.

EFFECTS OF SEVERAL FOLIAR APPLIED HERBICIDES ON THE VIABILITY OF DYERS WOAD (*ISATIS TINCTORIA* L.) SEED

W. O. King and J. O. Evans[1]

Introduction

Dyers woad has been used since ancient times as a source of blue pigment which was obtained from its leaves. It was cultivated in Virginia in the Colonial period and still persists there as a weed. It has been introduced to Utah and is a rapidly spreading weed throughout Utah, Southern Idaho, and in parts of Wyoming and Montana. It is also found in Northern California and Oregon. This member of the Brassicaceae family is a biennial or short lived perennial. In Utah it typically germinates in the fall, overwinters in the rosette stage, flowers in May, and produces indehiscent, single-seeded fruits in June. Upon drying these pods, or silicles, turn black, giving woad infested hillsides a dark cast. In 1971 Evans and Young (1) reported that the pods contain a substance which greatly depresses germination of dyers woad and other Brassicaceae seeds. Without the pods seeds readily germinated over a wide temperature range with no other apparent dormancy mechanism.

Woad initially infest dry, gravelly areas along roads and hillsides. From there it invades into range and cropland. Often a single plant can be seen growing alone far away from other woad plants and for this reason can easily go undetected until it flowers. Single plants can be hand rogued, but herbicides are more effective on heavier infestations if applied before bolting. When applied after bolting or flower, most commonly used herbicides appear to do little damage. The purpose of this study was to determine the effects of late foliar herbicide applications on the production and viability of dyers woad seeds.

Materials and Methods

A field trial was established at Willard, Utah, May 20, 1982 on a sandy loam soil heavily infested with dyers woad. At that time the woad was in the late flower to early fruit stage and 2/3 m to 1 m tall. Plots were 4.3 m x 12.2 m and were in a randomized block design with three replications. Herbicides were applied with a compressed air bicycle type sprayer in 187 l/ha total volume. Herbicide treatments and rates used are shown in Table 1. Visual evaluation was made of the herbicides' effects on pod production on June 15, 26 days following treatment. On September 14 all pods within a one square meter area of each replication were collected. These pods were hand threshed in November. Enough pods were opened from each replication to obtain 50 seeds or until 100 pods were opened, whichever

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came first. Seeds were germinated on moist blotter paper in petri dishes for 15 days to determine viability. Overall, data were collected on: 1) percent pod production, 2) the percent of pods that contained seeds, and 3) the percent of seeds that germinated. Treatment means were compared using a protected LSD at the 95% confidence level.

Table 1. Seed viability, pod viability, pod production, and viable pod production of dyers woad plants treated with several herbicides in 1982.

Herbicides	gm/ha	(oz/ac)	Viable Seeds	Viable Pods	Pod Production	Viable Pod Production
			(% of untreated)			
2,4-D amine	2240	(32)	84[a]*	55[abc]	93[a]	51[abc]
2,4-D ester	1120	(16)	86[a]	43[abcd]	93[a]	39[abcd]
2,4-D ester	2240	(32)	63[a]	13[d]	93[a]	12[de]
Dicamba	1120	(16)	96[a]	81[a]	89[a]	72[a]
Amitrole	280	(4)	82[a]	75[ab]	20[ef]	15[de]
Dicamba + 2,4-D amine	1120 1120	(16) (16)	94[a]	55[abc]	96[a]	53[ab]
Dicamba + 2,4-D ester	560 1120	(8) (16)	87[a]	39[bcd]	93[a]	36[bcd]
Dicamba + 2,4-D ester	1120 1120	(16) (16)	61[a]	20[cd]	89[a]	18[cde]
Amitrole + 2,4-D amine	280 1120	(4) (16)	100[a]	78[a]	28[def]	22[bcde]
Amitrole + 2,4-D ester	140 1120	(2) (16)	84[a]	61[ab]	50[bc]	31[bcde]
Amitrole + 2,4-D ester	280 1120	(4) (16)	58[a]	13[d]	17[f]	2[e]
Chlorsulfuron	53	(3/4)	-	0**	54[b]	0**
Chlorsulfuron + 2,4-D ester	53 1120	(3/4) (16)	-	0	30[cdef]	0
Chlorsulfuron + Amitrole	53 280	(3/4) (4)	-	0	50[bc]	0
DPX-T6376	53	(3/4)	-	0	48[bcd]	0
DPX-T6376 + 2,4-D ester	53 1120	(3/4) (16)	-	0	35[bcdef]	0
DPX-T6376 + Amitrole	53 280	(3/4) (4)	-	0	39[bcde]	0

* Means within columns followed by the same letter are not significantly different at 5% LSD.

** Since there was no variation among experimental units of treatments with means of zero those means were not statistically tested in order to avoid violating the assumption of equal variances.

Results and Discussion

Table 1 shows results from each treatment, all results are expressed as percent of the untreated control. The first category, Viable Seeds, refers to the percentage of seeds of each treatment which germinated (expressed as percent of the control). The control germination was 91%. Amitrole (3-amino-*s*-triazole) at 280 gm/ha tank mixed with 1120 gm/ha of 2,4-D [(2,4-dichlorophenoxy)acetic acid] amine is listed as 100%, signifying that seeds from this treatment germinated equal to seeds from untreated plants. A great deal of variation among replications resulted in treatments not being significantly different from the untreated control with regard to viable seed. Although not statistically different, the treatment with the lowest seed viability was 280 gm/ha amitrole tank mixed with 1120 gm/ha 2,4-D ester. The next two most effective treatments also contained 2,4-D, i.e., dicamba (3,6-dichloro-*o*-anisic acid) at 1120 gm/ha with 1120 gm/ha 2,4-D ester and the high rate of 2,4-D ester (2240 gm/ha) alone. No data is available on seed viability for treatments containing chlorsulfuron (2-chloro-*N*-[[(4-methoxy-6-methyl-1,3,5-triazine-2-yl)amino] carbonyl]benzenesulfonamide) or DPX-T6376 because those treatments produced essentially no seed within the pods. Instead of seeds the pods contained a black powdery material. Out of 300 pods threshed from the chlorsulfuron treatment one seed was found and it was viable. Two seeds were obtained from 300 pods threshed from the chlorsulfuron plus 2,4-D ester treatment but neither germinated. No other seeds were found in pods from other chlorsulfuron or DPX-T6376 treatments.

The Viable Pods column in Table 1 refers to the proportion of pods opened which contained viable seed, expressed as percent of the control. (An average of 68% of the pods opened from the control treatments contained viable seeds.) Treatments with chlrosulfuron or DPX-T6376 all produced zero percent viable pods because virtually none of the pods contained seeds. All of the other chemical treatments produced less viable pods than the control. The most effective were again 2240 gm/ha 2,4-D ester, 280 gm/ha amitrole plus 1120 gm/ha 2,4-D ester, and 1120 gm/ha dicamba plus 1120 gm/ha 2,4-D ester, which resulted in 13%, 13% and 20% viable pod production, respectively.

The Pod Production category in the table contains means from visual estimates of the amounts of pods produced compared to pod production in the control plots. Amitrole at 280 gm/ha plus 2,4-D ester at 1120 gm/ha reduced pod production by 83% down to 17%. Amitrole alone at 280 gm/ha reduced it to 20%. When mixed with chlorsulfuron or DPX-T6376, 280 gm/ha amitrole did not have as great an effect. All treatments which included DPX-T6376 reduced it over 45%.

The category Viable Pod Production contains the most practical information in the table. It more accurately reflects the reproductive potential of the dyers woad and is a product of the proportion of viable pods times the percentage of pod production for a particular treatment. The control treatments averaged 68% viable pod production because only 68% of the pods contained viable seeds. All chlorsulfuron and DPX-T6376 treatments again had 0% viable pod production because of the lack of seed development. Amitrole at 280 gm/ha plus 1120 gm/ha 2,4-D ester reduced viable pod production by 98% to only 2%. The next most effective treatments were 2240 gm/ha 2,4-D ester alone which gave an 88% reduction, 280 gm/ha amitrole alone for an 85% reduction, and 1120 gm/ha dicamba plus 1120 gm/ha 2,4-D ester for an 82% reduction. Dicamba alone at 1120 gm/ha was the least effective treatment and the only one not significantly different from the control. It reduced pod production by 28%.

Summary and Conclusions

It appears that some herbicides show promise in reducing seed production of dyers woad when applied as late as late flower or early fruit stage. Although no treatments in which seeds were produced significantly altered viability of those seeds in this study, additional research will likely show that significant effects exist. Chlorsulfuron and DPX-T6376 were totally effective because they prevented the formation of seed within the pods. Amitrole at 280 gm/ha plus 1120 gm/ha 2,4-D ester reduced viable pod production to only 2%.

We feel justified in concluding from this study that: 1) some herbicides may have an effect in reducing viability of seeds produced when applied at late stages of growth even though there were no significant reductions in this study, 2) treatments with 280 gm/ha amitrole alone or with 2,4-D had the greatest effect in reducing the number of pods (72-83% reduction), and 3) chlorsulfuron and DPX-T6376 prevented the development of seeds within pods. They also reduced pod production about 50%.

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ALLELOPATHIC POTENTIAL OF YELLOW STARTHISTLE (*CENTAUREA SOLSTITIALIS* L.)

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Abstract: Aqueous extracts of intact fresh leaves decreased germination of yellow starthistle (*Centaurea solstitialis* L.), increased germination of Sherman big bluegrass (*Poa ampla* Merr.) and had no effect on the germination of downy brome (*Bromus tectorum* L.), rattlesnake brome (*Bromus brizaeformis* Fisch. and Mey.), intermediate wheatgrass (*Agropyron intermedium* (Host) Beauv.), Idaho fescue (*Festuca idahoensis* Elmer.), and bluebunch wheatgrass (*Agropyron spicatum* (Pursh) Scribn. and Smith). Radicle length was decreased in downy brome and bluebunch wheatgrass, increased in Idaho fescue and Sherman big bluegrass, and unaffected in the other indicator species. To determine if the developmental stage of yellow starthistle affects phytotoxin release, aqueous extracts of intact fresh, intact senesced, and ground senesced leaves were tested for their effect on radicle growth of four indicator species. The greatest radicle growth inhibition occurred with extracts from ground senesced leaves in seedlings of yellow starthistle, downy brome, and Idaho fescue. Extracts from intact senesced and intact fresh leaves resulted in growth reduction of yellow starthistle and downy brome. Aqueous extracts from intact senesced leaves caused a positive growth response with Idaho fescue. Radicle growth of bluebunch wheatgrass did not respond to the treatments.

An inversely proportional effect of soil-incorporated foliage and root residue, upon weight and height of indicator plants was elicited from yellow starthistle, downy brome, intermediate wheatgrass, bluebunch wheatgrass, and Idaho fescue. Root residues were generally more phytotoxic than foliage residues. Weight and height of indicator plants were

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more sensitive indicators than germination. Germination of yellow starthistle was increased with 0.69% w/w (residue to soil) foliage residue and with 0.23% root residue. Soil analyses after incubation with root residue indicated that available nutrients were not limiting.

A greenhouse plantback study indicated that growth of yellow starthistle, downy brome, or yellow starthistle plus downy brome for the previous 15 weeks, had no effect on germination or shoot weight, but significantly affected shoot height of intermediate wheatgrass, bluebunch wheatgrass, and downy brome. Shoot height was greatest in yellow starthistle soil, intermediate in downy brome soil, and least in yellow starthistle plus downy brome soil. Yellow starthistle rosette width was not affected by soil treatments. Soil analyses before replanting indicated that NO_3-N levels were 0.7 μg/g, 1.0 μg/g, and 0.4 μg/g for downy brome, yellow starthistle, and downy brome plus yellow starthistle soil, respectively.

HERBICIDE APPLICATORS FOR ALL TERRAIN VEHICLES

L. Coble, B. D. Maxwell, and P. K. Fay[1]

Abstract: Leafy spurge (Euphorbia esula L.) is commonly found on rangeland which is inaccessible to normal means of travel which makes chemical control difficult to achieve. Ranchers in Montana are using 3-wheeled All Terrain Vehicles (ATV) with floation tires as substitutes for travel by hourseback.

We have developed herbicide applicators for ATV's. The design of each implement had two major objectives: 1) to build durable herbicide applicators which could be used on difficult terrain, and 2) to build applicators which would provide precise, accurate application. Ranchers are presently applying herbicides with handguns, or with dry formulations without precision. This leads to harmful herbicide residues and unfavorable economic returns.

A granular applicator has been fabricated which is driven by a pulley system mounted on the ATV axle. A Controlled Droplet Applicator (CDA) was devised which permits accurate herbicide application in approximately 3.5 liters of water per ha. A front-mounted rope wick applicator was built for an ATV.

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RESIDUES OF HERBICIDES IN THE SACRAMENTO DELTA FOLLOWING APPLICATION FOR CONTROL OF WATERHYACINTH

L. W. J. Anderson, C. Tennis and L. Thomas[1]

Abstract: Applications of 2,4-D [(2,4-dichlorophenoxy)acetic acid, dimethylamine salt] were made to control waterhyacinth (Eichhornia crassipes) in the Sacramento Delta, California. Replicate water samples were taken

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before and after application inside and adjacent to sprayed plants. Analysis by high performance liquid chromatography (HPLC) showed that levels of 0.5 - 8.0 ppmw 2,4-D resulted immediately after application inside treated plots, and that levels adjacent and ca. 50-75 meters downstream did not exceed 0.016-.020 ppmw 30-90 min. after treatment. Concentration of 2,4-D in floating 500 ml entrapment bottle positioned under plant foliage ranged from .051 to 5.4 ppmw and averaged 1.047 ± .59 and 2.27 ± .80 ppmw in two separate applications. Results indicate that current federal tolerance for 2,4-D (0.1 ppmw) will not be exceeded adjacent to sprayed mats 1-2 h after treatment.

Introduction

Waterhyacinth (*Eichhornia crassipes*) has become an economically important pest in the Sacramento Delta waters during the past 2-3 years. The massive summer-to-early winter biomass has caused economic losses to various Delta marina operators and to the United States Bureau of Reclamation at their pumping plant in Tracy, California. Technology for chemical control of waterhyacinth is readily available: 2,4-D and diquat have been used successfully in Florida and other southeastern states to manage the plant. However, prior to 1982, there has been no registration (state label) for use of 2,4-D for control of waterhyacinth in flowing waters in California. The primary concern of state regulatory agencies has been the potential for introduction of excessive levels of 2,4-D in Delta waters. Currently, there is a federal (EPA) potable water tolerance of 0.1 ppmw.

In order to obtain data on 2,4-D residues resulting for control operations, ARS conducted water sampling and 2,4-D analyses in cooperation with the California Department of Boating and Waterways and the United States Bureau of Reclamation (Mid-Pacific Region). All applications were carried out following approvals by appropriate County Agricultural Commissioners. Their cooperation is greatly appreciated.

Personnel from the following organizations assisted in applications: USBR, California Department of Boating and Waterways, United States Army Corps of Engineers (Waterways Experiment Station), Aquatics Unlimited, Inc. ARS is appreciative of their assistance and cooperation in this project.

Methods

Location of treatments: Sites were selected in the Delta which afforded access by boat and which, taken together, represented typical operational situations. Locations of treatments near Coney Island, Oak Island and Disappointment Slough were delineated by buoys, flags, or natural landmarks.

Application of herbicide: In all except one trial, 2,4-D was applied by airboats equipped with pumps. Pressure was kept at or below 40 psi, and the drift control agent "Nalcotrol" was used. In one trial, diquat (6,7-dihydrodipyrido[1,2-α:2',1'-c]pyrazinediium ion) was used instead of 2,4-D. The final 2,4-D application was doen by conventional boat and motor.

Water sampling: Two types of sampling were conducted. In all treatments, pretreatment samples were taken 30 cm below the surface in duplicate followed by sequentially timed posttreatment samples. Fluorescein dye was used to determine flow pattern and sampling stations were then established at "upstream" and "downstream" sites. Samples were taken at the edge, within and downstream of sprayed waterhyacinth. New sample containers were pre-washed with hexane. Used containers were washed as follows: a. 3 X hot tap water, b. 0.IN NaOH soak 24 h, c. wash hot soap/water, d. 3 X hot tap water, e. 3 X deionized water, f. 1 X water, hexane and acetone mixture (1:0), g. drip dry. Diquat samples were acidified with 25 ml con. H_2SO_4. 2,4-D samples were fixed with 1 ml 10 NaOH, then kept on ice out of sunlight.

A second type of sampling was conducted to estimate the amount of herbicide that passes by waterhyacinth foliage. The tops of one liter polypropylene bottles were removed to provide a wide-mouthed container, around which was placed a "floatation" collar of styrofoam (Fig. 1). Five hundred ml of distilled water or unfiltered Delta water was placed in the container and the collar was positioned so that the lip of the bottle remained ca. 1-2 cm above the surface of the water within the mats of waterhyacinth. Helium-filled balloons were attached by long (ca. 2 m) strings to each float collar so that bottles could be located easily after herbicide applications. The string tethers allowed sufficient movement of the balloons to prevent possible accumulation of "balloon-drip" into the underlying bottles. After herbicide applications, samplers were retrieved and their contents transferred to bottles which were treated as described previously.

Figure 1. Floating-bottle sampler used to estimate amount of herbicide spray-through in mats of waterhyacinth.

Diquat analysis: Chevron Chemical Company, Richmond, California analyzed coded samples. An ion-exchange cleanup followed by spectrophotmetic detection was used. The level of detection was 0.004 ppmw.

2,4-D Analysis: Frozen samples were thawed at room temperature (25°C) and a series of sub samples from the pretreatment samples were fortified (spiked) with recrystallized 2,4-D to produce concentrations of 0.01, 0.1 and 1.0 ppmw. These samples were used to determine the efficiency of recovery. All other samples, as well as the spiked samples were analyzed using the outline in Figure 2. This method relies on concentrations of 2,4-D (and other organic compounds) on a reverse-phase preparatory column containing silica with C_{18} (Waters C_{18} Sep-Pak[2]) and subsequent elutions with acetonitrile. Thus, from an original 200 ml sub sample, the 2,4-D is eluted with 2 mls of acetonitrile. The amount of 2,4-D in the acetonitrile is determined using an HPLC (high performance

Figure 2. Protocol For Analysis of 2,4-D in Water

1-*l* water samples (stored frozen)
↓
pH 2.5 (acidified with conc. H_2SO_4 ~2 drops)
↓
0.45 filter (removes particulate)
↙ 2-200 ml sub samples ↘

A: Same
↓

B: Prep. columns (Waters C_{18} Sep Park)
↓
elute with 2 mls 100% acetonitrite (HPLC - grade)
↓
inject 25μ onto HPLC column (C_{18} Silica)
↓
HPLC conditions:

Solvent: 50:50 acetonitrite: 1% acetic acid.
Flow rate: 2.0 ml/min.
Column: C_{18} - Silica - reverse phase.
Detector: U.V. 280 nM
Retention time: 3.64 min.
Level of sensitivity: 2-5 ng in 25 μl.
(Corresponds to 0.0008 - .002 ppmw in original 200 ml sub sample).

[2]Mention of a product does not constitute an endorsement by the USDA.

liquid chromatography) coupled with a u.v. detector and reporting integrator. The acetonitrile fraction was diluted when necessary to keep the amount of injection within the range of 2,4-D standards used to calibrate the integrator. The dilution factor was used to back-calculate to true 2,4-D levels in water samples.

Results

Coney Island Applications

Diquat. Data are summarized in Tables 1 and 2. Diquat was found in only one water sample which was taken approximately 15 minutes after completion of the application at the upstream side of the plot just inside the perimeter of the treated plants. Results of analysis for diquat in the "floating sample bottles" (Table 2) showed that one bottle containing distilled water received a sufficient amount of diquat to produce a 1.21 part per million concentration. The average concentration of all floating sample bottles containing distilled water was 0.57 + .2 (ppmw) diquat; whereas, the average of all floating samples containing Delta water was 0.25 + .1 (ppmw) diquat.

If one uses the results from floating bottles containing actual Delta water, i.e. 0.25 ppmw, this converts to an areal water exposure of approximately 0.21 kg/ha (or 0.24 lb/A) diquat based on the area of the spray-through capture bottles. The nominal application rate was 1.5 lbs/A (1.68 kg/ha, so approximately 12.5% of the spray reached the surface of the water as available diquat. Based on residue in the bottles containing distilled water, about 25% of the total diquat reached the water surface. It is important to note that only free diquat cation is active; therefore the 12.5% figure is more representative of the proportion of active diquat in the water surface.

2,4-D. The results of analyses of spiked Delta water (Table 3) shows that the preparation and extraction using Sep-Paks is very efficient, 95-100% of added 2,4-D was recovered. No significant absorption peaks were adjacent to the retention time for 2,4-D. In fact, separation of 2,4-D on the HPLC was excellent in samples that required 1/10 or 1/100 dilutions. (These would generally correspond to concentrations of 0.1 - 1.0 ppmw in the original sample.)

Coney Island (7-1-82). Applications began at 11:00 am and ended at 12:00 noon. Water quality values were: pH, 7.10; temperature, 22.0C; turbidity, 48 NTU; total alkalinity, 56; Ca hardness, 56; total hardness, 74. Residue data are summarized in Table 4. Post-treatment water samples taken outside and adjacent to the sprayed plots had low levels of 2,4-D. The highest levels, ca. 8 ppmw, were found in samples from within a plot taken 15-20 min. after application. However, most levels were far below this. Residues in samples taken downstream at ca. 30 min. intervals gradually declined to near the limit of detection (<.002 ppmw) by 90 min. after application.

Oak Island (8-31-82). At this site 2,4-D was applied at 4 lb/A. Water quality is shown in Table 5. Only one pre-treatment sample had a trace of 2,4-D (Table 6). Aside from sample No. 10, residues did not exceed 0.035 ppmw. Sample 10 was about 10-fold higher for no apparent reason. It is possible the sample bottle was contaminated at some point. In general residues reached ca. .033 ppmw within 45 minutes after the end of the spray operations. These residues are well below current federally established potable water tolerances (i.e. 0.1 ppmw).

Table 1. Diquat Residues in Water Following Application to Water Hyacinth, near Coney Island.

Pre-Treatment Samples

Sample #	Diquat (ppmw)	Location
1	0	inside near marker #3
2	0	outside plot but within mat of hyacinth between markers #2 and 3
3	0	outside plot at edge of mat near marker #2
4	0	middle of plot
5	0	inside plot between marker #1 and 2
100	0	outside "C"
99	0	outside "B"
98	0	outside "A"
97	0	inside "A"
96	0	inside "B"
95	0	

Post-Treatment Samples

Sample #	Diquat (ppmw)	Time	Location
10	.025	within	inside - inflow end
11	0	15 min.	inside - inflow end
12	0	after	inside - inflow end
13	0	application	outside - inflow end
14	0	"	outside - inflow end
15	0	"	outside - inflow end
30	0	10:55 AM	inside between marker 1 and 2
31	0		inside between marker 3 and 4
32	0		inside near marker 4
34	0	11:12	outside between end 1 and 2 marker
35	0	11:15	outside near marker 2
17a	0	11:07	location-at edge of mat-ca. 100 ft outside plot
17b	0		"
18a	0	11:30	"
18b	0		"
19a	0	12:00	"
19b	0		"
20a	0	12:30	"
20b	0		"
21a	0	1:10 PM	"
21b	0		"

Table 2. Diquat Residues in Spray-through Capture Containers Following Application to Water Hyacinth

Sample	Diquat (PPMW)	
	Distilled Water	Delta Water
A	0	0
B	1.21	0.359
C	0.695	0.482
D	0.305	0.50
E	-----	0.07
F	0.641	0.105
	$\bar{X}$ 0.57 ± .2	$\bar{X}$ 0.25 ± 0.1

1/ Containers consisted of 1 ℓ nalgene bottles with their necks removed to produce a surface area of 58 cm^2.
Bottles contained 500 ml of either deionized water or Delta water collected from the site before application of diquat. Bottles were suspended about 1 inch above the water by styrofoam collars.

TABLE 3 Recovery of 2, 4-D from Fortified Delta Water1/

Sample	Fortified Level	ng/25µl	Dilution	ng	ppmw Found	
2B		30.4	1/10	304	0.12	
	@0.1ppm	29.9	1/10	299	0.119	
2A	@0.1ppm	33.6	1/10	336	0.134	
		33.6		336	0.134	$\bar{x}$ 0.127 ± .008
9A	@.01ppm	20.0	0	20.0	0.01	
		19.9	0	19.9	.008	
		22.5	0	22.5	.009	
9B	@.01ppm	31.7	0	31.7	.016	
		27.6	0	27.6	0.013	$\bar{x}$ 0.011 ± .003
1A	@1.0ppm	34.6	1/100	3460	1.38	
		30.4	1/100	3040	1.21	
1B	@1.0ppm	31.6	1/100	3160	1.26	
		24.4	1/100	2440	0.98	
		23.4	1/100	2340	0.936	$\bar{x}$ 1.06 ± .017
8A	@1.0ppm	28.5	1/100	2850	1.14	
		26.7	1/100	2670	1.068	
8B	@1.0ppm	31.5	1/100	3150	1.26	
		35.9	1/100	3590	1.456	$\bar{x}$ 1.23 ± .016

1/Re-crystallized 2, 4-D was used to spike known vol. of delta water which was subsequently analysed by HPLC.

Table 4. Levels of 2, 4-D in Delta Water Following Application for Control of Water Hyacinth near Coney Island

SAMPLE NO.	TIME	LOCATION	2,4-D PPMW ($\overline{X}$ + SE)
*1	Pre	Outside Plot	0
*2	Pre	Outside Plot	0
3	Pre	Outside Plot	0
4	Pre	Outside Plot	0
*5	Pre	Outside Plot	0
*6	Pre	Outside Plot	0
7	Pre	Inside Plot	0
*8	Pre	Inside Plot	0
*9	Pre	Inside Plot	0

*denotes samples subsequently used to determine recovery of spiked 2,4-D

SAMPLE NO.	TIME	LOCATION	2,4-D PPMW ($\overline{X}$ + SE)
21	12:20 pm (15-20 min)	Inside Upstream End	8.42 ± .29
22	12:20 pm (15-20 min)	Inside Upstream End	0.53 ± .11
23	12:20 pm (15-20 min)	Inside Upstream End	3.80 ± .22
24	12:20 pm (15-20 min)	Upstream End	0.059 ± .08
25	15-20 min	Outside	0.020 ± .01
26	15-20 min	Outside	0.017 ± .01
27	15-20 min	Inside Downstream	0.547 ± .02
28	15-20 min	Inside Downstream	0.168 ± .02
29	15-20 min	Inside Downstream	0.107 ± .01
30	12:30 pm (30 min)	Outside Downstream	0.005 ± .002
31	12:30 pm (30 min)	Outside Downstream	0.004 ± .002
32	12:30 pm (30 min)	Outside Downstream	0.002 ± .001
33	1:00 pm (60 min)	Within edge at Downstream End	0.701 ± .01
34	1:00 pm (60 min)	Within edge at Downstream End	1.389 ± .025
35	1:00 pm (60 min)	Within edge at Downstream End	0.593 ± .040

Table 4 continued

SAMPLE NO.	TIME	LOCATION	2,4-D PPMW ($\bar{X} \pm SE$)
36	1:10 pm	Outside	0.050 ± .040
37	1:10 pm	Outside	0
38	1:10 pm	Outside	0
39	1:30 pm	Inside Edge Downstream	0.100 ± .008
40	1:30 pm	Inside Edge Downstream	0.100 ± .013
41	1:30 pm	Inside Edge Downstream	0.157 ± .007
42	1:30 pm	Outside Plot Downstream	0.003 ± .004
43	1:30 pm	Outside Plot Downstream	0.004 ± .004
44	1:30 pm	Outside Plot Downstream	.023 ± .008

Table 5. Water quality in Old River near Oak Island 8/31/82, 10:15 AM

	Outside Plant Mats	Within Plant Mats
Temp (°C)	21.6	21.8
D.O.	7.28	5.77
pH	6.75	6.85
Conductivity (μm OHM)	+0.4	+0.41

Table 6. 2,4-D Residues in Delta Water Samples Taken 31 August 1982, Near Oak Island

Sample Number	Location[1/]	Time	ng/25 μℓ	Corrected Sample Concentration ppmw
Pre-Treatment				
1 A (1)	DS	9:15	0	0
1 A (2)			0	0
1 B (1)	DS		0	0
1 B (2)			0	0
2 A (1)	50 yds	9:22	0	0
2 A (2)	DS		0	0
3 A (1)	US	9:30	0	0
3 A (2)			0	0
3 B (1)			0	0
3 B (2)			∿1.0 ?	0.004 ?
Post-Treatment				
1 A (1)	DS		85.9	0.034
	Edge	11:07	81.5	0.032
1 A (2)			57.6	0.023
			65.8	0.026
2 A (1)	50 yds		10.8	0.004
2 A (1)	DS	11:11	11.4	0.005
2 A (2)			10.4	0.004
3 A (1)	DS		30.7	0.013
3 A (1)	Edge	11:35	26.4	0.016
3 A (2)			32.2	0.016
4 A (1)	50 yds		8.4	0.003
	DS	11:38	5.9	0.002
4 A (2)			3.0	0.001
6 A (1)	50 yds	12:07	0	0
6 A (2)	DS		0	0
7 A (1)	DS	12:35	11.1	0.004
7 A (1)	Edge		5.9	0.002
7 A (1)			7.5	0.003
8 A (1)	50 yds	12:37	3.0	0.001
8 A (1)	DS		7.7	0.003
9 A (1)	DS	1:05	12.2	0.003
9 A (1)	Edge		11.4	0.005

Table 6. continued

Sample Number	Location[1/]	Time	ng/25 µℓ		Corrected Sample Concentration ppmw
		1:07			
10 ?	50 yds	(dil 1/100)	6.47	X 100→	0.259
	DS	(dil 1/100)	8.16	X 100→	0.328
11 A (1)	US	1:10	0		0
11 A (2)	Edge		0		0
Spiked Samples:					
A) Delta Water Plus 2,4-D to produce nominal 0.01 ppmw					
	(1)		28.4		0.011
	(2)		27.4		0.011
B) Delta Water Plus 2,4-D to produce nominal 0.1 ppmw					
	(1) diluted 1/10		29.4		0.118
	(2) diluted 1/10; 106 ml instead of 200 ml		18.3		0.138

1/ DS = Downstream

2/ US = Upstream

Dissappointment Slough (9-30-82 - 10-2-82). Three sites were treated on two consecutive days. Some waterhyacinth mats were sprayed at the peripheries of small islands and sampling locations were stationed around them. Results (Table 7) showed that 2,4-D levels did not exceed 0.006 ppmw in any sample.

Residues in Floating Samplers. Highest concentration of 2,4-D in the floating samplers was 5.40 and 3.15 ppmw after application at Oak Island and Coney Island, respectively (Table 8). However, some of the other samples received very little through-spray (e.g. 0.07 ppmw and .051 ppmw). The mean concentration in samplers containing distilled water was 1.14 ppmw and 1.05 ppm for samplers with Delta water at Coney Island. With some exceptions the sampler containing Delta water had slightly less 2,4-D than the distilled water samplers. The lower concentration in the Delta water probably is due to some adsorption to particulate organic constituents as well as some adsorption by organisms (including plankton).

Table 8a. 2,4-D Residue in "Float-Samplers" following application to waterhyacinth, 8/31/82 near Oak Island, Sacramento Delta.

	ppmw ($\bar{x}$ ± S.E.)	
Sample	Distilled Water	Delta Water
A	1.38±.04	0.14±.01
B	1.04±.04	1.08±.11
C	1.53±.07	3.47±.05
E	4.02±.21	4.47±.05
F	5.40±.13	2.23±.09
$\bar{x}$	2.67±.9	2.27±.8

Table 8b. Level of 2,4-D in "Float-Samplers" Following Application for Control of Waterhyacinth near Coney Island, Sacramento Delta, 7/1/82.

	2,4-D ppmw ($\bar{x}$ ± S.E.)	
Sample	Distilled Water	Delta Water
A	2.35±.20 (3)	0.08 ±.01 (4)
B	0.28±.04 (4)	0.051±.003 (4)
C	1.64±.14 (4)	0.403±.01 (4)
D	1.94±.09 (4)	3.15 ±.06 (4)
E	(Sampler not recovered)	1.56 ±.06 (4)
$\bar{x}$	1.55-.44	1.047±.59

1/ Wide-mouth (58 cm^2) bottles containing 500 ml distilled water or Delta water were placed at water level below waterhyacinth foliage and collected after 2,4-D application. Application rate was 5 lb/acre (7/1/82) and 4lb/A (8/31/82).

If one assumes a range of 0.5 - 1.0 ppmw in Delta water samplers following an application of 3-4 lb/A, this indicates that around 0.5 - 1 lb/A passed through the foliage and was still available (i.e. not associated with particulates) at the time of treatment. This represents approximately 10-20% of the rate applied which is within the range found for spray-through of diquat.

Discussion

The 2,4-D applications were made in different locales so as to include a range of typical environmental conditions found in the Delta. The Coney Island site was fairly well off the main channel, although there was clearly some tidal flow adjacent to the area. Heinbuckle Harbor/Oak Island is more open and had more direct exposure to tidal flows. Within the treated plots, initial samples sometimes contained up to 8 ppmw, but most had from .02 - 1.5 ppmw. Samples outside the treated area generally contained less than .05 ppmw within 60-90 minutes after applications.

Applications of diquat at label rates resulted in detectable residue in only one of 21 samples (0.025 ppmw). This sample was taken within the treated mat approximately 10 minutes after the end of the application. The high affinity of diquat for particulates probably explains this. That diquat did pass by waterhyacinth leaves is shown by its presence in the "floating" bottle samplers. This "sampler" data also shows that less diquat was "free" in the samplers which contained Delta water than in those which contained distilled water.

A comparison of the data from the "floating samplers" shows that this method gives a reasonably reproduceable estimate of the "spray-through" whether diquat or 2,4-D is applied. For 2,4-D, the concentrations within the "float samples" were in the range of levels found in "within-plot" water samples taken immediately after spraying was completed. It is important to realize that these estimates are based on: (1) no mixing with adjacent water (i.e. the bottles are closed systems) and (2) no diffusion of the sample. Both these processes dramatically reduce the concentration of diquat or 2,4-D and, in fact, occur in the relatively unconfined water within and adjacent to the waterhyacinth mats. This undoubtedly accounts for the failure to detect diquat (except in one sample) in posttreatment water samples. From the sequential sample taken outside the treated plots it is clear that 2,4-D is rapidly dissipated, presumably by rapid dilution.

These results suggest that when 2,4-D is applied at 3-4 lb/A, resulting residues in the upper 6-12" of the treated area will rarely exceed 0.5 ppmw within 1-2 h after application. It is more likely that 2,4-D concentrations will generally be in the range of .05 - 0.1 within a few hours after application. Actual levels will be determined by (1) accuracy and uniformity of application, (2) extent of horizontal mixing by tidal currents, (3) amount of sorption by organic particulates and organisms. It is unlikely that significant vertical mixing will occur within 1 ft. under the plant mats since the dense root system blocks water flow. However, flows outside the mat area will lead to rapid dilution. This appears to have occurred at the "outside downstream" station in this study. Therefore, unless water is taken directly within or adjacent to a sprayed mat, concentration of 2,4-D in the immediate downstream areas should be negligible (i.e. below 0.01 ppmw). Applications should be timed to (1) utilize tidal flows or slack (slack time) to help dissipate the 2,4-D, and (2) coincide with cessation of withdrawal of water directly from a treated site for several hours (e.g. 12-24 h).

DIFFERENTIAL SUSCEPTIBILITY OF WILD OAT ACCESSIONS TO HERBICIDE TREATMENT

K. G. Beck, D. C. Thill, and R. H. Callihan[1]

Abstract: Experiments were conducted in 1982 to determine if wild oat (*Avena fatua* L.) accessions are differentially susceptible to herbicide treatment. In a field experiment, six wild oat accessions were randomly allotted to four herbicide treatments and a check. Triallate (S-(2-3,3-trichloroallyl) diisopropylthiocarbamate) was applied preplant incorporated at 1.4 kg/ha, barban (4-chloro-2-butnyl *m*-chlorocarbanilate), difenzoquat (1,2-dimethyl-3,5-diphenyl-1*H*-pryazolim), and diclofop (2-(4-(2,4-dichlorophenoxy)phenoxy) propanoic acid) were applied post emergence at 0.42, 1.12, and 1.12 kg/ha, respectively. Four replications of each treatment were arranged in a split plot design. In the growth chamber, 11 wild oat accessions were randomly assigned to five treatments including a check. The experiment was a randomized complete block design with four replications per treatment. Triallate was applied at 0.70 kg/ha, barban at 0.21 kg/ha, difenzoquat and diclofop each at 0.57 kg/ha. Triallate was preplant incorporated while barban, difenzoquat, and diclofop were applied post emergence. No significant differences due to herbicides were found in the field experiment except when compared to the checks. However, differences were discovered in the growth chamber experiment. The decreasing order of effectiveness was triallate, difenzoquat, then diclofop, while barban did not differ from the check. No differential susceptibility of wild oat accession by herbicide treatment interactions were found in either experiment.

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SOIL PLACEMENT OF DICLOFOP-METHYL FOR CONTROL OF DOWNY BROME

M. H. Ehlhardt and D. C. Thill[1]

Abstract: Downy brome (*Bromus tectorum* L.) a winter annual member of the Gramineae family is a major weed problem throughout the winter wheat growing areas of the Pacific Northwest. Downy brome is most competitive with winter wheat from early spring of the crop year through the remainder of the growing season. Early elimination of the weed should result in reduced competition and increased grain yield. The preemergence soil activity of diclofop-methyl (methyl 2-[4-(2,4-dichlorophenoxy)phenoxy]-propanate) and its initial metabolite diclofop (2-[4-(2,4-dichlorophenoxy)-phenoxy] propanoic acid) has been demonstrated on a number of annual grass species. Results have shown that at least 80% control of the weed may be obtained with a 1.12 kg/ha preplant incorporated application of diclofop-methyl. Tests were conducted under greenhouse conditions to determine the relationship between increased depth of herbicide incorporation and downy brome control. Diclofop-methyl at 1.4 kg/ha was applied to a non-absorbing medium. Treatments were incorporated to depths of 0 cm (surface application), 5.1, 10.2 and 20 cm. Maximum efficiency, determined by measurement of shoot length and dry weight reduction was observed with

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the 5.1 cm incorporation depth. As incorporation depth increased the degree of control decreased. Control with the surface application of herbicide was comparable to the 5.1 cm incorporation if an overhead irrigation followed application. When the soil media was irrigated before herbicide application growth reduction in the surface application was erratic. Some plants displayed symptoms similar to the shallow incorporation treatment (5.1 cm) and others resembled the control plants. Site of uptake studies were conducted using 0.5 - 0.75 cm bands of an activated charcoal and sand mixture to restrict herbicide movement. Downy brome root zone, shoot zone, a combination root and shoot zone and to the area immediately adjacent to the germinating seed were exposed to 4.5 to 6.25 ppm of diclofop-methyl. Maximum reduction in root and shoot length was obtained with the combination root and shoot exposure treatment.

CHLORSULFURON: ITS USE AND FUTURE IN MONTANA

W. E. Dyer and P. K. Fay[1]

Chlorsulfuron (2-chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) aminocarbonyl] benzenesulfonamide) is a new herbicide for broadleaf weed control in small grains. Over 28,000 ha of cropland in Montana were treated with chlorsulfuron in 1982. Field experiments have shown that chlorsulfuron controls a broad spectrum of annual weeds and suppresses Canada thistle (*Cirsium arvense* L. Scop.).

Chlorsulfuron applied at rates of 17, 35, and 70 g/ha to Canada thistle in the 5 leaf stage reduced the number of stems/m^2 the following year by 23, 52, and 90%, respectively. Applications made at the bud stage were not as effective.

Fall treatments of chlorsulfuron (35 and 70 g/ha) were applied to a Bozeman silt loam soil with pH 8.3. The following year plant height, number of tillers, seeds per head, and crop yield were reduced in spring wheat (*Triticum aestivum* L. 'Pondera'), at the highest rate of application. The lower rate did not significantly affect the crop. Two years after treatment, barley (*Hordeum vulgare* L. 'Piroline') yields were reduced by 21% at the higher rate.

Previous work showed that chlorsulfuron leached rapidly and uniformly in soil columns. Subsequent research has indicated that chlorsulfuron does not move as readily when allowed to equilibrate before leaching.

Chlorsulfuron soil residues of 35 and 70 g/ha significantly reduced dry weights of safflower (*Carthamus tinctorius* L.), sunflower (*Helianthus annuus* L.), corn (*Zea mays* L.), pinto beans (*Phaseolus vulgaris* L.), and sugar beets (*Beta vulgaris* L.), 2 years after application.

At suggested use rates, chlorsulfuron appears to have good crop safety on winter and spring wheat. More information is needed on the breakdown rate of chlorsulfuron in soil, particularly in highly alkaline soils.

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[1]Montana State University, Bozeman, MT.

CANADA THISTLE, FIELD BINDWEED, AND QUACKGRASS RESPONSE TO SEVERAL PROMISING SHORT RESIDUAL HERBICIDES

G. Peel and J. O. Evans[1]

A real interest has been shown towards short residual, foliar applied, contact or translocated herbicides. Many such products have been tested experimentally to determine their effectiveness. Paraquat (1,1'-dimethyl-4,4'bipyridinium ion), a relatively old compound, is an excellent contact, quick burn-down herbicide. Glyphosate (*N*-(phosphonomethyl)glycine) has received wide acceptance throughout the world as an extremely good translocated herbicide that has been used extensively in a wide variety of situations. These types of short residual herbicides are very useful in agronomic cropping situations where a quick weed kill with no soil residual is desired. These herbicides allow crops to be planted shortly after treatment has been made. Several new products including SC 0224 (trimethylfonium carboxymetholamino methylphosphinate), SC 0545 (chemistry not available) and HOE 00661 (ammonium(3-amino-3-carboxypropyl)-methylphosphinate), are currently being investigated which also show promise as short residual herbicides.

The primary objective of this experiment was to determine the effectiveness of these foliar applied, phosphinate herbicides as short residual or translocated compounds. Paraquat and glyphosate were used as standards for these experiments.

Materials and Methods

In the summer of 1982 test plots were established at several locations in northern Utah to test these short residual materials. Individual plots measuring 2.4 x 6.1 m (8 x 20 ft) with 3 replications were established in a randomized block design. Herbicide applications were made with a bicycle sprayer calibrated to apply 187 l/ha (20 gpa).

At the time of application field bindweed (*Convolvulus arvensis*) was in the flower stage and showed a population density of 90-98 percent ground cover (Table 1). Canada thistle (*Cirsium arvense*) plots had 3-7 plants per square foot, which were 46-102 cm (18-40 in) high and in the late bud to early flower stage. Quackgrass (*Agropyron repens*) was 41-66 cm (16-26 in) high, in the full head stage and showed 90% ground cover.

Table 1. Growth stage and population density of field bindweed, Canada thistle, and quackgrass at the time of herbicide treatment.

Weed	Height	Growth Stage	Population Density
Field bindweed (*Convolvulus arvensis*)	--	flower	90-98% grnd cvr
Canada thistle (*Cirsium arvense*)	18-40"	late bud early flower	3-7/sq. ft.
Quackgrass (*Agropyron repens*)	16-26"	full head	90% grnd cvr

[1]Utah State University, Logan, UT.

Results and Discussion

Canada thistle control with SC 0224 and SC 0545 was very similar to control demonstrated by glyphosate (Table 2). Both SC 0224 and SC 0545

Table 2. Canada thistle response to selected short residual herbicides evaluated over a period of nine weeks. *

Treatment	Rate	% Control		
		Weeks after application		
	kg/ha	2	6	9
HOE 00661	2.24	94	52	33
	4.48	96	62	37
paraquat	2.24	97	35	13
	4.48	100	37	23
SC 0224	2.24	93	95	96
	4.48	93	95	97
SC 0545	2.24	88	93	97
	4.48	95	96	95
glyphosate	2.24	63	91	97
	4.48	83	94	97
control	--	0	0	0

*Treated July 7, 1982.

acted faster upon the plant than glyphosate as can be noted at the two week evaluation. When evaluated nine weeks after treatment all gave 96-97% control of Canada thistle. The activity of HOE 00661 closely resembles that of paraquat. Two weeks after treatment HOE 00661 and paraquat demonstrated almost identical burn-down type control of Canada thistle. At the six and nine week evaluations the burn-down effect exhibited by these herbicides had stopped and Canada thistle was able to regrow. However, after nine weeks HOE 00661 demonstrated 15-20 percent better control of Canada thistle than paraquat, indicating that HOE 00661 is able to give more extended control than paraquat.

Control of quackgrass was similar to Canada thistle control by these herbicides (Table 3). SC 0224 and SC 0545 gave similar results to glyphosate. HOE 00661 and paraquat demonstrated quick burn-down type control on quackgrass, as was noted in the control of Canada thistle. Quackgrass began to grow back four weeks after treatment as did Canada thistle when treated with paraquat and HOE 00661. After nine weeks HOE 00661 was again giving better control of quackgrass than was paraquat.

Table 3. The effect of four short residual herbicides on Quackgrass over a nine week period. *

Treatment	Rate	% Control Weeks after application		
	kg/ha	2	6	9
HOE 00661	2.24	97	47	30
	4.48	98	67	48
paraquat	2.24	78	38	13
	4.48	90	27	13
SC 0224	2.24	78	92	95
	4.48	98	100	99
SC 0545	2.24	78	95	95
	4.48	95	100	100
glyphosate	2.24	88	96	97
	4.48	98	100	100
control	--	0	0	0

*Treated June 25, 1982.

Field bindweed control by these herbicides was similar to control of quackgrass and Canada thistle (Table 4). Data on paraquat control of field bindweed was not available for this experiment. HOE 00661 demonstrated better control of field bindweed at the two week evaluation than the other herbicides tested. A quick burn-down type effect was noted in that field bindweed plants were able to regrow and only 24 and 36 percent control respectively for the 2.24 and the 4.48 kg/ha rates of HOE 00661 at nine weeks after treatment.

Control of field bindweed by SC 0224, SC 0545 and glyphosate were very similar shortly after treatment, however, nine weeks after treatment, glyphosate was demonstrating better control of field bindweed.

Conclusions

SC 0224 and SC 0545 have very similar herbicide action to glyphosate. SC 0224 and SC 0545 seem to be translocated throughout the plant similar to glyphosate, killing the entire plant.

HOE 00661 shows promise as a contact herbicide with quick burn-down action similar to that noted with paraquat. Both herbicides destroy all vegetation shortly after treatment, but allow plant regrowth from unkilled root stock four to six weeks after treatment. HOE 00661 demonstrates better overall control after nine weeks than does paraquat, indicating that more of the root stock is killed by this herbicide.

As demand continues to increase for short residual foliar applied compounds, greater efficiency and phytotoxicity will be required. These herbicides demonstrate excellent potential for future use in agricultural situations requiring quick plant destruction and no soil residue.

Table 4. Field bindweed control after treatment with several short residual herbicides.*

Treatment	Rate	% Control		
		Weeks after application		
	kg/ha	2	4	6
HOE 00661	2.24	94	40	24
	4.48	96	57	36
SC 0224	3.36	68	87	78
	5.60	81	84	74
SC 0545	3.36	81	64	61
	5.60	86	78	81
glyphosate	3.36	70	74	83
	4.48	86	80	84
control	--	0	0	0

*Treated July 7, 1982.

ALFALFA (MEDICAGO SATIVA L.) DESICCATION USING GLYPHOSATE IN THE FINAL YEAR OF SEED PRODUCTION

D. Packer and J. M. Krall[1]

Abstract: A preharvest application of glyphosate (N-(phosphonomethyl)glycine) was applied to a final season alfalfa (*Medicago sativa* L.) seed crop to desiccate foliage for harvest, and remove the alfalfa stand as well as control field bindweed (*Convolvulus arvensis* L.). Glyphosate, in comparison to dinoseb (2-*sec*-butley-4,6-dinitrophenol) plus Mor-Act adjuvant produced equivalent foliage drydown, alfalfa seed yield, and immature alfalfa seed. Seed lots from treatments germinated and emerged at the same rate. Glyphosate reduced the alfalfa stand as measured by alfalfa regrowth after harvest. Additionally, glyphosate suppressed field bindweed growth before harvest. Long term field bindweed control awaits further evaluation.

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APPLICATION OF INTEGRATED PEST MANAGEMENT (IPM) PRACTICES TO DRYLAND SMALL GRAIN PRODUCTION IN NORTH-CENTRAL MONTANA

S. Nissen[1]

Abstract: The implementation of Integrated Pest Management (IPM) programs in high value commodities has provided a means for improved decision making and increased efficiency of production inputs. Most university research and Extension Service programs have largely ignored dryland production of crops with marginal economic returns. The Montana State University Cooperative Extension Service has completed a 2-year pilot IPM program in dryland small grain production. The basic theme of this project has been maximum utilization of plant available moisture (generally the major limiting factor). United States Department of Agriculture research data from North Dakota and Montana has provided the necessary background to allow establishment of reasonable yield potentials based on early spring stored soil moisture and growing season precipitation (May 1 - July 31). Through field monitoring of pest and crop management problems, 26% more sites reached yield potentials improving from 42% in 1981 to 68% in 1982. In 1981, 35% of the field locations produced 1100 kg/ha below potential yields predicted by plant available moisture. However, in 1982 no locations were in this category. These increases in efficient conversion of plant available moisture into grain can be attributed to detection and elimination of crop and pest management problems similar to IPM in other crops.

[1]Montana State University, Bozeman, MT.

IDENTIFICATION OF GROWTH STAGES IN WINTER WHEAT AND RESPONSE TO BROADLEAF WEED HERBICIDES

R. E. Whitesides[1]

Abstract: Broadleaf weeds have been controlled for many years in wheat with selective herbicides such as 2,4-D [(2,4-dichlorophenoxy)acetic acid], MCPA [[(4-chloro-o-tolyl)oxy]acetic acid], dinoseb (2-sec-butyl-4,6-dinitrophenol), and bromoxynil (3,5-dibromo-4-hydroxybenzonitrile), applied alone and in combination with other herbicides. When phenoxy herbicides are applied to wheat, treatment is recommended when the crop is fully tillered but before it is in the boot stage. The transition from fully tillered, to boot stage, is not clearly defined and leads to difficulty in making appropriate herbicide recommendations. To more easily identify growth stages of wheat during the boot stage a growth indexing system has been developed.

After tillering, wheat growth stages are identified as nodes become detectable (by feel) along the developing stem. When the internodes expand it is possible to easily identify 2, 3, 4 and sometimes 5 nodes on wheat (variety Daws). To further refine the technique the distance between the head and the next lower node is measured. The developing head sits

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closely associated with uppermost nodes and by carefully sectioning the plant it is possible to determine the distance from the head to the next lower node. This makes it possible to identify growth stages by indicating the number of nodes detectable and the position of the head in relation to the nodes.

In 1982, this system of growth indexing was used to identify the stages of growth of wheat (variety Daws) when 2,4-D, MCPA, dinoseb, bromoxynil, bromoxynil + MCPA, and chlorsulfuron [2-chloro-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide] were applied. The growth stages were 3 to 4 tillers, 3 nodes (1 cm to head), 4 nodes (< 1 cm to head), 4 nodes (25 cm to head), and 4 nodes (29 cm to head and grain in the soft dough stage). Wheat yield was reduced when 2,4-D (1.0 lb/A), MCPA (1.0 lb/A), dinoseb (1.5 lb/A), or bromoxynil + MCPA (0.38 + 0.38 lb/A), were applied at the 3 node stage or later. Application of chlorsulfuron (0.016 lb/A) had very little influence on wheat yield at any growth stage tested when compared to application at the 3 to 4 tiller stage.

The growth indexing system provides a mechanism for rapid determination of crop safety while in the field and should be an aid in determining time of treatment. All herbicides tested, except chlorsulfuron, reduced wheat yield when applied during the boot stage. It may be possible to obtain broadleaf weed control with chlorsulfuron at stages of growth in wheat previously considered too sensitive for treatment.

USE OF PRONAMIDE IN SMALL GRAIN REDUCED TILLAGE SYSTEMS

T. J. Neidlinger[1]

Abstract: Control of winter annual grassy and broadleaved weeds in reduced tillage systems for small grain production helps to: 1) conserve soil moisture, particularly in low rainfall areas, 2) prevent soil erosion by allowing fields to be left with standing stubble, 3) allow for easier spring tillage by preventing sod formation, 4) reduce disease problems by eliminating host plants over winter, 5) aid in fuel cost reduction by relieving the number of tillage operations during the fallow year.

When fall applied at several test locations in Eastern Oregon and Washington, pronamide [3,5-dichloro (N-1,1-dimethyl-2-propynl)benzamide] was consistently highly effective in controlling downy brome (Bromus tectorum L.), volunteer wheat (Triticum aestivum L.), and volunteer barley (Hordeum vulgare L.). Use rates ranged from .28 kg/ha to 1.12 kg/ha. Rates of .28 kg/ha and .43 kg/ha were consistently equal to or slightly superior to propham (isopropyl carbanilate) + PPG 124 (p-chlorophenyl N-methylcarbamate], for control of volunteer wheat and downy brome. The isopropylamine salt of glyphosate (*N*-(phosphonomethyl)glycine) at .56 kg/ha resulted in overall inferior control, although at some locations control was excellent. Poor control from glyphosate was due to: 1) Rain too soon after application and/or, 2) emergence of volunteer grain and downy brome after application.

Combination treatments of pronamide were made with dicamba (3,6-dichloro-*o*-anisic acid), 2,4-D amine, dimethylamine salt of [(2,4-dichlorophenoxy) acetic acid], metribuzin (4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one), glyphosate, and chlorsulfuron (2-chloro-*N*-[[4-

[1]Rohm and Haas Co., Portland, OR.

methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide). The objective was to determine which herbicide would result in best control of broadleaved weeds in combination with pronamide. Treatments of pronamide with chlorsulfuron appeared to show most promise, at rates of .28 + .018 kg/ha, and .28 + .035 kg/ha. Metribuzin and 2,4-D amine also showed some potential, when used with pronamide at .28 + .28 kg/ha and .28 + .56 kg/ha.

Triton AG-98 (alkyl aryl-polyoxethylene glycol) spray adjuvant was applied with pronamide to determine if, under conditions of heavy stubble residues, the addition of this non-ionic surfactant might enhance penetration of pronamide to the soil surface. Treatments were compared using Triton AG-98 at .125% (v/v) and .25% (v/v) with pronamide at .28 kg/ha. Neither treatment enhanced activity over pronamide alone.

Pronamide treatments were applied at two Eastern Washington locations in mid-November at .28, .50, and 1.12 kg/ha, with late-January treatments also applied at .56 and 1.12 kg/ha. Spring wheat and barley were planted, using conventional tillage (discing) vs. no-till planting. Varieties were Advance barley and Dirkwin wheat. Severe injury occurred from most pronamide rates, indicating a need for label restriction to winter grains only. Injury was relatively equal between wheat and barley but much greater stand reduction occurred where conventional tillage was used.

Table 1. Control of Winter Annual Grassy Weeds

		% Control		
Treatment	kg/ha	Downy Brome	Volunteer[3] Wheat	Volunteer[4] Barley
pronamide	.28	91[1]	92	87
pronamide	.42	95[1]	97	
pronamide	.56	95[1]	98	96
pronamide + glyphosate	.28 + .28	96[2]	96	
glyphosate	.56	68[2]	69	
propham	3.36	92[2]	95	

[1]Average of 9 tests
[2]Average of 6 tests
[3]Average of 4 tests
[4]Average of 3 tests

Table 2. Control of Winter Annual Broadleaf Weeds.

Treatment	kg/ha	Control (%) Prickly Lettuce	Blue Mustard	Tumble Mustard	Fiddleneck	Jagged Chickweed
pronamide + dicamba	.28 + .28	56	84		45	94
pronamide + dicamba	.42 + .28	94	73	81	71	94
pronamide + metribuzin	.28 + .28	87[1]		91		
pronamide + 2,4-D amine	.28 + .56	78[1]		95		
pronamide + glyphosate	.28 + .14	56[1]	33	68	30	91
pronamide + glyphosate	.28 + .28	62[1]	74	56	40	90
pronamide + chlorsulfuron	.28 + .018	93[1]		94		
pronamide + chlorsulfuron	.28 + .035		88		85	95

[1]Summary from 2 tests.

THE RELATIONSHIP BETWEEN WHEAT ROOTING DEPTH AND METRIBUZIN ABSORPTION

S. K. Parrish, L. A. Morrow, and D. R. Gealy[1]

Abstract: The absorption and activity of metribuzin [4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one] by roots of wheat seedlings at different soil depths was investigated. Wheat was planted 6 cm deep and activated carbon layers were placed at 1, 3, 5, 7, or 9 cm. Metribuzin at 0.56 kg/ha was applied to all plots, one-half of which were mulched to increase soil moisture. Seedling growth was progressively inhibited as the carbon layer was plowed deeper in the soil profile. Seedlings in mulched treatments died when the charcoal layer was below planting depth, but were only stunted in unmulched treatments. When the subcoronal internode was protected from treated soil, plant injury was reduced.

[1]Washington State University, Pullman, WA.

RHIZOME JOHNSONGRASS CONTROL IN COTTON WITH SETHOXYDIM

R. Kukas and G. Cramer[1]

Abstract: In 1982 BASF Wyandotte Corporation through their market development group, established several large sethoxydim (2[1-(ethoxyimino)-butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexon-1-one) studies in Arizona and California. The purpose was to establish rates, timing of initial applications, and timings for sequential treatments to control rhizome johnsongrass (Sorghum halepense L. Pers) in cotton (Gossypium hirsutrum L.).

Sethoxydim rates of 0.3, 0.4, 0.5 and 0.6 lb/A were applied to 6-10 inch and 15-18 inch johnsongrass. Second applications of 0.3 lb/A were sprayed either at two weeks after the initial application or at 4-8 inch johnsongrass regrowth. A third application was made of 0.2 lb/A when johnsongrass regrowth or new emerging plants reached 4-8 inches in height. All treatments received oil concentrate at the rate of 1 qt/A as a spray tank additive.

When the johnsongrass was treated at 6-10 inches in height, the cotton plant was not stunted, due to competition, and squares formed earlier than in other treatments. When treatment was delayed until the johnsongrass was 15-18 inches tall, significant stunting of the cotton plant occurred. There was no phytotoxicity observed with any of the sethoxydim treatments.

[1]BASF Wyandotte Corporation, Modesto, CA.

(One Application)
TABLE 1. Percent control of 6-10" and 15-18" johnsongrass with a single[3] application.

Sethoxydim rate ai/A	6-10"[1]	15-18"[2]
0.3	40	38
0.4	40	42
0.5	58	42
0.6	63	50

[1]6-10" johnsongrass sprayed 5/18/82 - rated 6/9/82.
[2]15-18" johnsongrass sprayed 5/28/82 - rated 6/21/82.
[3]Represents an average of 4 trials.

(Two Applications)
TABLE 2. Percent control of 6-10" and 15-18" johnsongrass with a sequential[2] application.

Sethoxydim rate ai/A	6-10"[1]		15-18"[1]	
	2 Week	4-8" Regrowth	2 Week	4-6" Regrowth
0.3 + 0.3	62	56	48	56
0.4 + 0.3	65	64	49	64
0.5 + 0.3	77	75	51	80
0.6 + 0.3	88	84	63	83

[1]Second treatment sprayed 2 weeks after initial application and 4-8 inch johnsongrass regrowth.
[2]Represents an average of 4 trials - rated 7/7/82.

TABLE 3. Precent Control of 6-10" and 15-18" johnsongrass with 3 applications.(1)

Sethoxydim rate ai/A	6-10"(2) 2 Week	6-10"(2) 4-8" Regrowth	15-18"(2) 2 Week	15-18"(2) 4-8" Regrowth
0.5 + 0.3 + 0.2	72	71	64	63
0.6 + 0.3 + 0.2	82	85	73	71

[1]Average of 4 trials - rated 9/2/82.
[2]Third treatment of 0.2 lb/A applied at 4-8" regrowth of johnsongrass.

GROWTH ANALYSIS OF COTTON AND FOUR WEED SPECIES UNDER FIELD CONDITIONS OF THE CENTRAL VALLEY, CALIFORNIA

M. L. Roush and S. R. Radosevich[1]

Abstract: Growth analysis under summer field conditions in Davis, California was performed for redroot pigweed (*Amaranthus retroflexus* L.), lambsquarters (*Chenopodium album* L.), barnyardgrass (*Echinochloa crus-galli* L. Beauv.), ivyleaf morninglory (*Ipombea hederacea* L. Jacq.), and cotton (*Gossyprium hirsutum*).

Plants were container grown in sand insulated beds under ambient conditions, with mean maximum daily temperatures of 33°C (SD = 3.0) and mean daily minimum of 13°C (SD = 2.3). Four day harvest intervals, over a 44 day period, provide data for reliable growth curves, and relative growth rates were mathematically derived for intervals ($\ln Wt_2 - \ln Wt_1$/Days) and as local curve fits (dlm Wt/dt).

Growth curves obtained, as ln dry weight versus time, were nearly identical for redroot pigweed, lambsquarters, and barnyardgrass, with maximum relative growth rates of 0.40 per day at 2 to 4 weeks from emergence. Annual morninglory and cotton showed low to negative growth throughout the study period, being severely limited by unseasonably cool summer conditions. The three rapidly growing species exhibit competitive neutrality to each other in terms of growth rate at the ambient conditions experienced.

These growth curves will serve as components in a competition model based on growth and germination, to examine weed/crop interactions and community dynamics. Growth data will be coupled with germination/temperature responses to predict relative competitive ability, which is tested by pairwise replacement series experiments. Further investigations will include plant-environment interactions and management impacts.

[1]Botany Department, University of California, Davis, CA.

CONTROL OF PERENNIAL GRASSES IN COTTON WITH FLUAZIFOP

M. R. Hargrave and S. D. Watkins[1]

Abstract: Johnsongrass, (*Sorghum halepense* L. Pers.) and bermudagrass (*Cynodon dactylon* L. Pers.) are troublesome perennial weeds in western irrigated cotton (*Gossypium hirsutum* L.). Both have proven difficult to control due to their aggressive growth habits, and because their rhizomes are easily spread throughout fields with cultivation equipment. Field studies in Arizona and California cotton have shown fluazifop [(±)-butyl 2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoate] to be highly effective in providing seasonal control of both grass species. Sequential over-the-top applications of 0.42 + 0.42 and 0.56 + 0.56 kg/ha, separated by two to four weeks, consistently provided excellent control without significant injury to cotton. Two applications of fluazifop at rates of 0.42 kg/ha or greater were generally superior to single applications of the same total dose. Best results were achieved on johnsongrass 30 to 45 cm in height, and on bermudagrass with stolons 10 to 20 cm in length. Grasses in advances stages of growth were not effectively controlled. Yields from plots treated with fluazifop were significantly greater than untreated cotton or plots treated with DSMA, MSMA, or glyphosate.

Introduction

Johnsongrass and bermudagrass are aggressive perennial weeds that continue to infest Arizona and California cotton. Early season competition from these and other important weed species can significantly reduce cotton yields. At harvest, severe infestations may interfere with mechanical harvesting and cause a discount of fiber grade (3). Recent field surveys revealed that both grasses continue to rank among the ten worst weeds infesting cotton (5). In western irrigated cotton, control measures currently include mechanical cultivation, hand-hoeing, and postemergent herbicides. However, these mothods have not proven entirely effective. Moreover, the use of nonselective herbicides and close cultivations for weed removal sometimes results in substantial cotton injury (1, 4).

Field research conducted within ICI Americas since 1979, and more recently by university and extension researchers, have demonstrated the efficacy of fluazifop in controlling johnsongrass and bermudagrass in cotton. Fluazifop is a highly selective grass herbicide that controls a broad range of annual and perennial grasses, while possessing a wide margin of safety when applied topically to broadleaved crops. Research conducted with fluazifop during 1982 focused on determining minimum effective use rates; optimum retreatment timings; and subsequent effects on cotton growth, vigor, and yield following broadcast foliar treatments.

Materials and Methods

A total of nine field experiments were conducted in Mohave and Yuma County, Arizona and in the California counties of Imperial, Kern, Kings and Tulare. Normal cultural practices such as discing, chiseling, bed preparation, preirrigation, and preplant incorporated treatments of dinitroaniline and/or diamino-s-triazine herbicides preceded the initiation of each study. Soil textures ranges from sandy loam to clay loam with less than 2.0 percent organic matter.

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[1]ICI Americas Inc., Visalia, CA, and Yuma, AZ.

Experiments were established in cotton fields moderately to severely infested with rhizomatous johnsongrass and/or bermudagrass. Generally, initial treatments were administered during May and June to johnsongrass 10 to 50 cm in height (30 cm average), and to bermudagrass 5 to 15 cm in height. Bermudagrass stolon length ranged from 5 to 35 cm. Applications on grasses in more advanced stages of growth occurred in selected studies. Treatment of grasses displaying signs of moisture stress was avoided. Cotton was generally 5 to 35 cm in height at initial herbicide treatment. The cotton cultivars included in Arizona and Southern California tests were 'DPL 61', 'DPL 62', and 'Stoneville 825'. Cultivars in Central California were 'Acala SJ-2' and 'Acala SJ-5'.

All initial treatments of fluazifop were applied broadcast at 188 to 376 l/ha with a tractor-mounted, compressed-air sprayer. Flat fan nozzles (Teejet 8003-8004) attached to a four-row boom were used in all experiments. For maximum coverage, directed sprays utilizing drop-pipe nozzles were used in subsequent treatments on bermudagrass in San Joaquin Valley trials. Plot size was 4 m by 15 or 30 m and all treatments were replicated 4 or 5 times in a randomized complete block design. A nonionic surfactant or crop oil concentrate was added to fluazifop at 0.10% v/v and 2.34 l/ha, respectively.

Single over-the-top treatments of fluazifop were administered at 0.42 to 1.12 kg/ha and compared to split applications totaling 0.70 to 1.26 kg/ha. The retreatment interval generally ranged from 3 to 6 weeks. Broadcast applications of fluazifop, DSMA, and MSMA were compared to direct contact application of glyphosate (sponge-wick). Seed cotton yields were collected from selected studies and were determined by harvesting the center two rows of each plot with a mechanical picker.

Weed control and crop injury evaluations were visually estimated and conducted at frequent intervals until harvest. Ratings were based on a scale of 0 = no injury and 100 = complete kill. Analyses of variance were calculated for all efficacy and yield data. Duncan's Multiple Range Test was used to determine significant differences among means at the 0.05 level of probability.

Results and Discussion

Johnsongrass Control. The effectiveness of single and repeated treatments of fluazifop was studied at two locations during 1982. Results from Winterhaven indicated that single applications at 0.42, 0.56 and 1.12 kg/ha provided good seasonal johnsongrass control through 12 weeks posttreatment. Identical rates administered at Poston resulted in only fair midseason control with poor results 11 weeks following treatment (Table 1). Previous studies have shown the performance of single fluazifop treatments to be variable, and in general, only marginally effective (2, 4). This has been particularly evident in trials conducted in the San Joaquin Valley.

In contrast, split treatments at 0.42 + 0.42 and 0.56 + 0.56 kg/ha proved to be 80 to 95% effective, season-long, at both locations, following applications to actively growing grass, 15 to 50 cm in height. At Winterhaven, all treatments of fluazifop provided better control and higher cotton yields than plots treated with glyphosate. Glyphosate was applied with a hand-held sponge-wick applicator. Two applications in opposite directions ensured thorough herbicide coverage. The glyphosate treatment was delayed until an adequate height differential occurred between the crop and weed to prevent cotton injury. Yield differences among fluazifop treated cotton were not significant. Crop phytotoxicity was not observed following any herbicide treatment.

Table 1. Comparative Effectiveness of Single vs. Sequential Treatments of Fluazifop on Johnsongrass Control and Seed Cotton Yield.

Treatment[a/]	Rate[b/] kg/ha	Percent Control at Weeks After Treatment and Locations Shown						Yield[c/] kg/ha
		Poston, AZ			Winterhaven, CA			
		2	6-7	11	1-2	6-7	12-14	
Fluazifop	0.42	61	70	43	78	82	81	3411 a
Fluazifop	0.56	73	79	51	81	84	82	3441 a
Fluazifop	1.12	78	83	73	87	90	88	3218 a
Fluazifop	0.42 + 0.42	88	80	-	93	88	92	3129 a
Fluazifop	0.56 + 0.56	94	84	-	97	94	93	3204 a
Glyphosate	25% v/v	-	-	-	41	46	51	1780 b
Cultivated Check		0	0	0				
LSD (0.05)		3.7	6.5	16.2	6.4	7.4	12.3	582.9

a/ Fluazifop applied broadcast to johnsongrass 15 to 50 cm tall, glyphosate applied sponge-wick to johnsongrass approximately 100 cm tall. Sequential treatments applied 28-32 days apart.

b/ Crop oil concentrate added to all fluazifop treatments at 2.34 l/ha.

c/ Means followed by the same letter are not significantly different at the 0.05 level of probability as determined by Duncan's Multiple Range Test.

Two field studies conducted in the San Joaquin Valley compared sequential treatments of fluazifop at varied rates and treatment timings. At Hanford, split applications with dosage totals ranging from 0.70 to 1.26 kg/ha provided excellent johnsongrass control through 8 weeks posttreatment (Table 2). Initial treatments were applied to 15 to 35 cm tall johnsongrass, with sequential treatments following 27 days later. There was no significant advantage to initial treatments exceeding 0.42 kg/ha, or total dosages exceeding 0.70 kg/ha. However, past studies have shown johnsongrass control to be inadequate when initial fluazifop treatments totalled less than 0.42 kg/ha (2).

Table 2. Control of Johnsongrass with Sequential Treatments of Fluazifop, Hanford, CA.

Treatment	Rate[a/] kg/ha	Percent Control at Indicated Weeks after Treatment	
		3	8
Fluazifop	0.42 + 0.42	89	91
Fluazifop	0.42 + 0.28	86	90
Fluazifop	0.56 + 0.56	91	92
Fluazifop	0.56 + 0.42	93	94
Fluazifop	0.56 + 0.28	81	92
Fluazifop	0.84 + 0.42	89	95
Fluazifop	0.84 + 0.28	90	89
Fluazifop	0.84 + 0.21	85	88
Cultivated Check		0	0
LSD (0.05)		7.6	6.4

a/ Sequential treatments applied 27 days apart. Crop oil concentrate added to all treatments at 2.34 l/ha.

The Poplar study examined the effectiveness of several fluazifop rate combinations and compared retreatment intervals of 18 and 46 days (Table 3). Johnsongrass ranged from 15 to 50 cm in height when treated, with a small percentage of grass at early boot stage. Sequential applications at 0.42 + 0.28 and 0.84 + 0.28 kg/ha constituted the lowest and highest dosages tested. Results indicated that fluazifop combinations administered on a 18-day retreatment schedule provided excellent seasonal johnsongrass control with each consistently outperforming the 46-day interval counterpart. However, this trend was not reflected in the yield data. All treatments of fluazifop gave significantly better control than two applications of DSMA at 2.24 kg/ha. Most fluazifop treatments were numerically and statistically higher yielding than DSMA and all herbicide treatments were superior to the cultivated check.

Table 3. Influence of Varied Fluazifop Rates and Retreatment Timing on Johnsongrass Control and Seed Cotton Yield, Poplar, CA.

Treatment	Rate kg/ha[a/] Retreatment Interval (weeks)			Percent Control at Indicated Weeks After Treatment			Yield[b/] kg/ha
		2.5	6.5	4	4 and 8	12 and 16	
Fluazifop	0.42 +	0.42		94	98	94	4153 a
Fluazifop	0.42 +		0.42		86	88	4494 a
Fluazifop	0.42 +	0.28		97	95	93	4397 a
Fluazifop	0.42 +		0.28		84	80	4739 a
Fluazifop	0.56 +	0.56		95	97	96	4153 a
Fluazifop	0.56 +		0.56		93	94	4543 a
Fluazifop	0.56 +	0.42		96	97	96	2736 b
Fluazifop	0.56 +		0.42		89	86	3957 ab
Fluazifop	0.84 +	0.28		95	99	95	4153 a
Fluazifop	0.84 +		0.28		92	95	4201 a
DSMA	2.24 +	2.24		55	45	0	2785 b
Cultivated Check				0	0	0	1026 c
LSD (0.05)				5.2	10.7	8.0	912.6

a/ Crop oil concentrate added to all treatments at 2.34 l/ha.
b/ Means followed by the same letter are not significantly different at the 0.05 level of probability as determined by Duncan's Multiple Range Test.

Field experiments near Roll and Old River examined the effect of fluazifop, DSMA, and MSMA applied alone, in admixture, and sequentially on johnsongrass control, cotton injury, and yield (Table 4). Initial over-the-top treatments were administered to johnsongrass 10 to 40 cm in height at each location. Sequential applications followed 24 days later. Excellent control was demonstrated with split treatments of fluazifop at 0.42 + 0.42 and 0.56 + 0.56 kg/ha. Repeat treatments of each methanearsonate herbicide at 2.24 kg/ha provided fair midseason control, but results were poor at harvest. Sequential treatments of fluazifop at 0.56 kg/ha plus

DSMA or MSMA at 2.24 kg/ha provided poor late-season control. Seed cotton yields were greatest in plots treated with fluazifop. Repeat applications of admixtures containing fluazifop at 0.56 and 1.12 kg/ha and DSMA or MSMA at 2.24 kg/ha were neither synergistic nor antagonistic with johnsongrass control equivalent to split treatments of fluazifop alone (data not shown). Cotton foliage contacted by DSMA or MSMA was slightly injured (necrotic speckling and blotching) at both locations. At Old River, leaf speckling also occurred in plots treated twice with fluazifop at 0.56 kg/ha. All injury was localized and temporary with subsequent cotton growth and development normal.

Table 4. Comparative Effectiveness of Fluazifop, DSMA, and MSMA Applied Alone and Sequentially on Johnsongrass Control and Seed Cotton Yield.

Treatment	Rate[a/] kg/ha	Percent Control at Weeks After Treatment and Locations Shown						Yield[b/] kg/ha
		Roll, AZ			Old River, CA			
		1	6	18	1	6	17	
Fluazifop	0.42 + 0.42	79	85	79	-	-	-	-
Fluazifop	0.56 + 0.56	95	90	71	69	97	96	3566 a
DSMA	2.24 + 2.24	61	35	16	24	8	0	635 c
MSMA	2.24 + 2.24	70	48	18	38	18	0	684 c
Fluazifop + DSMA	0.56 + 2.24	-	-	-	63	73	28	2149 b
Fluazifop + MSMA	0.56 + 2.24	-	-	-	69	78	38	2931 a
Cultivated Check		0	0	0	0	0	0	635 c
LSD (0.05)		6.0	7.9	21.3	7.0	13.1	15.3	667.7

a/ Crop oil concentrate added to all treatments at 2.3+2 l/ha. Sequential Treatments applied 24 days apart.
b/ Means followed by the same letter are not significantly different at the 0.05 level of probability as determined by Duncan's Multiple Range Test.

Bermudagrass Control. Four field trials were conducted during 1981 and 1982 and results are presented in Table 5. Control was inadequate when initial treatments of fluazifop were applied to well established, flowering bermudagrass 10 to 20 cm in height (Rosedale, 1981). Only grass suppression was achieved with single treatments at 0.56 to 1.12 kg/ha, and with a split treatment of 0.56 + 0.56 kg/ha. Early season grass competition had severely retarded cotton vigor and growth prior to treatment.

In contrast, early season treatment of bermudagrass 2 to 10 cm in height (5 to 35 cm stolons) resulted in excellent season-long control (Rosedale, 1982). Control achieved with single fluazifop treatments at 1.12 kg/ha were comparable to split treatments totaling 0.70 to 1.12 kg/ha.

Results from Winterhaven and Mohave Valley were variable, with single and multiple treatments of fluazifop demonstrating fair to excellent seasonal grass control. At each locale, grasses were treated during growth development stages (5 to 15 cm tall, 2 to 20 cm stolons) that favored optimum control. However, only fluazifop applied twice at 0.56 kg/ha was consistently efficacious in both experiments.

Results from these studies suggest that the efficaciousness of fluazifop in controlling perennial grasses is significantly influenced by weed maturity. Early season treatment of young weeds provided effective control and liberated the crop from injurious weed competition. The interaction of ample soil moisture at or near treatment and vigorous crop competition aided in the control of both grass species. ICI research has shown grasses with rhizomes well fragmented during preplant tillage operations to be more sensitive to fluazifop than grasses with undisturbed root systems.

Results suggest that two treatments of fluazifop may be needed to achieve effective control of rhizomatous johnsongrass. In bermudagrass studies, single treatments of fluazifop in conjunction with timely cultivation (no sooner that 7 days posttreatment), generally provided acceptable, season-long control. Retreatment of bermudagrass proved sometimes difficult due to frequent grower cultivations that concealed grass regrowth. However, lengthening cultivation intervals, a practice amenable to San Joaquin Valley cotton infested predominately with perennial grasses, would alleviate difficulties in achieving adequate herbicide spray coverage.

Table 5. Control of Bermudagrass with Single and Repeated Treatments of Fluazifop.

		Percent Control at Weeks After Treatment and Locations Shown[b/]											
	Rate[a/]	Mohave Valley, AZ					Winterhaven, CA			Rosedale, CA ('81)		Rosedale, CA ('82)	
Treatment	kg/ha	2	4	8	16	22	4	14	19	7	14	6	12
Fluazifop	0.42	-	74	51	-	46	72	-	88	-	-	-	-
Fluazifop	0.56	-	74	73	-	74	78	-	93	16	65	-	-
Fluazifop	0.84	-	81	68	-	78	-	-	-	35	70	-	-
Fluazifop	1.12	-	84	68	-	75	84	-	91	33	65	95	95
Fluazifop	0.42 + 0.42	78	-	-	68	-	-	96	-	-	-	96	95
Fluazifop	0.42 + 0.28	-	-	-	-	-	-	-	-	-	-	89	92
Fluazifop	0.56 + 0.56	79	-	-	83	-	-	97	-	50	70	91	95
Fluazifop	0.56 + 0.42	-	-	-	-	-	-	-	-	-	-	94	96
Fluazifop	0.56 + 0.28	-	-	-	-	-	-	-	-	-	-	95	94
Fluazifop	0.84 + 0.28	-	-	-	-	-	-	-	-	-	-	97	98
Cultivated Check		0	0	0	0	0	0	0	0	0	0	0	0
LSD (0.05)		19.6	3.7	27.2	23.6	27.9	7.3	5.7	9.6	19.6	17.3	10.2	7.1

a/ Crop oil concentrate added to all treatments at 2.34 l/ha except at Rosedale (1981) which included nonionic surfactant at 0.10% v/v.

b/ Sequential treatments applied 43, 32, 6 and 45 days apart, respectively.

Acknowledgements

We thank Bob Colby and Marilyn Reynders for their helpful suggestions and critical review.

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SELECTIVE GRASS HERBICIDES ON COTTON IN CALIFORNIA

H. M. Kempen[1]

Introduction

Several trials were conducted in Kern County with selective grass herbicides in cotton during 1981 and 1982. A summary of 1981 results was reported (3, 4). For clarity, the methodology, results and summary are reported for each experiment.

Effect of one hoeing on performance. Since a hoeing of johnsongrass (*Sorghum halepense* (L.) Pers) infested fields often does not exceed $25.00/A, this trial assessed the feasibility of hoeing in lieu of an early herbicide treatment. Previous trials had shown that one treatment was not adequate, inasmuch as a high degree of control is necessary or rapid reinfestation occurs. Yet initial herbicide costs for fluazifop-butyl or sethoxydim were expensive enough to warrant a study of such an option.

The trial was moderately infested with johnsongrass at trial initiation on 5/25/82. Three replications were sprayed when johnsongrass was mostly 12 inches and re-sprayed when again about 12 inches on 6/17/82. Companion replications were hoed on 5/29/82 and sprayed on 6/17/82 when about 14 inches tall. Temperatures were near 100 degrees F at each treatment but soil moisture was never wanting. The first post-emergence irrigation was on 6/3/82.

Plots were two rows by 20 feet. Sprays were in 40 gpa at 32 psi and contained 1 qt/A of crop oil concentrate (COC): trade name, Surfel. Rates tested were 0.38 and 0.5 lb a.i./A.

Abridged results in Table 1 summarize results. Very little difference occurred between Hoe/Spray vs Spray/Spray treatments but the latter sequence was favored, especially as measured by regrowth at harvest time. Evaluation of rhizomes produced after Dowco 453 [(±)-butyl 2-[4-((5-(trifluoromethyl)-2-pyridinyl)oxy)phenoxy)propanoate] and fluazifop-butyl [methyl 2-(4-((3-chloro-5-(tifluromethyl)-2-pyridinyl)oxy)phenoxy) propanote], the two best treatments, showed no appreciable differences between treatment sequences but Dowco 453 was superior in reducing rhizome survival. The check produced 10 Tons/A of rhizomes and 501 nodes/sq. ft. (Table 1a). Hoe 33171 and Dowco 453 caused considerable leaf symptoms (bronzing and speckling) when evaluated 3 days after treatment, but no retardation was evident on 6/15/82, 20 days after treatment.

Yield evaluation by taking boll counts showed no differences between treatments except untreated checks wich produced 35 to 50% as many bolls. No competitive stress on cotton was evident from allowing the johnsongrass to remain to these growth stages in this field. The results suggest that a hoeing would substitute for a treatment. (See Reference 1 for detailed results.)

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Table 1. Johnsongrass Control Results:
Hoe/Spray vs. Spray/Spray

Treatments [1/]	Control (8/24/82 at harvest)		Plants/Plot (8/24/82 at harvest)	
	Unhoed	Hoed	Unhoed	Hoed
Check	0	0	25+	25+
sethoxydim	7.7	7.	15	12
fluazifop-butyl	9.0	8.7	5.0	9.3
Dowco 453	9.8	9.8	0.7	1.7
Hoe 00581	9.3	9.0	6.0	18.0
CGA 82725	8.8	6.3	5.3	16.0

1/ Applied at 0.38 lb. a.i./A plus crop oil concentrate at 1 qt/A in 40 gpa at 32 psi. Unhoed was sprayed on 5/25/82 at 12 inches and resprayed on 6/17/82. Hoed was chopped on 5/29/82 and sprayed on 6/17/82. Irrigated first time on 6/3/82.

Table 1 a: Rhizome Results: Hoe/Spray vs. Spray/Spray

Treatments [1/]	Unhoed		Hoed		Nodes/
	lb/A	%	Lb/A	%	sq.ft.
Untreated	41,231	0	52,210	0	501.1
Dowco 453	405	99.0	118	99.7	1.4
fluazifop-butyl	1,957	95.3	1,756	96.6	22.6

1/ Applied as in Table 1. Evaluated 8/24/82.

Surfactant rates on performance. Manufacturer representatives have reported a consensus has occurred that crop oil concentrates (COC) enhanced performance of these selective grass herbicides the best. Previous studies here concur (2).

This trial was an evaluation of whether higher rates might reduce herbicide rates required and thus effect a savings to growers. Table 2 and 2a summarizes the procedure and results.

Cotton evaluations again showed Hoe 00581 and Dowco 453 caused the greatest symptoms but differences in herbicide rates (.38 or .76 lb. a.i./A) in 40 or 80 gpa or COC volumes (1, 2, 4, or 8 qts/A) were minimal. CGA 82725 showed the most difference, due mostly to rate of herbicide. All showed some stunting 12 or 18 days after treatment with not appreciable differences. On impact on verticillium wilt, which was very prevalent and early, none occurred.

Johnsongrass control ratings showed no appreciable improvement from COC volumes but did from herbicide increases. DGA 82725 and sethoxydim (2[1-(ethoxyiminol)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one) were improved somewhat by COC volumes. Perhaps the high degree of control by Dowco 453, fluazifop-butyl and Hoe 00581 masked the differences one might expect. Perhaps computer evaluation might aid in determining least cost combinations of herbicide/COC ratios when grower usage occurs.

Table 2. Surfactant Rates on Cotton Treated With Selective Grass Herbicides [1/]

Treat-ment	Lb/ A	COC qt/A	GPA	Sympt 6/	6/9	Stunting 6/15	6/15	VW 6/15
Check	-	-		0.5	0.3		0.8	0.8
Check	-	-		0	0	0	1.3	1.3
sethoxydim	.38	1	40	1.0	0	0	0.5	0.5
sethoxydim	.76	2	80	1.3	1.5	1.0	2.8	2.8
sethoxydim	.38	4	40	1.5	0.5	1.8	1.3	1.3
sethoxydim	.76	8	80	1.8	1.0	2.0	3.3	3.3
fluazifop-buty	.38	1	40	1.8	0.8	1.0	2.8	2.8
fluazifop-butyl	.76	2	80	1.5	1.3	2.0	1.8	1.8
fluazifop-butyl	.38	4	40	2.0	1.0	2.0	1.8	1.8
fluaxifop-buty	.76	8	80	3.5	1.8	1.8	2.8	2.8
Dowco	.38	1	40	3.5	2.0	1.5	2.3	2.3
Dowco	.76	2	80	5.3	3.0	2.3	3.0	3.0
Dowco	.38	4	40	3.0	1.5	1.8	0.5	0.5
Dowco	.76	8	80	4.5	2.3	1.5	2.3	2.3
Hoe 00581	.38	1	40	4.8	2.0	2.	2.0	2.0
Hoe 00581	.76	2	80	6.0	3.0	2.8	0.8	0.8
Hoe 00581	.38	4	40	4.8	2.0	2.0	3.0	3.0
Hoe 00581	.76	8	80	5.8	2.0	3.0	1.3	1.3
CGA 82725	.38	1	40	1.5	1.5	2.5	1.5	1.5
CGA 82725	.76	2	80	3.5	2.0	2.0	1.8	1.8
CGA 82725	.38	4	40	2.8	1.5	2.3	1.3	1.3
CGA 82725	.76	8	80	5.0	2.0	2.0	1.8	1.8

LSD 5%	1.1	.90	1.02	NS
LSD 1%	1.47	1.19	1.35	

Treated 5/28/82 when cotton had 4 leaves and johnsongrass was 12 inches; temperature 100 degrees F; moisture adequate. Ratings made were 0 to 10: 0 = no leaf symptoms, stunting or retardation; 10 = 100% kill. Averages of 4 replications.

1/ Abbr. for table headings: COC = Surfel; Sym. = Symptoms; VW = No. of plants with Verticillium wilt.

Spot-treatment comparisons. Again on johnsongrass, a comparison of the two early contenders for registration-fluazifop-butyl and sethoxydim was made as spot-treatment applications. Spray-to-wet applications were made on 6/9/82 to 18 to 24 inch johnsongrass, a practice many growers might and should opt for after registration.

Table 3 shows results that fluazifop-butyl was satisfactory at the 0.5 and 1.0 lb a.i./100 gallons. Earlier treatment probably would have improved results but may have caused need for a second spot-treatment. (In practice, a second treatment is needed anyway.)

Table 2a. Surfactant Rates on Johnsongrass Control When Tested With Selective Grass Herbicides.[1]

Treat-ment	Lb/ A	COC qt/A	GPA	0-10 6/9	% 6/15	Regr 6/15
Check	-	-		0	0	25+
Check	-	-		0	0	25+
sethoxydim	.38	1	40	4.7	46.7	25+
sethoxydim	.76	2	80	6.3	73.8	20
sethoxydim	.38	4	40	5.8	73.8	27
sethoxydim	.76	8	80	7.0	86.3	10
fluazifop-butyl	.38	1	40	5.5	72.5	11.5
fluazifop-butyl	.76	2	80	6.0	83.8	5.3
fluazifop-butyl	.38	4	40	5.8	80.0	11.5
fluazifop-butyl	.76	8	80	6.8	86.3	3.5
Dowco	.38	1	40	6.3	88.8	5.8
Dowco	.76	2	80	7.8	93.8	4.8
Dowco	.38	4	40	7.5	91.3	5.5
Dowco	.76	8	80	7.8	93.8	3.5
Hoe 00581	.38	1	40	6.8	90.0	14
Hoe 00581	.76	2	80	7.8	95.0	4.5
Hoe 00581	.38	4	40	6.8	91.3	11.5
Hoe 00581	.76	8	80	8.0	96.3	6.8
CGA 82725	.38	1	40	5.8	77.5	23.8
CGA 82725	.76	2	80	6.5	81.3	8.0
CGA 82725	.38	4	40	6.3	78.8	12.8
CGA 82725	.76	8	80	7.3	86.3	4.8
LSD 5%				.74	7.1	9
LSD 1%				.99	9.4	11.9

Treated as Table 2. [1] Abbr. for headings: COC= Surfel; 0-10: Rated 0 = no control; 10 = kill; % = control; Regr = regrowth in plants/plot.

Table 3. Spot-Treatment Comparisons on Johnsongrass [1]

Treatments		Cotton Symptoms	Johnsongrass Control 6/15	7/8	8/24
Check		0	0	0	0
sethoxydim	1/4	0	3.5	4.8	0
"	1/2	0	5.0	6.8	1
"	1	0	5.8	7.8	4.3
fluazifop-butyl	1/4	0	5.3	7.5	6.3
"	1/2	0	5.0	8.3	9.5
	1	0	5.8	8.3	9.8
LSD 5%			1.1	1.2	1.8

[1] Treated 6/9/82 when johnsongrass was 18 to 24 inches. MorAct crop oil concentrate was added at 1/2 gallon/100 gallons. Sprayed to wet. Herbicide rate in pounds active per 100 gallons.

Directed-sprays on bermudagrass (Cynodon dactylon (L.) Pers). A previous study (3) showed that a treatment of 11 inch bermudagrass in vigorous cotton which was hoed once, resulted in seasonlong control (not with total kill). This study included two different herbicides - Dowco 453 and Hoe 00581.

Two trials were conducted but the early application involving a hoeing was lost. The second test was done at mid-season (7/12/82) and confirms the previous study. Additionally, results in Table 4 showed that Dowco 453 was definitely superior to the other four compounds. One treatment essentially killed the bermudagrass whereas marked suppression and then some regrowth occurred with the others. Because cotton growth was 36 inches (less than the optimum 66 inches) at harvest, such kill would be beneficial. Often bermudagrass is worse where cotton growth is limiting due to some soil or management factor.

Table 4. Selective Grass Herbicides on Bermudagrass in Cotton [1/]

		Cotton		Bermudagrass Control		
Treatment	Lb/A ai	Stunt 7/24	(In.) 8/24	0-10 7/24	% Stand 8/24	(In.) 8/24
Untreated	-	1.8	29	0	100	22.5
Untreated	-	2.8	28	0.3	100	24
sethoxydim	.33	0.8	35	4.3	72.5	11
sethoxydim	.50	1.3	37	3.3	57.5	9.5
fluazifop-butyl	33	2.0	33	2.3	87.5	6.5
fluazifop-butyl	50	1.3	37	4.6	50	7.3
CGA 82725	.33	2.0	36	2.5	80	16
CGA 82725	.50	1.8	37	3.5	72.5	15.5
Hoe 00581	.33	1.0	3	6.2	47.5	20
Hoe 00581	.50	0.5	9	6.3	56.7	14.7
Dowco	.33	1.8	33	8	3.8	0.8
Dowco	.50	1.0	37	8.6	1.3	0.3
sethoxydim	.50	2.0	34	4.3	56.7	9.0
LSD 5%		1.25	5.0	1.57	16.3	5.5
LSD 1%		1.66	6.7	2.1	21.8	7.3

[1/] Treated 7/2/82 with 1 qt/A of Surfel crop oil concentrate at 46 gpa and 24 psi as a directed spray on 8-12 inch bermudagrass, treating a 15 inch swath.

Barnyardgrass control (Echinochloa crus-galli (L.) Beauv.). A previous study in 1981 confirmed that early treatment of barnyardgrass resulted in control with Poast and MAAG RO-13-8895 (4). This trial tried to confirm a previous season's observation that 'escape' barnyardgrass, occurring because of faulty dinitroaniline application may not be controlled once established, if no rains occur after planting. Such an environmental sequence happens 50% of the time and results in survival of grassy weeds on their primary root. Adventitious roots fail to develop until irrigation or rainfall and result in a physiologically moisture stressed plant.

Results of this growth/treatment sequence confirmed that these selective herbicides essentially fail (Table 5).

Table 5: Selective Grass Herbicides on Barnyardgrass in Cotton[1/]

		Crop Response		Control (0 to 10)	
		Cotton		Barnyardgrass	
Treatment	Lb/A a.i.	Inj. 7/7	Sympt. 7/7	Old 7/7	Young 7/7
Check	-	0	0	0	0
Check (hoed)	-	0	0	10	0
sethoxydim	.5	0	0	4.8	0.5
sethoxydim	1.	0	0.3	6.5	0.5
fluazifop-butyl	1.5	0	0.6	4.5	1.8
Hoe 00581	.5	0	3.0	4.2	1.0
Hoe 00581	1.0	0	4.2	5.0	2.2
CGA 82725	.5	0	1.7	3.7	4.0
CGA 82725	1.0	0	2.2	5.8	4.8
Dowco 453	.5	0	2.8	5.7	3.7
Dowco 453	1.0	0	3.8	6.8	7.7

Treated 6/10/82 when barnyardgrass was 7 inches but still surviving on its primary root, as is typical when no rains occur after planting; therefore physiologically droughty. Cotton was 6-14 inches. Mor-Act crop oil concentrate added at 1 qt/A in 40 gpa at 32 psi. Furrow irrigation was about 6/30/82; ratings on young barnyardgrass after irrigation were difficult to make.

[1/] Abbreviations of headings: Inj. = Injury; 0-10 - 0 = none; Sympt. = Leaf Symptoms

Perhaps the stunting of grasses would permit 'dirting' and cover the weeds since cotton is tall enough to permit that by this stage. But in all probability an irrigation prior to treatment would substanstially improve performance. Obviously, close monitoring would be necessary to permit treatment when escape grasses are only two to four inches.

General Discussion

That recent selective herbicides will fit into western weed management systems is evident from these research findings. Droughtiness is the chief deterrent to successful usage, and can be overcome. Considerable leeway exists on treatment timing, but herbicide costs dictate using optimum timing and/or spot treatment. Band treatments can be utilized to reduce costs, at least for the first treatment on johnsongrass and for early or sequential treatments on bermudagrass. Annual grasses would require early treatment which could be combined with the first cultivation.

Further research is needed on optimum usage on annual grasses and in combinations with post-emergence broadleafed herbicides to see if prophylactic herbicides can be eliminated on relatively clean fields. Because pigweed and nightshade are very prevalent and soil storage of these seeds seems to be long, preplant residuals will probably continue to be needed. Perennial grassy weeds are not wide-spread in California, but are very competitive when present; therefore, researy efforts need not be great.

Further research is needed on special application techniques with these herbicides, such as the rope-wick, low volume applications and aerial treatments.

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CHEMICAL FALLOW IN THE CENTRAL GREAT PLAINS

R. L. Anderson and D. E. Smika[1]

Introduction

Chemical fallow offers the following advantages for maximizing water retention efficiency: a) stubble will remain upright during winter months to retain snow, b) fallow land will be weed free during the fall to eliminate water loss via weed growth, and c) weed control will be maintained without tillage operations, which would reduce soil water evaporation. The objective of this study was to determine which herbicides are most suitable for the Central Great Plains cropping systems.

Materials and Methods

Several herbicides ar various rates were tested over three 14-month fallow periods. The herbicide tested included atrazine (2-chloro-4-(ethylamino)-6-(isopropylamino)-*s*-triazine), isouron (*N*'-[5-(1,1-dimethylethyl)-3-isoxazolyl]-*N*,*N*-dimethylurea), metribuzin (4-aminto-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one), cyanazine (2-[[4-chlorc-6-(ethylamino)-*s*-triazin-2-yl]amino]-2-methylpropionitrile), and terbutryn (2-(*tert*-butylamino)-4-(ethylamino)-6-(methylthio)-*s*-triazine). A conventional tillage treatment of sweep plowing was included for comparison. The herbicides were applied in late July of each year, immediately after wheat harvest. In September of the following year, 14 months after the herbicide application, winter what was seeded with a Noble no-till seeder. Grain yields, water storate, and length of weed control were determined for each treatment. The soil type was Weld silt loam, with a pH of 7.4 and an organic matter of 1.3%.

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[1]USDA-ARS, Akron, CO.

Results and Discussion

Table 1 summarizes the yield and water storage data for two years, 1981 and 1982. In 1981, significant yield increases resulted for all the chemical fallow treatments. The amount of increased water storage did not completely explain the large yield increases, indicating other

Table 1. The grain yield and water storage of chemical fallow treatments at Akron, CO in 1981 and 1982.

Treatment	Rate	Grain yields		Water storage	
		1981	1982	1981	1982
	(kg ai/ha)	--------	(% of Conv. till)		----------
Atrazine	1.1	157	101	106	115
Atrazine + cyanazine	1.1 + 2.2	114	90	97	84
Atrazine + metribuzin	0.8 + 0.6	157	97	113	93
Atrazine + metribuzin	0.8 + 0.8	146	106	108	112
Atrazine + isouron	0.6 + 0.6	161	92	89	76
Atrazine + isouron	0.7 + 0.5	140	82	104	89
Isouron	0.6	135	90	100	87
Terbutryn	3.4	154	85	111	82
Conventional till	–	100	100	100	100
LSD .05		16	NS	9	7

than increased water storage are apparently resulting in yield increases. Possible explanations for this yield increase without more stored soil water includes residual weed control in the following wheat crop; a reduced weed seed source to infest the following wheat crop; and more soil water near the surface in the herbicide treatments, resulting in more vigorous seedlings. In 1982, due to cooler temperatures than normal in June and unusually high precipitation in May and June the conventional tillage treatment yielded as well or higher than several herbicide treatments. The favorable environment apparently eliminated the advantages created by the herbicide treatments in previous years.

The herbicides maintained weed control until July or early August in all years of the study. Residual herbicide carryover resulting in injury to winter wheat did occur with atrazine at 2.2 kg/ha and isouron at 1.7 kg/ha. If an exceptionally dry year should occur, residual carryover damage with atrazine and isouron at lower rates could possibly occur, as the amount of rainfall received by August 1 of each year ranged around the 10 year average.

Conclusions

Residual herbicides can be used as an alternative to mechanical tillage in years of average or above precipitation, but possibly may injure winter wheat if a dry fallow season occurs. Weed control was satisfactory by all treatments. The inclusion of atrazine in combination with other herbicides would insure long season control of weeds.

HOE 35609 (HOE 00583) - A NEW GRASS HERBICIDE

P. D. Olson and M. H. Ehlhardt[1]

Abstract: HOE 35609 is a new grass herbicide for the control of annual and perennial grasses in broadleaf crops. HOE 33609 acts primarily through the foliage and, therefore, is most active as a postemergence treatment after the grasses have emerged. The chemical and physical properties of HOE 33609 are to be released later. Optimum results for biological activity of HOE 33609 are when soil moisture is good and the grassy weeds are actively growing. It is not a contact herbicide. Its effects on the grasses is a general chlorosis followed by a blackened stem tissue that does not become evident until seven to fourteen (7-14) days after application. This is followed by complete necrosis of all foliage in thirty days. The use rate of HOE 33609 will range between 0.40 to 0.60 pounds of active ingredient per acre. For maximum activity on annual grasses, application should be made when the grass has four leaves to early tillering. This is also true of volunteer grain and several perennial grasses. Hoe 33609 is very active on quackgrass (*Agropyron repens*). Application on quackgrass should be made when it is six to eight (608) inches in height. Major attention to date has been evaluating HOE 33609 for quackgrass and volunteer grain control in peas and lentils. HOE 33609 is very weak on Johnsongrass (*Sorghum halepense*).

[1]American Hoechst Corp., Post Falls, ID.

PPG-844 - POSTEMERGENCE ON SEVEN BEAN TYPES

T. M. Cheney, J. Deli and F. R. Taylor[1]

Abstract: PPG-844 has been widely evaluated as a broadleaf herbicide in beans controlling a wide spectrum of broadleaf weed preemergence and

[1]PPG Industries, Moscoe, ID

postemergence. Excellent selectivity has been observed on soybeans, and in previous years, dry and processed beans. Common lambsquarter is particularly tolerant to low rates of PPG-844, and grasses are not controlled by this compound. PPG-844 injury is observed as bronzing and crinkling of the leaf surface and margins and stunting with foliar burn observed within 48 hours after treatment. Herbicide effectiveness in crop injury may be increased with high temperatures, low humidity, and intense sunlight at application. PPG-844 is most effective postemergence in seedling broadleaves. Non-ionic surfactants and spray adjuvants enhance postemergence activity of PPG-844.

A study was initiated in Lewiston, ID, to evaluate the influence of three rates of PPG-844, 0.056, 0.112, and 0.224 kilograms per hectare applied postemergence alone and in combinations with surfactants on the tolerance of seven bean types--pinto, red kidney, snap, navy, great northern, baby lima, and two varieties of soybeans. Acifluorfen was applied at 0.84 kilograms per hectare as a standard. All treatments were applied when the beans were in the first to second trifoliate leaf. Treatments were replicated four times in a randomized complete block. Plots were evaluated 7, 14, and 28 days after treatment with readings taken on bean phytotoxicity by bean type. A definite rate response within each bean type was observed. PPG-844 applied with surfactant increased bean phytotoxicity in all bean types. Both soybean varieties showed the most tolerance to PPG-844 when applied with or without surfactant. Great northern and baby lima beans showed good tolerance at the two lowest rates of PPG-844 applied without surfactant. A more acceptable level of phytotoxicity was observed treated with Blazer. Bean phytotoxicity continually declined by two and four weeks after application with acceptable phytotoxicity levels observed 28 days after application with treatments of PPG-844 without surfactant.

PPG-844 continues to show promise as a postemergence broadleaf herbicide in beans; however, potentially unacceptable levels of crop injury will warrant further investigation.

AC 222,293 A NEW POSTEMERGENCE HERBICIDE FOR CEREALS

D. R. Colbert[1]

AC 222,293, a new selective postemergence herbicide for cereals was discovered at the Agricultural Research Center of American Cyanamid Company located in Princeton, New Jersey. AC 222,293 is a mixture of *m*-toluic acid, 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-, methyl ester and *p*-toluic acid, 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-, methyl ester. Preliminary toxicological data indicate that AC 222,293 has a low order of mammalian toxicity. For example, the oral LD50 of AC 222,293 is greater than 5,000 mg/kg for both rats and mice and the dermal LD50 is greater than 2,000 mg/ka for rabbits. Furthermore, AC 222,293 does not cause any irritation to rabbit eye and only produces mild irritation to rabbit skin.

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[1]American Cyanamid Company, Lodi, CA.

Table 1. Acute Toxicity of AC 222,293 Technical to Mammals

Test Species and sex	LD_{50} (mg/kg body weight) or result
Oral	
Rat, male and female	5,000
Mouse, male and female	5,000
Dermal	
Rabbit, male and female	2,000
Eye irritation	
Rabbit, male	Nonirritating
Skin irritation	
Rabbit, male	Mildy irritating

The postemergence application of AC 222,293 has been globally evaluated in the field since 1980. The results obtained from the field have demonstrated that the postemergence application of AC 222,293 effectively controls wild oats (Avena spp.), blackgrass (Alopecurus myosuroides), mustards (Brassica spp.), field pennycress (Thlaspi arvense), and wild buckwheat (Polygonum convolvulus). In addition, this herbicide also suppresses the growth of kochia (Kochia spp.), Tartary buckwheat (Fagopyrum tataricum) and Russian thistle (Salsola kali). AC 222,293 also exhibits excellent selectivity in all varieties of barley and wheat tested to date. For optimal biological activity of AC 222,293 a non-ionic surfactant is required.

Today I will present a summary of test results available to date from the 1982 tests conducted in the U.S. and Canada, as well as the results of a representative test conducted in Tulelake, California in 1982. The test results of the postemergence application of AC 222,293 in the U.S. and Canada were conducted in small research plots. DM 710, a non-ionic surfactant, at 0.25% v/v in the final spray solution was added to all AC 222,293 treatments.

When AC 222,293 was applied at the 1 to 3 leaf stage of wild oats, the lowest rate of 0.38 lb ai/A provided 84% control of wild oats. This was slightly better than difenzoquat (1,2-dimethyl-3,5-diphenyl-1*H*-pyrazolium), at 0.75 and 1.0 lb ai/A or diclofop-methyl (2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid), at 0.75 lb ai/A. Both difenzoquat and diclofop-methyl were applied according to the label. The timing of application for difenzoquat was the 3-5 leaf stage of wild oats, and for diclofop-methyl it was the 1-4 leaf stage of wild oats. The higher rates of AC 222,293 showed about 90% control and there was no difference among these rates in terms of the wild oat control.

Control of field pennycress was 99% at the lowest rate of application. Wild mustard control ranged from 97-88%; wild buckwheat from 81-95% and kochia from 73-94%. As expected, difenzoquat and diclofop-methyl did not control these broadleaf weeds.

The plots treated with AC 222,293 at all rates had higher yields than the check plots. In most cases, AC 222,293 treatments outyielded the standard treatments.

In 1982 the wild oat control AC 222,293 applied at the 3 to 5 leaf stage was slightly better for the higher rates of 0.625 lb ai/A and up, than for the lower rates of 0.38 or 0.5 lb ai/A.

Wild mustard, wild buckwheat and field pennycress were still effectively controlled by all rates of AC 222,293 that were evaluated. Kochia control was not effective, possibly due to advanced size of kochia at the time of application.

The yield data for the later timing of the AC 222,293 application also indicated that all AC 222,293 treated plots had higher yields than the untreated plots both in the case of wheat and barley. Phytotoxicity of AC 222,293 to cereals was also evaluated in 1982. All varieties of wheat and barley that were evaluated have shown great tolerance to the postemergence application of AC 222,293.

Table 2. Varieties of Wheat and Barley Treated With AC 222,293 in 1982.

Wheat

Aldura, Anza, Benito, Canuck, Columbus, Dirkwin, Era, Filder, Fildwin, *Gem, Glenlea, Jori, Leader, Macoun, Mexicali, Modoc, Neepawa, Olaf, Oslo, Park, Probrand, Probred, Produra, Shasta, Sinten, Stephens, TL 409,* W444, Wakooma, WB803, WB881, WB911, WB1000D, WB5003, WS1, Yavaros, Yecora Rojo, and Yolo.

Barley

Bedford, Betzes, Bonanza, Briggs, CM67, Conquest, Elrose, Fergus, Galt, Harrington, Johnston, Klages, Norbert and Summit.

The spring, 1982 trial at the Tulelake Experiment Station in Tulelake, California was under the supervision of Mr. Ken Baghott, Modoc-Siskiyon County farm advisor. Postemergence applications of AC 222,293 at 0.38, 0.5, 0.625 and 0.75 lb ai/A and difenzoquat at 0.75 lb ai/A were made on May 26, 1982, to wheat variety Yecora Rojo when the wild oats were in the 3-5 leaf stage of growth. Barban (4-chloro-2-butynyl *m*-chlorocarbanilate), at 0.38 lb ai/A and diclofop-methyl at 1.0 lb ai/A were applied on May 18, 1982, when the wild oats were in the 1-3 leaf growth stage.

Treatments were replicated four times and arranged in a randomized block design with a plot size of 10 feet by 30 feet. Applications were made with a CO_2 backpack sprayer in a volume of 30 gallons per acre. Visual weed control and crop tolerance observations were made on August 3, 1982. Yield data was taken on September 22, 1982.

Postemergence application of AC 222,293 at all rates provided excellent control of wild oats, while the standard treatments did not show commercially acceptable control of wild oats. None of the treatments caused any crop injury.

The plots treated with AC 222,293 at all rates produced 39% to 50% higher yield than the untreated check plots. The bushel weight which indicates the quality of grains from all AC 222,293 plots was also higher than that from the untreated check.

Table 3. Visual Evaluation Ratings and Yield Data from 1982 Wild Oat Control Trial in Wheat, Tulelake, CA.

Treatment	Rate lb ai/A	Average-Percent Crop Injury	Average-Percent Wild Oat Control	Wheat Yield lb/A	Wheat Bushel Wt. lb/bu
AC 222,293	0.38	0	97	5888	63.9
AC 222,293	0.5	0	98	5663	63.7
AC 222,293	0.625	0	99	5436	63.7
AC 222,293	0.75	0	99	5957	63.9
difenzoquat	0.75	0	67	5519	62.3
diclofop	1.0	0	83	5575	63.7
barban	0.38	0	53	5237	63.2
Untreated	--	0	0	3917	59.3

[1]Average of 4 replicates

[2]A nonionic surfactant was added to all AC 222,293 treatments at .25% v/v.

Based on the data presented today, we can conclude that: 1) AC 222,293 at rates of 0.38 to 1.0 lb ai/A controls wild oats, wild mustard, field pennycress and wild buckwheat and also suppreses kochia, 2) AC 222,293 can be applied anytime furing the 1-5 leaf stage of wild oats. However, AC 222-293 is more effective against wild oats when applied at the 1-3 leaf stage than at the 3-5 leaf stage, and 3) wheat and barley tolerance to AC 222,293 is excellent. When applied as a postemergence treatment, there has been no significant damage to any variety tested to date.

SETHOXYDIM FOR ANNUAL AND PERENNIAL GRASS CONTROL IN ALFALFA

C. W. Carter and L. W. Hendrick[1]

Introduction

Sethoxydim (2-[1-(ethoxyimino)butyl)]-5-[2-(ethylthio)propyl)]-3-hydroxy-2-cyclohexan-1-one), has been tested extensively on many different crops by BASF Wyandotte Corporation, university and extension service personnel for the control of annual and perennial grasses under the code number of BAS 9052 0 H and the trade name of Poast for the past four years. Among these crops was alfalfa, which is the crop being considered here.

A wide variety of environmental and production factors can have a great influence on limiting alfalfa yields. Among these factors, weeds can be responsible for minimizing yields and quality to such an extent that the crop becomes economically unfeasible to produce.

[1]BASF Wyandotte Corporation, Concord California, and Farmington, Minnesota.

Weed problems in alfalfa can be divided into three different groups: stand establishment weeds, winter weeds, and summer weeds. Severe losses can be sustained in newly planted alfalfa by infestations of weeds such as fiddleneck (Amsinckia spp.), common groundsel (Senecio vulgaris L.), chickweed (Stellaria media (L.) Cyrillo), annual bluegrass (Poa annua L.), rabbitfootgrass (Polypogon monspeliensis (L.) Desf.), wild barley (Hordeum leporinum Link), and volunteer cereals. Winter annual weeds that invade established alfalfa inlclude chickweed, mustards, shepherdspurse (Capsella bursapastoris (L.) Medic), common groundsel, annual bluegrass, canarygrass (Phalaris canarienis L.), foxtail barley (Hordeum jubatum L.) and wild oat (Avena fatua L.). Annual grasses, especially yellow foxtail (Setaria lutescens (Weigel) Hubb.), and barnyardgrass (Echinochloa crus-galli (L.) Beauv.), cause the major summer weed problems in established alfalfa. Perennial grasses, such as bermudagrass (Cynodon dactylon (L.) Pers.) and quackgrass (Agropyron repens (L.) Beauv.) can also be a problem.

Present weed management systems, including both preemergence and post-emergence herbicides, will control many of the broadleaf problems, but are very weak on the grassy weeds.

Materials and Methods

Field experiments were conducted throughout the alfalfa growing areas of the western United States with sethoxydim alone and in combination with broadleaf herbicides. Those materials used in combination include bromoxynil [(3,5-dibromo-4-hydroxybenzonitrile], 2,4-DB [4-(2,4-dichlorophenoxy) butyric acid], alachlor [2-chloro-2',6'-diethyl-*N*-(methoxymethol) acetanilide], and diethatyl [N-(chloroacetyl)-N-(2,6-diethylphenyl)glycine]. A crop oil concentrate was added to each treatment, usually at the rate of 1.0 quart per acre. All fields were subjected to cultural practices normal for each respective area.

Sethoxydim was applied as single over-the-top treatments at rates of 0.25 to 2.0 lb ai/A. The plot size ranged from 60 sq. ft. to 0.5 acre. Treatments were applied at various stages of alfalfa growth to seedling alfalfa and to established alfalfa before the first cutting and after the first, second, third and fourth cuttings.

Visual evaluations were made usually at two and four weeks after treatment on the seedling alfalfa studies and immediately after the next cutting following the application on the established alfalfa trials. Ratings were based on a scale of 0 = no injury and 100 = complete kill.

Results and Discussion

Weed Control in Seedling Alfalfa (Tables 1A, 1B, 2)

In these studies sethoxydim (Poast), was applied alone and in combin-ation with 2,4-DB and bromoxynil. The alfalfa was in the 3-6 trifoliate leaf stage of growth. The wild oat ranged from 3-10 inches tall, and the volunteer wheat was 12 inches are larger. Common grounsel was about four inches with seed heads forming. The chickweed was well established and 2-8 inches in diameter. Shepherdspurse and minors lettuce were 3-6 inch rosette, and both were flowering.

Applications of 2,4-DB at 1.0 lb/A or bromoxynil at 0.5 lb/A alone did not effectively control any of the weeds present. The only treatments pro-viding long lasting control of volunteer wheat, common groundsel, and shepherdspurse was bromoxynil at 0.5 lb/A in combination with sethoxydim at either 0.5 or 1.0 lb/A. The higher rate of sethoxydim appeared to decrease groundsel control. Wild oat control was not adversely affected by the addi-tion of 2,4-DB, nor was volunteer wheat by the addition of bromoxynil.

TABLE 1A

Weed Control - Seedling Alfalfa
Applied 2-9-82

Treatment	Rate (lb/A)	Alfalfa 3-26	Wheat 3-9	Wheat 3-26	Groundsel 3-9	Groundsel 3-26
Untreated		77				
2,4-DB Ester	1.0	70	10	33	17	17
Bromoxynil	0.25	80	0	17	77	80
Bromoxynil	0.5	70	0	0	67	67
Sethoxydim + o.c.	0.5 + 1 qt	77	83	53	13	27
Sethoxydim + o.c.	1.0 + 1 qt	73	93	100	10	13
Sethoxydim + 2,4-DB + o.c.	0.5 + 1.0 + 1 qt	57	88	90	13	23
Sethoxydim + Bromoxynil + o.c.	0.5 + 0.25 + 1 qt	70	87	98	67	73
Sethoxydim + Bromoxynil + o.c.	1.0 + 0.25 + 1 qt	67	93	100	83	63
Sethoxydim + Bromoxynil + o.c.	0.5 + 0.5 + 1 qt	60	88	87	100	100
Sethoxydim + Bromoxynil + o.c.	1.0 + 0.5 + 1 qt	77	90	100	83	87

TABLE 1B

Weed Control - Seedling Alfalfa
Applied 2-9-82

Treatment	Rate (lb/A)	Shepherds-purse 3-9	Shepherds-purse 3-26	Minors Lettuce 3-9	Minors Lettuce 3-26	Chickweed 3-9	Chickweed 3-26
2,4-DB ester	1.0	53	80	10	53	30	33
Bromoxynil	0.25	100	40	20	17	10	0
Bromoxynil	0.5	100	57	43	33	13	27
Sethoxydim + o.c.	0.5 + 1 qt	0	27	33	33	0	0
Sethoxydim + o.c.	1.0 + 1 qt	17	0	33	0	17	27
Sethoxydim + 2,4-DB + o.c.	0.5 + 1.0 + 1 qt	80	57	17	17	10	0
Sethoxydim + Bromoxynil + o.c.	0.5 + 0.25 + 1 qt	100	67	13	17	0	0
Sethoxydim + Bromoxynil + o.c.	1.0 + 0.25 + 1 qt	100	63	43	10	0	10
Sethoxydim + Bromoxynil + o.c.	0.5 + 0.5 + 1 qt	100	97	60	57	40	0
Sethoxydim + Bromoxynil + o.c.	1.0 + 0.5 + 1 qt	100	93	43	70	13	0

TABLE 2

Wild Oat Control - Seedling Alfalfa
Applied 5-13-81

Treatment	Rate (lb/A)	Oat - 3"-6" 5-26	6-12	Oat 6"-10" 5-26	6-12
Sethoxydim + o.c.	0.4	95	-	85	95
Sethoxydim + o.c.	0.5	90	-	65	99
Sethoxydim + 2,4-DB amine + o.c.	0.4 + 1.5 + 1 qt	90	-	72	97
Sethoxydim + 2,4-DB ester + o.c.	0.4 1.0 + 1 qt	98	-	88	98

Quackgrass Control in Alfalfa Grown for Seed (Table 3)

Sethoxydim was applied as single and sequential treatments. At the first application the quackgrass was 6-20 inches tall and was 12-30 inches at the time of the second treatment. The alfalfa was 6-12 inches tall.

None of the single applications of sethoxydim at 0.5, 0.75 or 1.0 lb/A effectively controlled quackgrass. The 1.0 lb/A rate did provide 75% control. Sequential applications of sethoxydim at 0.75 plus 0.75 lb/A give good kill of this extremely large quackgrass, and the 1.0 plus 1.0 lb/A sequential application provided nearly complete control.

TABLE 3

Quackgrass Control - Seed Alfalfa
Applied 6-18-81 and 7-13-81

Treatment	Rate (lb/A)	% Control 7-25-81	9-5-81
Sethoxydim	0.5	40	30
Sethoxydim	0.75	48	50
Sethoxydim	1.0	60	75
Sethoxydim + Sethoxydim	0.5 + 0.5	53	65
Sethoxydim + Sethoxydim	0.75 + 0.75	57	80
Sethoxydim + Sethoxydim	1.0 + 1.0	70	98

All treatments contain oil concentrate at 1 qt/A.

Yellow Foxtail Control in Established Alfalfa (Table 4).

Sethoxydim was applied alone and in combination with diethatyl on April 6, 1982, to semidormant established alfalfa before the first cutting. The yellow foxtail was only partially germinated. This clearly demonstrates that this is not the proper timing of application as very little grass control was obtained.

When the same treatments were applied to 2-5 inch yellow foxtail after the first cutting, near complete grass control was obtained. Antor alone gave poor foxtail control. Grass control was slightly decreased with the combination of sethoxydim plus diethatyl as compared to the same rate of sethoxydim alone.

TABLE 4

Yellow Foxtail Control - Established Alfalfa

Treatment	Rate (lb/A)	% Control 7-29	% Control 8-11
Applied 4-6-82			
Sethoxydim + o.c.	0.5 + 1 qt	75	48
Diethatyl	4.0	52	0
Sethoxydim + Diethatyl + o.c.	0.5 + 2.0 + 1 qt	65	40
Applied 5-28-82			
Sethoxydim + o.c.	0.5 + 1 qt	97	96
Diethatyl	4.0	55	43
Sethoxydim + Diethatyl + o.c.	0.5 + 2.0 + 1 qt	92	92

Yellow Foxtail Control When Sethoxydim was Applied in the Same Alfalfa Field After Various Cuttings (Table 5)

Sethoxydim applications were made in June (after the second cutting), July (after the third cutting), and August (after the fourth cutting). Alfalfa regrowth was about 2.5 inches. The yellow foxtail population on all application dates was dense and uniform. In June, the grass was just starting to tiller, in July it was flowering, and in August it was flowering and ground coverage was approaching 100%. Evaluations were made after the third, fourth and fifth cuttings.

Sethoxydim in a single application of 0.25 lb/A did not give effective control of this grass population. In a double application it achieved satisfactory later season control when treatment was started after the second cutting. The 0.5 lb/A rate gave good contron only when applied after the third cutting. Earlier and later applications were not as effective. A double treatment of 0.5 lb/A gave excellent results. The

1.0 lb/A rate gave excellent control when applied after the second and third cuttings. The split treatment can control almost 100% of the grass. The 2.0 lb/A rate gave excellent control whenever it was applied.

TABLE 5

Postemergence Yellow Foxtail Control

Treatment	Rate & Date of Application			% Control	
	6-17	7-22	8-23	8-31	10-7
Sethoxydim	0.25	-	-	53	40
Sethoxydim	-	0.25	-	33	65
Sethoxydim	-	-	0.25	10	27
Sethoxydim	0.5	-	-	77	60
Sethoxydim	-	0.5	-	83	92
Sethoxydim	-	-	0.5	7	60
Sethoxydim	1.0	-	-	93	85
Sethoxydim	-	1.0	-	100	98
Sethoxydim	-	-	1.0	37	62
Sethoxydim	2.0	-	-	93	92
Sethoxydim	-	2.0	-	100	100
Sethoxydim	-	-	2.0	0	93
Sethoxydim	0.25	0.25	-	78	83
Sethoxydim	-	0.25	0.25	47	52
Sethoxydim	0.5	0.5	-	97	98
Sethoxydim	-	0.5	0.5	97	100
Sethoxydim	1.0	1.0	-	100	99
Sethoxydim	-	1.0	1.0	100	100

All treatments have oil concentrate applied at 1.0 qt/A.

Robert Norris, Botany Dept., UC Davis.

Summary

Because weeds, particularly grassy weeds, germinate over a long period of time, it may be necessary to either use sequential treatments of sethoxydim or wait until all the grass has germinated and use a higher rate to achieve complete control.

Literature Cited

1. Norris, R. F. Botany Department, University of California, Davis, California

EXTENDED EFFECTS OF HERBICIDES APPLIED TO FALLOW WHEAT FIELDS

N. E. Humburg and H. P. Alley[1]

Abstract: Herbicides applied to fallow winter wheat fields customarily are evaluated for vegetation control during the fallow season and phytotoxicity to the planted crop. Total weed control at harvest without detrimental effects to the crop resulted when herbicides were applied to research plots in Wyoming one to two years before harvest. Herbicides that degrade slowly controlled a broad spectrum of weed species throughout the fallow and crop-growing periods. Plots treated with herbicides which are considered to be materials for short-term effects have been free of certain weed species at harvest. Weed-free fields make emergency treatments unnecessary if rain delays harvest operations. Weed control procedures after harvest might not be required.

[1]Plant Science Division, University of Wyoming, Laramie, WY.

INTRODUCTION OF HOE 39866 (HOE 00661)

P. D. Olson[1]

Abstract: HOE 39866 (HOE 00661) is an experimental non-selective, non-residual, contact herbicide that controls a side spectrum of annual and perennial weeds. Its proposed common name is Glufosinate. The chemical name of HOE 39866 is Ammonium (3-amino-3-carboxyproply)-methylphosphinate. HOE 39866 is a non-selective contact herbicide with minimal translocation. There is not enough movement of HOE 39866 to prevent regrowth from roots or rhizomes in perennials. It disturbs ammonium metabolism, producing the accumulation of NH_4, a powerful cytotoxin, in the plant. A pale yellowish discoloration of green parts of the plant occurs in 2 to 5 days followed by withering and dying. Symptoms and death are somewhat slower than paraquat, but faster than glyphosate. The rate of action of HOE 39866 is reduced by temperatures below 10°C or moisture stress. Activity is favored by high temperatures and moist conditions. The rates of HOE 39866 depending on weed species and size of weeds are 0.5 to 3.0 kg/ha ai/A. HOE 39866 can be applied through various types of equipment and nozzles as long as thorough coverage is obtained (a continuous spray film in a form of small droplets are deposited on the leaves). Smaller weeds can be controlled in principle at lower rates than larger ones. Favorable environmental conditions for active plant growth insures good herbicidal activity. Cold or dry weather reduces metabolic activity of weeds. No precipitation or irrigation should occur within six hours after application of HOE 39866. Soil residue analysis reveal a rapid biodegration of HOE 39866, hence no soil activity or residual effects.

[1]American Hoechst Corporation, Post Falls, ID.

ANNUAL WEED CONTROL IN FALLOW SYSTEMS OF THE NORTHERN UNITED STATES USING DICAMBA AND DICAMBA TANK MIXES

W. O. Noel, B. A. Brinkman, J. M. Foster, J. M. Gehrett and J. M. Tichota[1]

Introduction

In geographic areas that receive less than 15 inches of annual precipitation, erratic yields make annual cropping an undesirable practice. Fallowing has been adopted in these areas as a means of moisture conservation. Other benefits derived from this phase of the cropping cycle include improved nitrification and annual weed control. One of the first documented benefits realized from fallowing in the Northern Great Plains is elucidated in the following passage from Joseph Kinsey Howard's book Montana, High, Wide and Handsome - "At Indian Head, Saskatchewan there lived a Scotch farmer named Angus McKay. In the spring of 1885 his farm help went off to put down a local uprising. One of McKay's fields was plowed, but not planted; alone on the farm, he did not have time to sow the wheat. He did find time to keep the plowed field clean, cultivating it to kill the weeds. It lay fallow all that year, and the next spring he planted it. This was during a time of severe drought and McKay marveled when the field produced 35 bushels of wheat to the acre. A continuously cropped field beside it yielded but 2 bushels per acre. McKay had 'discovered' the principle of summer tillage or summer fallow. It was not new, but he was probably the first to use it on the Northern Great Plains."

Summer fallow is defined as a farming practice wherein no crop is raised and all plant growth is controlled by cultivation or herbicides during a time when a crop might normally be grown. Cultivation has proven to be conducive to excessive soil erosion by wind and water. A study conducted in Whitman County, Washington over a 26-year period revealed an average erosion rate of 0.7 tons of soil for each bushel of wheat raised there. During six of the 26 years of study, the loss exceeded one ton of soil per bushel of wheat. As a result of these losses, alternative methods to cultivation for fallowing are being explored.

The advantages of including herbicide treatments in a fallow system must be coupled with an increased economic benefit in order to be useful. The minimization of soil losses is an important aspect of chemical fallow. More recently, the reduction of tillage operations which undoubtedly reduce operating and fuel costs is of much conern.

Materials and Methods

Herbicides studies include dicamba (3,6-dichloro-O-anisic acid), glyphosate (N-[phosphonomethyl]glycine), 2,4-D ([2,4-dichlorophenoxy] acetic acid), and paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) applied alone and in various combinations. Applications were made to replicated small plots using CO_2 pressurized backpack equipment fitted with various types of flat fan nozzles. Operating pressures (2.1 - 3.9 kg/cm^2) and nozzle tip selections (800067, 8001, 8002, 8003) were adjusted to obtain desired rate of carrier applied (37.4 - 373.6 l/ha). Treatments were applied at various developmental phases of weed species present. Periodic visual evaluation was employed to document treatment efficacy.

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[1]Velsicol Chemical Corporation, Chicago, IL.

Results and Discussion

None of the four herbicides studied provided adequate broad spectrum control of annual broadleaf and annual grassy weeds present under most Northern Great Plains fallow conditions. Dicamba and 2,4-D are efficaceous only on broadleaf species at normal use rates. Of these two materials, dicamba is extremely efficaceous on important broadleaf summer annuals that occur in fallow. These include Russian thistle (*Salsola kali* L.), kochia (*Kochia scoparia* (L.) Roth) and wild buckwheat (*Polygonum convolvulus* L.). While glyphosate is very effective on downy brome (*Bromus tectorum* L.) and volunteer small grains (*Triticum* sp and *Hordeum* sp), control of the aforementioned broadleaf species is occasionally erratic. Also, the glyphosate treatment will only be effective on emerged species while dicamba with its soil activity will provide a measure of control on those annual broadleaves that are emerging at the time of treatment. Discussion will, therefore, be limited to results obtained with tank mix herbicide combinations designed to control both annual broadleaf and annual grassy weeds.

Tank Mix Options

Since a tank mix of herbicides is necessary for broad spectrum weed control, studies were initiated to determine the optimum rate range, timing and chemical combination to attain the desired results. Paraquat and glyphosate were selected as candidate grass herbicides to be mixed with dicamba or 2,4-D.

Dicamba vs. 2,4-D (Chart I). As the chart illustrates, the dicamba plus glyphosate treatment results in consistently better performance than does the combination of 2,4-D plus glyphosate. Antagonism between 2,4-D and glyphosate is suspected for the diminished grass control while wild buckwheat is inherently tolerant to both 2,4-D and glyphosate. Therefore, the dicamba plus glyphosate mixture is the treatment of choice. This combination is efficaceous to a wide variety of species and presents no problems from the standpoint of antagonism.

Glyphosate vs. Paraquat (Chart II). Glyphosate and paraquat were then tested for efficacy on grassy species. When applied in combination with dicamba, glyphosate consistently provides better control than does paraquat. Efficacy on volunteer wheat and downy brome is excellent with the 0.28 + 0.28 kg/ha rate of dicamba + glyphosate. In many of the Northern United States' fallow areas, water for application purposes is in short supply. Since paraquat applications require relatively large amounts of water to be effective, another factor which limits its utility is apparent.

Application Timing (Charts III and IV). Timing of application must be geared toward weed growth stage rather than the calendar to insure success. Efficacy on volunteer wheat, kochia and downy brome is commercially acceptable at rates as low as 0.28 + 0.28 kg/ha of dicamba plus glyphosate when application is made early. As weed growth progresses, increased amounts of herbicide are required to gain control. Removal of weed species early then, provided advantages from a herbicide cost standpoint as well as from a moisture conservation standpoint.

Carrier Volume

The next factor studied was the effect of carrier volume on herbicide performance. Studies indicate that optimum control will be obtained with a dicamba + glyphosate tank mix when applied in 46.7 to 93.4 l/ha (5-10 GPA). Wild oat (*Avena fatua* L.) control (Chart V) is near perfect with a dicamba plus glyphosate application (0.14 + 0.14 kg/ha) in carrier

CHART I. BROADLEAF AND GRASS CONTROL WITH DICAMBA + GLYPHOSATE vs. 2,4-D + GLYPHOSATE (0.56 + 0.28 KG/HA).

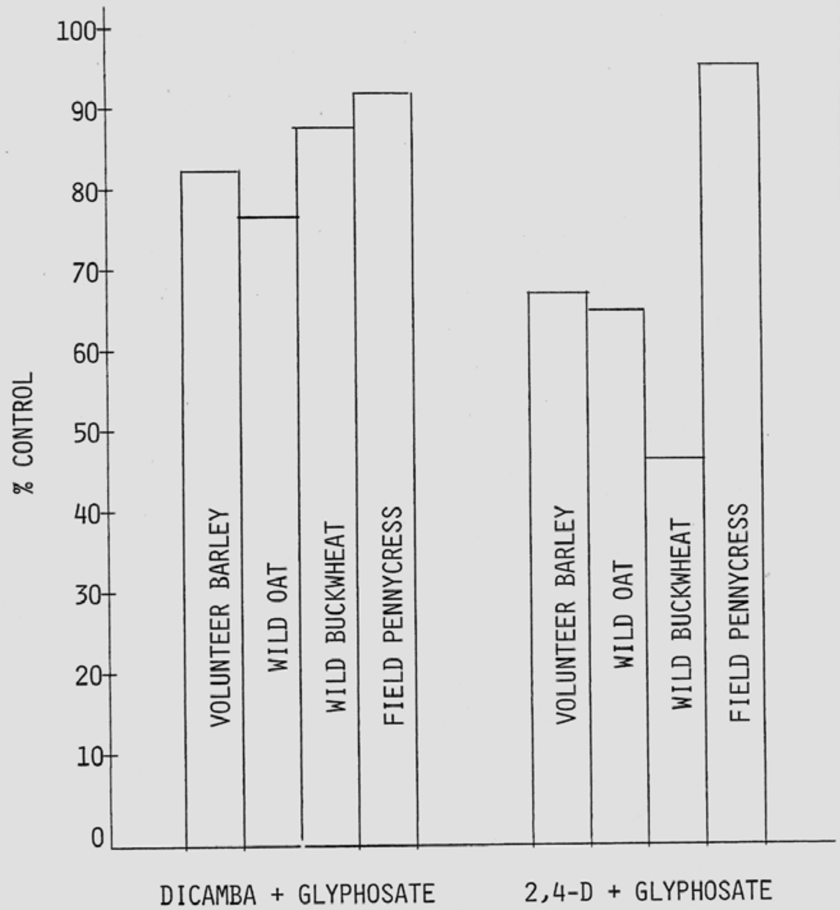


CHART II. VOLUNTEER WHEAT AND DOWNY BROME CONTROL WITH DICAMBA + PARAQUAT vs. DICAMBA + GLYPHOSATE

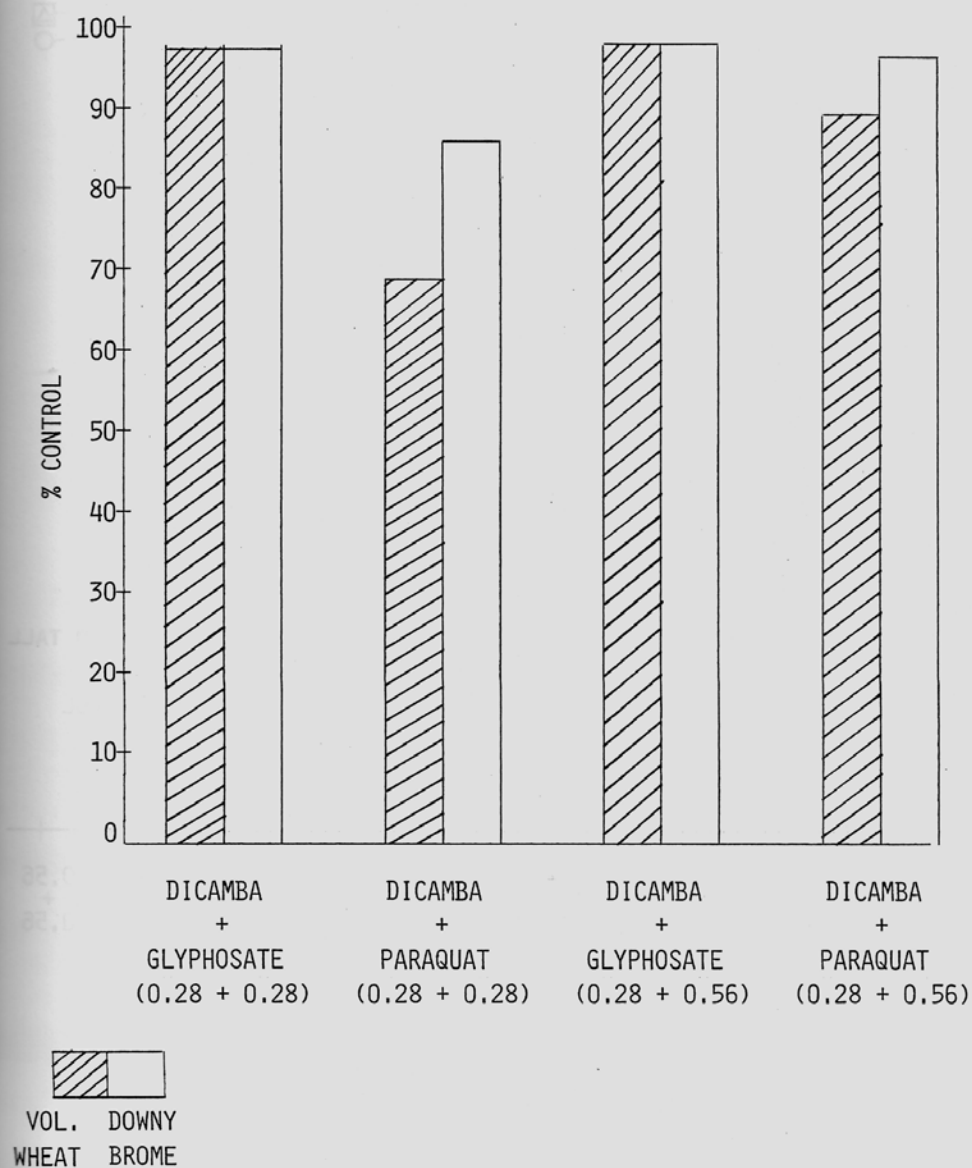
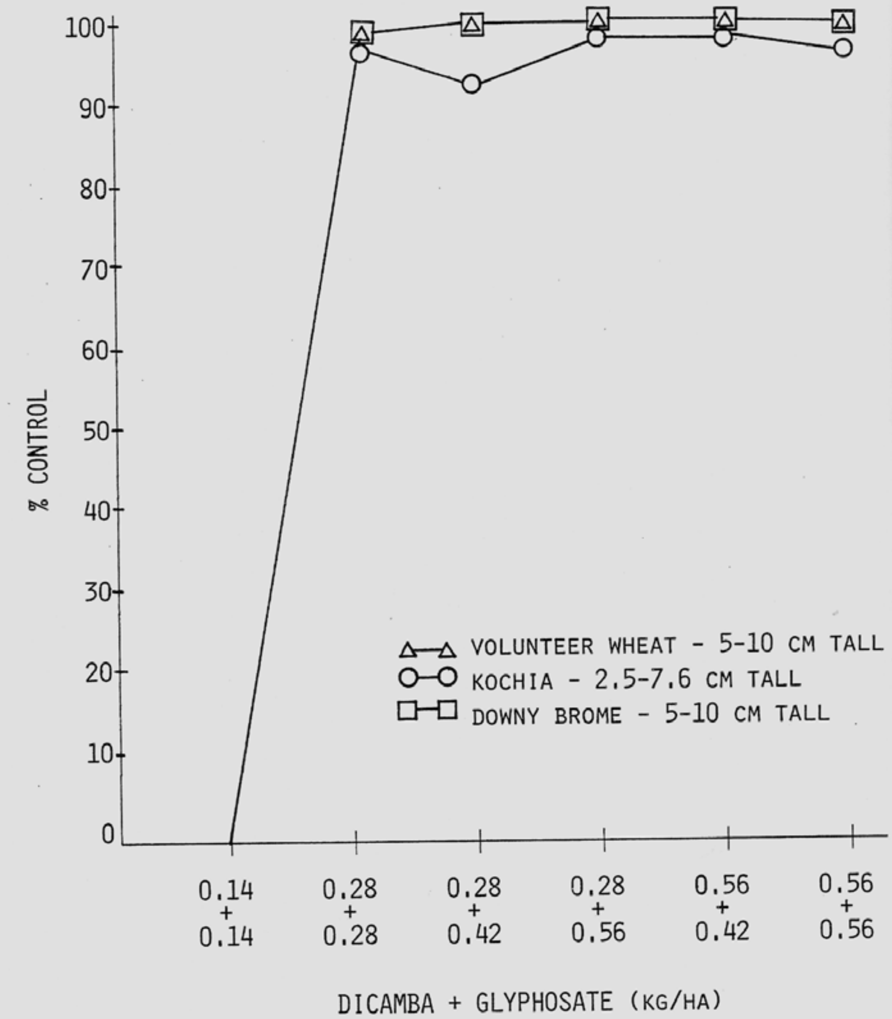
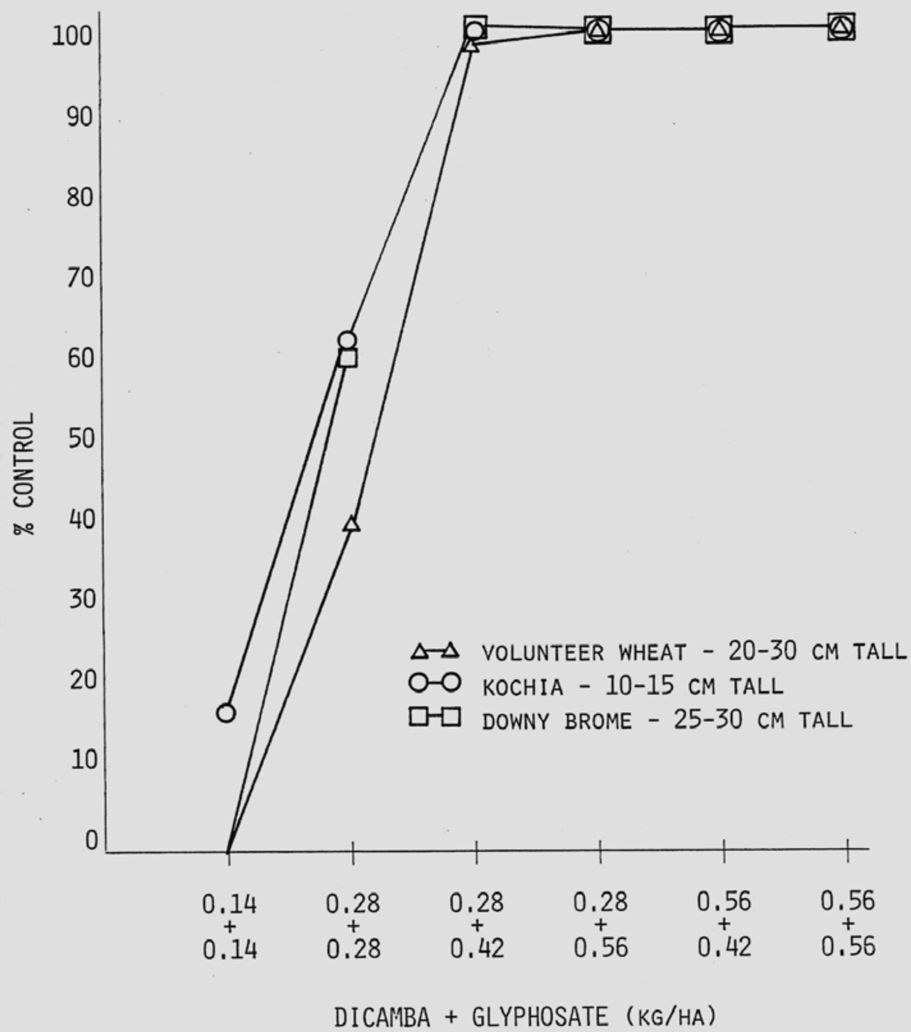


CHART III. INFLUENCE OF GROWTH STAGE ON HERBICIDE EFFICACY - EARLY



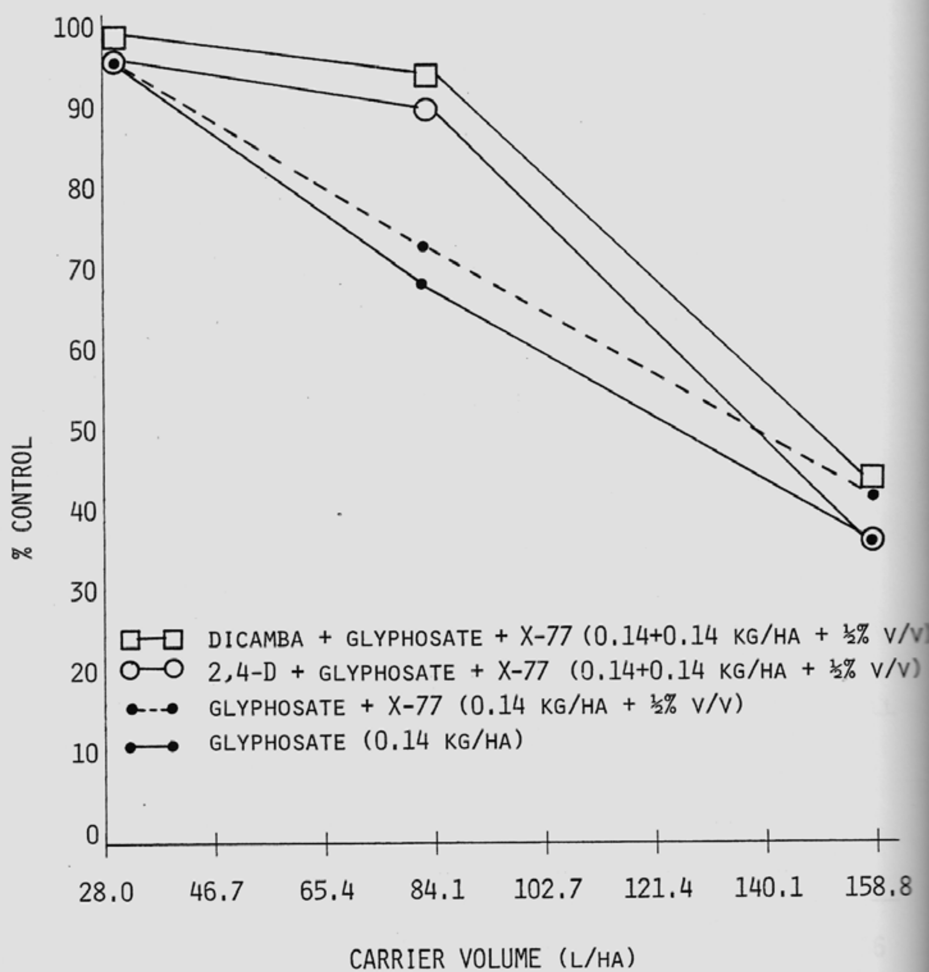
APPLIED: 5/20/82
EVALUATED: 6/29/82

CHART IV. INFLUENCE OF GROWTH STAGE ON HERBICIDE EFFICACY - LATE



APPLIED: 6/08/82
EVALUATED: 6/29/82

CHART V. INFLUENCE OF CARRIER VOLUME ON WILD OAT CONTROL



volumes up to 93.7 l/ha (10 GPA). As the carrier increases, control decreases in a corresponding manner. The same (Chart VI) relationship holds true with respect to annual boradleaf weed control. Therefore, applications can be made with a minimum amount of carrier which is of utmost concern in many of our fallow areas.

Surfactant

The final factor studied was the question of the need to add surfactant to the herbicide solution. Studies reveal that the addition of an agriculturally approved non-ionic surfactant at the rate of 1/2% v/v in the spray solution increased the efficacy of the herbicide mixture. As the illustration shows (Chart VII), efficacy is markedly improved on both annual broadleaf and annual grassy weeds with the addition of a surfactant.

Summary and Conclusion

Summer fallowing is a necessary phase of the cropping cycle in dryland areas where insufficient moisture makes continuous cropping a very risky business. While much fallowing is accomplished with various types of cultivating equipment, soil losses, moisture losses, and more recently, fuel costs have sparked research oriented toward replacement of some of these tillage operations with herbicides. Studies have shown a tank mix combination of dicamba plus glyphosate to be very effective on weed species commonly found in the Great Plains. Applications should be made when the weed growth is small to insure optimum control (Chart VIII). Rates that have proven effective are dicamba at 0.28 to 0.56 kg/ha (0.25 to 0.50 lbs/A) plus glyphosate at 0.28 to 0.56 kg/ha (0.25 to 0.50 lbs/A) applied in 46.7 to 93.7 l/ha (5 - 10 GPA) water. The addition of an agriculturally approved non-ionic surfactant at a 1/2% v/v rate is recommended. Proper application of this combination of herbicides will provide broad spectrum weed control for a 4 to 6 week period.

CHART VI. INFLUENCE OF CARRIER VOLUME ON ANNUAL WEED CONTROL

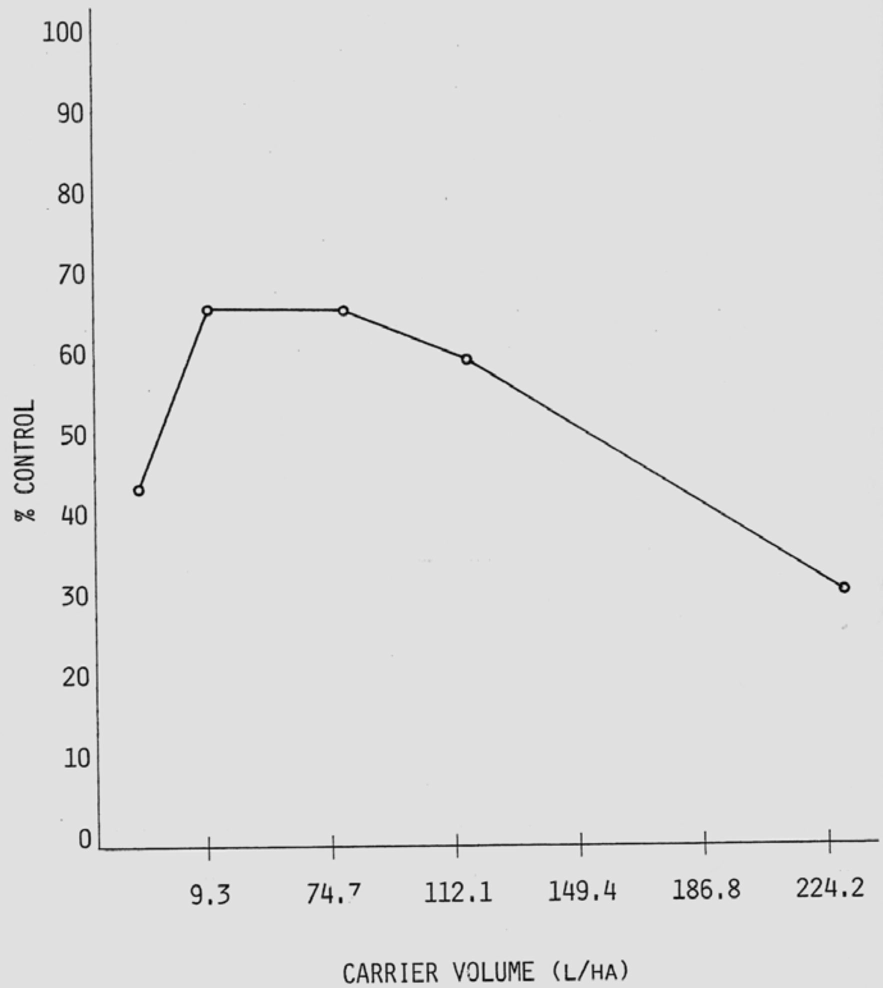


CHART VII. INFLUENCE OF SURFACTANT ON ANNUAL WEED CONTROL WITH BANVEL PLUS ROUNDUP (0.05 + 0.05 KG/HA)

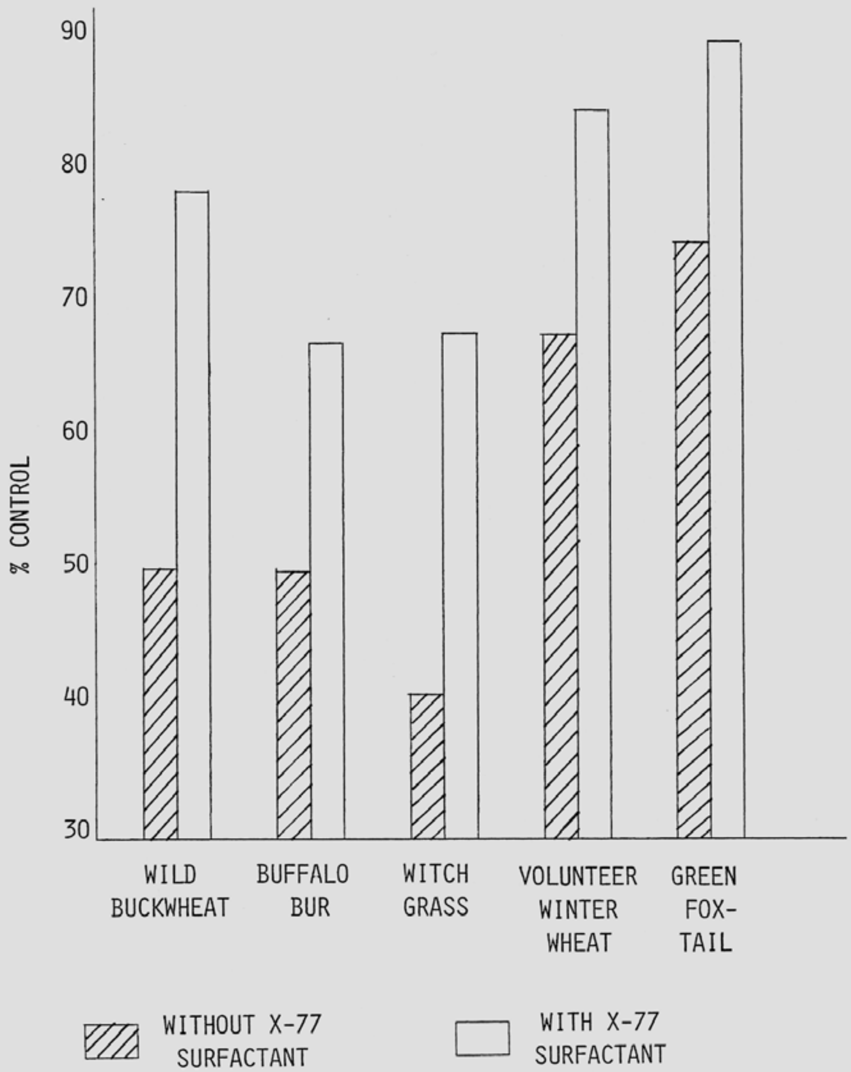
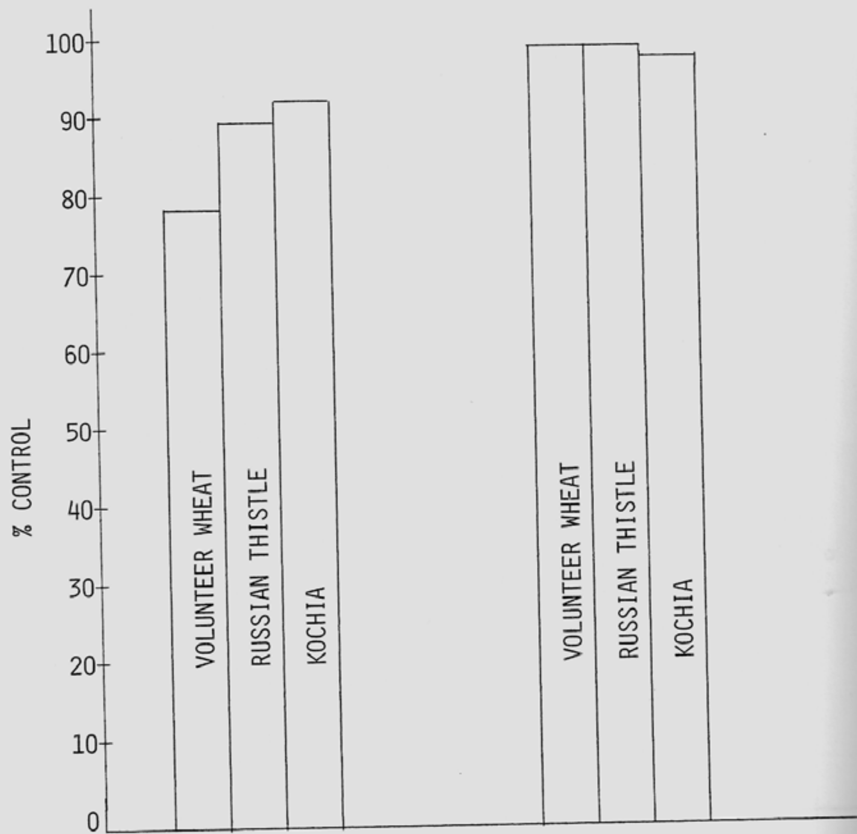


CHART VIII. AVERAGE PERFORMANCE OF BANVEL + ROUNDUP COMBINATIONS ACROSS THE NORTHERN UNITED STATES



BANVEL + ROUNDUP + SURFACTANT
0.28 + 0.28 + 1/2 % v/v

BANVEL + ROUNDUP + SURFACTANT
0.28 + 0.56 + 1/2 % v/v

VOLUNTEER WHEAT - 10 LOCATIONS
RUSSIAN THISTLE - 6 LOCATIONS
KOCHIA - 6 LOCATIONS

CENTER PIVOT INJECTION AND SURFACE APPLICATION OF ETHALFLURALIN FOR WEED CONTROL IN CUCURBITS, DRYBEANS AND GARDEN BEANS

W. T. Cobb, R. A. Hyer and D. E. Robinson[1]

During 1981 and 1982 under Experimental Use Permit Number 1471-EUP-63, ethalfluralin [N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-trifluromethyl) benzenamine] was surface applied post plant to cucurbits at five sites in California, two sites in Oregon and one site in Washington. Soils at these different trial sites ranged from sandy loam with less than 1 percent OM to silt loam soils with 1.5 percent OM. By crop the breakdown was as follows: watermelons, four trials; cucumbers, two trials; pumpkin, one trial and squash, one trial. Concurrent with these Lilly-supervised trials, several university trials were also conducted along the same basic format.

The general scheme of the trials was that the seedbed was prepared by conventional tillage methods, the cucurbits were planted and within 24 hours of planting, the ethalfluralin treatments were sprayed on the soil surface. Within 24 hours of application the plots were overhead irrigated (hand lines, wheel lines or center pivot) with a minimum of 0.3 inches of water. Ethalfluralin rates ranged from 0.56 to 3.0 lb/A. Crop tolerance and weed control information was taken periodically through the season.

Results of the three watermelon trials conducted in the PNW are summarized in Table 1. Results of the trials conducted on various cucurbit types in California are shown in Table 2.

Table 1. Weed control ratings with various rates of Ethalfluralin, surface applied postplant to watermelons and watered in.

	Percent Weed Control				
Ethalfluralin (Lb/A)	Barnyard-grass	Lambs-quarter	Green-foxtail	Russian thistle	Redroot pigweed
0.56	88	100	-	-	100
0.75	96	90	91	50	-
0.94	95	92	-	80	-
1.12	97	100	100	-	100
1.31	100	100	-	100	-

Note: Blanks due to not all trials containing all rates of all weed species.

Table 2. Weed control and crop tolerance when Ethalfluralin is postplant surface-applied to cucurbits and sprinkler incorporated at various sites in California.

		Percent Weed Control			
Ethalfluralin (Lb/A)	CI[1/]	Barnyard-grass	Redroot Pigweed	Ground cherry	Lambs-quarter
1.31	0	89	86	63	98
1.5	0.2	93	89	68	-
3	1.0	100	98	87	-

[1/] Crop injury rated on a 0-10 scale: 0 = no injury; 10 = dead plants.

[1]Lilly Research Laboratories, Kennewick, WA & Fresno, CA.

Crop tolerance to the surface-applied ethalfluralin treatments was excellent, in fact in two out of the three PNW trials, a significant increase in early season crop vigor was noted with the ethalfluralin treatments. In the third trial, a slight delay in emergence was noted which was attributed to the postplant irrigation cooling down the soil. Excellent crop tolerance was also noted in the California trials.

In the fall of 1982, a non-crop surface applied, sprinkler activated vs. preplant incorporated comparison with various ethalfluralin rates was conducted at Lilly Research Laboratory's California research station at Fresno, California. Soil type at the trial site was a loam (medium) with 1.1 percent OM. Three different levels of overhead irrigation were used to activate the surface-applied ethalfluralin treatments, 0.5, 1 and 2 inches of water. Three herbicide rates were evaluated, 0.75, 0.94 and 1.31 lb/A; only the 1.31 lb/A rate would be in the labeled rate range for nightshade and groundcherry control. Rate for rate, the PPI treatments provided better groundcherry control than did the water-incorporated treatments (Table 3). Ethalfluralin, when water incorporated, provided excellent control of redroot pigweed and barnyardgrass.

Table 3. Control of lance-leaved groundcherry when ethalfluralin is preplant soil incorporated vs. preemergence surface applied and sprinkler incorporated with different amounts of water.

Ethalfluralin lb a.i./acre	Percent Groundcherry Control		
	0.5"	1"	2"
1.31 PPI	100	97	99
SI	63	71	82

PPI = preplant incorporated

SI = sprinkler incorporated

In 1982 two center pivot injected trials with ethalfluralin were conducted on beans in the PNW, one trial in Idaho and one trial in Washington. The Idaho trial was conducted on a loam soil with 1.2 percent OM on several varieties of garden beans grown for seed. Half of the circle was treated with the standard rate of trifluralin (α,α,α-trifluoro-2,6-dinitro-*N*,*N*-dipropyl-*p*-toluidine), and EPTC (*S*-ethyl dipropylthiocarbamate), applied and incorporated preplant. The other half of the circle was treated with ethalfluralin + EPTC (0.94 + 3.5 lb/A), with the herbicides being injected through the center pivot system and water incorporated postplant to the crop.

The second trial was conducted on a "half-circle" located about 12 miles from Pasco, Washington. The soil type at this trial site was a loamy sand with 0.3 percent OM. Three different treatments were used in the Washington trial: ethalfluralin at 1.31 lb/A - preplant surface applied, ethalfluralin at 1.31 lb/A preplant soil incorporated and ethalfluralin plus EPTC (0.94 + 2.65 lb/A) - preplant surface applied. The surface applied, water incorporated treatments were applied in 0.6" of water; the preplant soil incorporated treatment was incorporated with one pass with a PTO driven roto-vator.

Weed control and crop tolerance ratings from the Washington trial can only be termed outstanding! Results from this trial are summarized in Table 4.

Table 4. Crop tolerance and weed control results from the Washington center pivot injected trial on dry beans.

		Percent Weed Control			
Treatment/Rate	Crop* Vigor	Barnyard-grass	Redroot pigweed	Lambs-quarter	Russian thistle
Ethalfluralin 1.31 lb/A PPSA-WI	140	99	98	98	97
Ethalfluralin 1.31 lb/A PPI	122	99	97	99	99
Ethalfluralin (0.94 + 2.65 lb/A) PPSA-WI	142	98	99	98	97

* Crop vigor rating: control = 100, better vigor than control = >100, less vigor than control = <100.

Crabgrass (Digitaria spp) and green foxtail control at the Washington trial site was outstanding also. Overall weed control was so complete that the grower did not even cultivate or hand weed the field. The only weed present which appeared not adequately controlled by any of the herbicide treatments was a sandbur (Franseria acanthicarpa); of which only a sparse population was present in the trial site.

Weed control and crop tolerance was commercially acceptable at the Idaho trial site. However, this trial did point up potential problems with postplant; center pivot injected applications. Because of rain during the planting operation, about eleven days elapsed from the last tillage operation prior to planting until the herbicide application was made post planting. A significant population of wild oats (Avena fatua) and hairy nightshade (Solanum sarrachoides) was able to germinate before the herbicide was present. A timely cultivation by the grower/cooperator eliminated most of this early season flush of weeds. Overall weed control did not approach that experienced at the Washington trial site.

As was stated earlier, several university/USDA studies were conducted independent of, but concurrent with the trials just described. Results of these trials also showed ethalfluralin's potential as both a surface applied, water incorporated herbicide and a center pivot injected, water incorporated herbicide. Notice that the type of irrigation system for injection is clearly specified as center pivots only, hand lines, wheel lines and solid-sets are not felt to have an adequate level of uniform water application to lend themselves to this type of herbicide application.

Future work will concentrate on comparing nightshade control with conventional preplant, soil incorporated ethalfluralin treatments to surface applied, water incorporated or center pivot injected ethalfluralin treatments.

DRY BEAN WEED CONTROL RESEARCH IN CALIFORNIA, 1981-1982: A SUMMARY

S. A. Fennimore and L. W. Mitich[1]

Dry beans are among the more extensively grown crops in California, with approximately 175,000 harvested acres in 1982. Among the major classes cultivated are blackeyes, baby and large limas, red kidneys, small whites, pinks and garabanzo beans. The principal growing regions are the Sacramento, San Joaquin, Salinas and Santa Maria valleys. Blackeyes are grown almost exclusively in the mid to southern portions of the San Joaquin Valley. Kidney, limas and pink beans are produced in the Sacramento and northern San Joaquin valleys while small white and garabanzo beans are grown in the coastal Salinas and Santa Maria valleys.

Weeds, especailly those resistant to the dinitroanalines, are a severe threat to dry bean yields. Among the most common problem weeds in dry beans are black nightshade (Solanum nigrum), hairy nightshade (Solanum sarrachoides), ground-cherry (Physalis spp.), yellow nutsedge (Cyperus esculentus), field bindweed (Convulvulus arvensis), and johnsongrass (Sorghum halepense). Research efforts during the past two years have focused uponthe chemical control of these weeds with several preplant incorporated and postemergence herbicides.

Results presented are from trials conducted under field conditions in 1981 and 1982 in Butte (1981 only), Colusa (1981 only), Monterey (1982 only), San Joaquin, Santa Barbara, Stanislaus, Sutter and Tulare counties and at the University of California experimental farm at Davis. All herbicides were applied with a CO_2 backpack sprayer except glyphosate [*N*-(phosphonomethyl) glycine], which was applied with a hand held rope-wick applicator. All preplant herbicides were soil incorporated to a depth of 2 to 3 inches immediately following application. Postemergence herbicides were applied when the beans were in the 3 to 6 trifoliate leaf stage and the weeds 1 inch in height. Visual estimates of phytotoxicity and weed control were made 10 to 15 days after treatment.

Among the preplant incorporated herbicides, several provided excellent control of yellow nutsedge and the nightshades. The percent yellow nutsedge control achieved is presented in Table 1. Alachlor [2-chloro-2',6',diethyl-N-(methoxymethyl) acetanilide], diethatyl [*N*-(chloroacetyl)-*N*-(2,6-diethyl phenyl) glycine], EPTC [*S*-ethyldipropylthiocarbamate], ethalfluralin [*N*-ethyl-*N*-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl) benzenamine], plus metolachlor [2-chloro-N-(2 ethyl-6-methyphenyl)-*N*-(2-methoxy-1-methyl-ethyl) acetamide], and metolachlor plus trifluralin [α,α,α-trifluoro-2, 6-dinitro-*N*, *N*-dipropyl-*p*-toluidine] gave good to excellent control of yellow

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[1] Cooperative Extension Service, University of California, Davis, CA.

nutsedge (results varied over 50% from trial to trial) and the other herbicides gave poor to moderate control.

TABLE 1: Control of yellow nutsedge with preplant incorporated herbicides.

HERBICIDE	LB/A	% CONTROL
Alachlor	3.0	85 - 95
Chloramben	3.0	50
Diethatyl	3.0	75 - 95
EPTC	3.0	80 - 95
Ethalfluralin	1.5	40 - 70
Ethalfluralin + Metolachlor	1.5 + 3.0	88
Metolachlor	2.5	90
Metolachlor + Trifluralin	2.5 + 0.75	98
Naptalam	2.0 and 4.0	25 - 50
Trifluralin	0.75	40 - 70
UBI-5734	1.0	75

Table 2 shows the results of black and hairy nightshade control from several preplant incorporated herbicides. Among the herbicides which gave good to excellent control were the emulsifiable concentrates and micro-encapsulated formulations of alachlor, EPTC plus trifluralin, and

TABLE 2: Black and hairy nightshade control with preplant incorporated herbicides.

HERBICIDE	LB/A	% CONTROL
Alachlor EC	3.0	80 - 100
Alachlor ME	3.0	85 - 100
Chloramben	3.0	60
Diethatyl	3.0	Hairy 40 - 60 Black 80 - 95
EPTC	3.0	* *
EPTC + R 33865	3.0	0 - 25
EPTC + Trifluralin	3.0 + 0.5	90
Ethalfluralin + Metolachlor	0.75 + 3.0	100
Metolachlor	2.5	90
Naptalam	2.0 and 4.0	50 - 80
Trifluralin	0.75	0 - 30

* * Highly variable

ethalfluralin plus metolachlor. EPTC and metolachlor applied separately gave variable control of nightshades (results varied over 50% from trial to trial); the other herbicides gave poor control.

The only notable phytotoxicity from a preplant incorporated herbicide was EPTC on baby lima beans. However, it is not registered on this crop.

Of the postemergence herbicides evaluated for black and hairy nightshade control, acifluorfen [5-[2-chloro-4-(trifluoromethyl) phenoxy]-2-nitrobenzoic acid] as Tackle gave excellent black nightshade control (see Table 3). Both commercial formulations of acifluorfen, Tackle and Blazer, gave poor to moderate control of hairy nightshade. Bentazon [3-isopropyl-1H-2,1,3-benzothia diazin-4 (3H)-one 2,2-dioxide], gave poor control of black nightshade but outstanding control of hairy nightshade, while CGA-82725 gave highly variable control possibly due to the difference in tolerance of the two nightshade species to this herbicide. PPG-844 gave poor to moderate control of both nightshade species, however, excellent control was achieved with PPG-1013.

TABLE 3: Black and hairy nightshade control with postemergence herbicides.

		% NIGHTSHADE CONTROL	
HERBICIDE	LB/A	BLACK	HAIRY
Acifluorfen 1/	0.25	-	70
Acifluorfen 2/	0.25	90	50 - 70
Bentazon	0.75	60	90 - 100
CGA - 82725	0.5	* *	* *
PPG-844	0.2	65 - 80	65 - 80
PPG-1013	0.04	90	90

* * variable

1/ Blazer (TM)

2/ Tackle (TM)

The performance of the grass herbicides evaluated for seedling johnsongrass control is given in Table 4. Fluazifop-butyl [butyl 2-[4-trifluoromethyl-2-pyridyloxy) phenoxy] propionate], HOE-33171, and sethoxydim [2-[1-(ethoxyimino) butyl]-5-[2-(ethylthio) propyl]-3-hydroxy-2-cyclohexen-1-one]], provided excellent control of johnsongrass. Glyphosate, applied as a 33% solution with a wiper applicator, gave moderate control.

As indicated in Table 5, several of the postemergence herbicides caused considerable early injury to most classes of dry beans, with blackeyes and limas being the least tolerant and kidneys and pinks the most tolerant to the treatments. PPG-844, and PPG-1013 caused severe initial injury to blackeyes and baby limas. Pink beans were fairly tolerant to PPG-844 and gradually recovered from the injury, however, MC-10978, glyphosate, and PPG-1013 caused severe injury from which kidney beans never completely recovered. The other herbicides caused only slight to no injury in all classes of beans.

TABLE 4: Seedling johnsongrass control with postemergence herbicides.

HERBICIDE	LB/A	% CONTROL
Fluazifop butyl	0.5	96
Glyphosate	33%[1/]	75
HOE-33171	0.2	93
Sethoxydim	0.5	95

1/ wiper solution

TABLE 5: Herbicide injury resulting from various postemergence herbicides.

		% INJURY[3/]	
HERBICIDE	LB/A	SMALL BABY LIMAS	RED KIDNEYS AND PINKS
Acifluorfen[1/]	0.25	5	0
Acifluorfen[2/]	0.25	5	0
Bentazon	0.75	10	0
CGA-82725	0.5	15	5
Diclofop	1.0	--	5
Fluazifop-butyl	0.5	--	5
Glyphosate	33%	--	25
HOE-33171	0.2	10	5
MC-10978	0.375	--	40
PPG-844	0.2	35	20
PPG-1013	0.04	45	30

1/ Blazer (TM)

2/ Tackle (TM)

3/ Injury 0 = Injury

100 = Crop Death

In summary, progress is being made in determining the more effective preplant incorporated herbicides and herbicide combinations for controlling difficult weeds. Alachlor remains one of the most effective preplant incorporated herbicides for the control of yellow nutsedge and the nightshades. Among the promising herbicide combinations are ethalfluralin plus metolachlor for control of the nightshades and yellow nutsedge and metolachlor plus trifluralin for the control of yellow nutsedge.

Acifluorfen provides excellent control of emerged black nightshade while bentazon offers superb control of hairy nightshade. Of the postemergence herbicides evaluated, only bentazon gives acceptable control of yellow nutsedge.

SOIL SOLARIZATION AS A WEED CONTROL METHOD IN FALL PLANTED CANTALOUPES

C. E. Bell and C. L. Elmore[1]

Abstract: Soil solarization is a relatively new method for controlling soil-borne pests. Originally investigated as a disease control technique, it has been expanded into research for weed control. This method involves using clear plastic tarps over moist soil to capture heat energy during periods of high temperatures and intense solar radiation.

In this trial, 40 inch beds were covered with strips of 2 ml polyethylene plastic 30 inches wide. The plastic was put in place using a commercial-type strawberry mulcher. Treatments were installed on June 4, 1982. The plastic on treatment #1 was removed immediately, treatment #2 after 2 weeks, treatment #3 after 4 weeks and treatment #4 after 6 weeks. The plots were irrigated on June 5, 1982. All beds were rototilled to a depth of 1 inch on July 20, 1982 and planted to cantaloupes, var. Topmark. Germination irrigation was on the same day.

The plots were rated for weed control on August 19, 1982. Treatments #1 & 2 failed to control weeds adequately. Treatment #3 resulted in approximately 90% weed control, while treatment #4 gave 100% control of tumble pigweed (*Amaranthus albus* L.) and common purslane (*Portulaca oleracea* L.).

Plots were harvested five times from October 13 to 22, 1982. Yield data showed a significant difference between treatments.

Introduction

Using solar radiation to heat soil under plastic tarps has been gaining interest amongst agricultural researchers for the last few years. Studies have been conducted in Greece, Jordan, Italy, England, United States and Israel. Israel has been the leading force in solarization research and today many Israeli farms use plastic mulch to alter the soil environment. In the U.S. the most research has taken place in California, but some work has also been done in the east and the southeast.

Soil solarization involves placing clear plastic tarps over moist soil for extended periods (4-6 weeks) during periods of high solar radiation and temperatures. Transparent polyethylene plastic is used in preference to black because it transmits more solar radiation that will convert to heat energy in the soil. Moisture in the soil is necessary to increase sensitivity of weed seeds and resting structures of other organisms to thermal effects.

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Although the majority of research has been conducted for the control of soil-borne diseases (2), weed control with solarization has been receiving increased emphasis.

Materials and Methods

The trial consisted of 4 treatments replicated 4 times in a randomized complete block design. Treatment #1 was tarped 0 weeks, treatment #2 was tarped 2 weeks, treatment #3 was tarped 4 weeks and treatment #4 was tarped 6 weeks. The tarp was 2 ml polyethylene plastic placed on the top and shoulders of 40 inch shaped beds. The soil was a sandy clay loam. Placement of the plastic was accomplished with a commercial strawberry mulcher. All treatments were installed on June 4, 1982. Plot size was 50 feet by one bed. Treated beds were separated by one untreated bed. The beds were furrow irrigated on June 5. The tarps from treatment #1 were removed on June 4, treatment #2 on June 18, treatment #3 on July 2, and treatment #4 on July 16. On July 20, all beds were rototilled to a depth of 1 inch. They were then shaped, planted to cantaloupe, var. Topmark, and irrigated on the same day.

Visual ratings of weed control were taken on August 19 (Table 1). Weeds present were common purslane (*Portulaca oleracea* L.) and tumble pigweed (*Amaranthus albus* L.).

Table 1 - Weed Control and Yield from Soil Solarization Treatments

Treatment	Weed Control (Percent)	Total Yield	Marketable Yield	Percent Marketable	Percent Sugar
0 weeks	0.0	131785 b	93770 b	71.2	11.22
2 weeks	37.5	186503 ab	150342 ab	80.6	11.12
4 weeks	90.0	192011 ab	153870 ab	80.2	11.22
6 weeks	100.0	220603 a	183650 a	83.2	10.6

Weeds present - common purslane and tumble pigweed

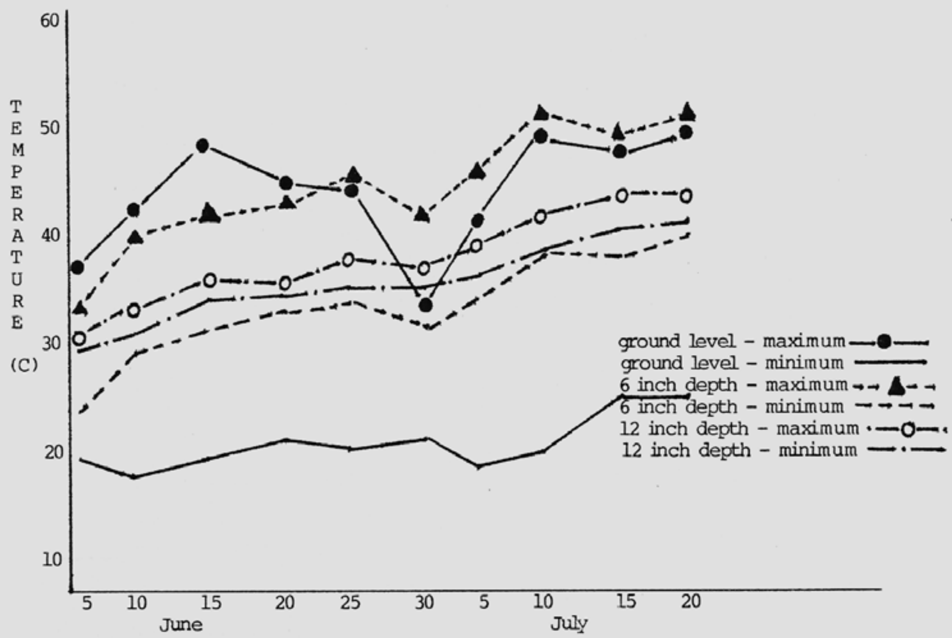
Yield in grams.

Numbers followed by the same letter are not significantly different at the 5% level according to Duncan' Multiple Range Analysis.

Yield data were gathered from a 40 foot section of each plot. Hand harvest of mature cantaloupes was performed on 5 days (October 13, 15, 18, 20 and 22). Each cantaloupe was weighed and graded for three quality characteristics (net, ground spot, and sunburn). The grade characters, in addition to weight, were used to determine marketability. Five melons from each sample were tested for sugar content using a refractometer. Results are presented in Table 1.

Temperatures were recorded daily using 3 thermograph probes. One probe was placed at ground level, another at 6 inches below ground level under the tarp and the third at 12 inches below ground level under a tarp. Temperature ranges are presented graphically in Figure 1.

Figure 1- Ground Level and Soil Temperatures



Results and Discussion

Soil solarization was shown to be an effective weed control method for the weeds present. Tarping appears to be required for a period of 4 to 6 weeks for beneficial results (Table 1). However, 6 weeks or tarping was necessary for a significant increase in yield over the untarped control.

All of the tarped treatments had a higher percentage of marketable fruit compared to the untarped control. This is probably due to the lower weed infestation around the fruit rather than to some beneficial aspect of tarping.

Maximum soil temperature below the tarp at the 6 inch depth exceeded the ground level temperature on most days from June 27 to July 16. Minimum temperatures at both the 6 and 12 inch depths exceeded the ground level throughout the experiment. These temperatures by themselves may not be sufficient to be lethal to the weeds present. It is felt by some (1) that sublethal temperatures may induce weed kill by causing germination in moistened soil and subsequent kill of the seedlings or by indirect kill by microorganisms.

At present, the method is probably too expensive and too inconvenient for immediate commercial application on a large scale. One objective of this experiment was to test the feasibility or tarping bed tops rather than flat ground. This bed top method offers two advantages, one is cost decrease by reducing the amount of plastic required, the other is convenience, since beds are made before tarping and don't have to be altered before planting. Results demonstrate the feasibility of this method.

One drawback to using plastic technology is the removal and disposal of the plastic. Low cost photodegradable plastics would make this technique more attractive.

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THE EFFECT OF SEVEN HERBICIDES ON THE ELEMENTAL STATUS OF CELERY (*APIUM GRAVEOLENS*)

W. J. Chism and M. J. Snyder[1]

Abstract: Seven herbicides were applied to transplanted celery as pre- or postemergent treatments to determine their effects on the levels of twelve nutrients at harvest. The preemergent treatments were linuron, pendimethalin and trifluralin. nhe postemergent treatments were chloroxuron, nitrofen, exyfluorfen and prometryn. The nutrients were total nitrogen, phosphorus, potassium, magnesium, calcium, sodium, iron, aluminum, manganese, boron, copper and zinc.

None of the herbicide treatments significantly affected plant populations or fresh weight at the time of harvest. Two herbicides significantly affected the level of more than one element. Prometryn significantly reduced the levels of five elements (phosphorus, magnesium, calcium, sodium and manganese) and tended to reduce the levels of four other elements (potassium, iron, aluminum and zinc) although not at significant levels. Linuron significantly increased the levels of three elements (magnesium, calcium and manganese) and tended to increase the level of five other elements (phosphorus, sodium, iron, copper and zinc) although not at significant levels.

Introduction

Recent work by several authors (5, 8, 9, 12) has focused on the effects of herbicides on the level of plant nutrients in terms of vitamins, minerals and elements. While this work did not show any nutritional response due to the effects of herbicides it indicates that researchers are beginning to delve into the effects of seven different herbicides (linuron, pendimethalin, trifluralin, chloroxuron, nitrofen, oxyfluorfen, and prometryn) on the levels of twelve elements (nitrogen, phosphorus, potassium, magnesium, calcium, sodium, iron, aluminum, manganese, boron, copper and zinc) in celery.

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Materials and Methods

On March 18, 1981, celery (Apium graveolens) cultivar 52 70 R. Improved, was mechanically transplanted into a sandy loam soil near Guadalupe, CA. The first herbicide treatments were applied immediately after transplanting to celery in the 2-3 true leaf stage of development. At this time, no weeds had emerged and the treatments were made preemergent to the weeds and postemergent to the crop. These preemergence treatments were sprinkler incorporated for 6 hours immediately after application (equivalent to 1.5 inches of water). A second set of herbicide treatments were applied on April 41. These treatments were made postemergent to the weeds when the plants were in the 4-5 true leaf stage of development.

The herbicides were tested at the following rates, chloroxuron (3[p-(p-chlorophenoxy) phenyl]-1, 1-dimethylurea) at 2.0 lbs a.i. (acitive ingredient per acre), linuron (3-(3,4-dichorophenyl) 1-methoxy-1-methylurea) at 1.0 lb a.i., nitrofen (2,4-dichlorophenyl-p-nitrophenyl ether) at 4.0 lbs a.i., oxyfluorfen (2-chloro-1-(3-ethoxy-4-nitrophenyloxy)-4-(trifluoromethyl) benzene) at .125 lb.s a.i., pendimethalin (N-(1-ethylproply)-3,4-dimethyl-2,6-dinitrobenzenamine) at 1.0 lb a.i., prometryn (2,4-bis (isopropylamino)-6-(methylthio)-s-triazine) at 1.0 lb a.i., and trifluralin (α,α,α,-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) at 4.0 lbs a.i. These rates were selected as being the most desirable in terms of weed control and minimum crop phytotoxicity. The treated plots were one bed (38 inches) wide by 15 feet long with four replications per treatment. All treatments were made with a CO_2 backpack sprayer with 3 (Teejet 8002) nozzles set to apply 40 gallons of diluent per acre.

The celery was evaluated for crop responses in phytotoxicity, plant stand, harvest weights and nutrient status for twelve different elements. Weed control was not evaluated in this trial due to the erratic distribution of weeds in the trial site. The evaluation of crop phytotoxic response was a visual estimate of the damage to the celery that the herbicides had elicited. The evaluation was made during the growing season and was based on a 0 to 10 scale where 0 represents no damage and 10 represents loss of the entire crop. At the time of harvest treated plants were evaluated for effects on plant stand and plant fresh weight. This harvest data was obtained on June 22, 1981 (96 days after transplanting). The harvest procedure consisted of removing the celery at ground level from the middle 10 feet of each plot, trimming it to 14 inches (the standard market length), then counting and weighing the total number of marketable stalks. Only the celery that was of marketable size (60 stalks per carton or larger) was counted and weighed since that was felt to be a better estimate of effects due to the herbicides and would mask out the effects of weak transplants in the trial area.

In addition to the harvest data a nutritional analysis was made on celery samples taken at the time of harvest. These samples were analyzed by A & L Agricultural Labs in Modesto, CA. This analysis was conducted to determine any effects the herbicides might have on the nutritional makeup of celery. The material analyzed consisted of four samples of ten celery petioles which had dried for 48 hours at 95°F.

The celery was analyzed for total nitrogen by the macro Kjeldahl method modified to include nitrates (4). Boron was analyzed using a dry ash method and curcurmin as a reagent using a photoelectric colorimeter (3). The remaining elements, phosphorus, potassium, magnesium, calcium, sodium, iron, aluminum, manganese, copper and zinc were analyzed by forming a perchloric wet ash solution with analysis by atomic absorption spectrophotometry.

Statistical analysis was performed by using an analysis of variance test (10) and an F test to determine significant difference (at the 95% confidence level) between means. Comparisons between means were performed using Duncan's New Multiple Range Test (6). This is an adjusted test for simultaneous comparison of more than one treatment.

Results and Discussion

The celery trial was visually evaluated on April 11 (4 weeks after transplanting), May 1 (6 weeks after tranplanting), and on May 16 (8 weeks after transplanting) to determine the phytotoxic response of the crop to these herbicides. These early phototoxicity ratings indicate that the linuron, pendimethalin and oxyflurofen treatments may be effecting the growth of the celery (Table 1).

On June 22, the test plots were harvested to determine the herbicides effects on plant stand and harvest weight. In this experiment none of the treatments showed any significant difference (at the 95% confidence level) in plant stand or harvest weight (Table 1).

Samples from each treatment were analyzed to determine their effects on the nutritional status of celery (see Table 2). The analysis was done as either a percent by weight (for the nitrogen, phosphorus, potassium, magnesium, calcium, or sodium) or as a parts per million by weight (for the iron, aluminum, manganese, boron, copper, or zinc) basis on dried petiole samples.

The analysis of the different herbicides for their effects on nitrogen level showed no significant differences. The values went from a low of 1.45% for the trifluralin sample to a high of 1.73% for the oxyfluorfen sample (see Figure 1).

The analysis of the treatments for herbicide effects of phosphorus showed significant differences. The lowest level was found in the prometryn sample with 0.47% P followed by oxyfluorfen with 0.50% P and pendimethalin with 0.54% P. The highest levels of phosphorus were found in linuron at 0.64%, nitrofen at 0.64% and chloroxuron at 0.64%. The remaining treatments showed little variation in phosphorus level with pendimethalin, trifluralin, oxyflourfen and with control all falling from 0.54 to 0.58 percent (see Figure 2).

Tissue analysis for potassium showed to statistical difference between any of the treatments. The range of values went from a low of 3.43% K for prometryn to a high of 4.17% K for nitrofen (see Figure 3).

Analysis for magnesium showed significant differences between several of the treatments (see Figure 4). The lowest level was found in the prometryn sample at 0.19% Mg while the highest levels were found in nitrofen, chloroxuron and linuron at 0.25, 0.26 and 0.27 percent Mg, respectively. Four of the treatments, oxyfluorfen, trifluralin, pendimethalin and the control, were not significantly different and had values between 0.21 and 0.24 percent Mg.

The analysis of calcium showed essentially three statistically different groups. The lowest level was found in the prometryn sample with 0.65% Ca. The highest levels were found in the pendimethalin, chloroxuron, nitrofen and linuron samples ranging from 0.85 to 0.98 percent Ca. Three of the treatments, trifluralin, oxyfluorfen and control fell into a middle range of 0.73 to 0.84 percent Ca (see Figure 5).

Table 1. The phytotoxic and quantitative evaluation of celery treated with seven different herbicides.

Transplanted: March 18, 1981 Harvested: June 22, 1981

TREATMENT	RATE (lbs. a.i.)	APPLIED	Crop Phytotoxicity Rating[1]			Harvest Date	
			4/11	5/1	5/16	Plants per ten feet[2]	Whole plant Wt. ten ft.[2]
linuron	1.0	Pre.	2.5	3.5	3.25	26.0	49.06
pendimethalin	1.0	Pre.	.75	2.5	3.5	27.25	52.75
trifluralin	4.0	Pre.	1.25	2.75	2.75	29.5	46.81
chloroxuron	2.0	Post.		2.25	2.25	28.75	51.06
nitrofen	4.0	Post.		2.75	1.75	28.25	56.13
oxyfluorfen	.125	Post.		5.25	3.0	28.5	54.13
prometryn	1.0	Post.		3.25	2.5	27.5	55.63
control			1.25	2.25	1.75	27.75	53.38

1. Crop Phytotoxicity; 0 is equal to no damage
10 is equal to the death of all plants

2. No significant differences exist among treatments.

Table 2. An Analysis of twelve different elements in celery as affected by seven different herbicides.

Transplanted: March 18, 1981 Harvested: June 22, 1981

PERCENT BY WEIGHT[1]

TREATMENT	NITROGEN[2]	PHOSPHORUS[3]	POTASSIUM[2]	MAGNESIUM[3]	CALCIUM[3]	SODIUM[3]
linuron	1.61 (1.54-1.70)	.64 de (.53-.83)	3.70 (3.31-4.13)	.27 e (.23-.32)	.98 d (.85-1.22)	2.13 de (1.96-2.40)
pendimethalin	1.64 (1.56-1.71)	.54 abc (.55-.57)	3.66 (3.54-3.90)	.23 bc (.22-.25)	.85 bcd (.80-.38)	1.82 ab (1.71-1.89)
trifluralin	1.45 (1.30-1.54)	.59 cde (.58-.61)	3.73 (3.24-3.98)	.23 bc (.21-.25)	.73 ab (.65-.83)	2.00 bcd (1.89-2.10)
chloroxuron	1.61 (1.49-1.77)	.67 e (.62-.72)	4.12 (3.98-4.32)	.26 de (.25-.27)	.95 cd (.90-1.03)	2.23 e (2.19-2.28)
nitrofen	1.58 (1.47-1.66)	.64 de (.58-.70)	4.17 (3.93-4.42)	.25 cde (.22-.29)	.97 d (.82-1.17)	2.15 de (1.92-2.32)
oxyfluorfen	1.73 (1.68-1.79)	.50 ab (.45-.54)	3.60 (3.28-3.90)	.21 ab (.20-.22)	.79 b (.72-.86)	1.93 bc (1.86-2.05)
prometryn	1.70 (1.59-1.93)	.47 a (.45-.49)	3.43 (3.34-3.54)	.19 a (.17-.20)	.65 a (.61-.68)	1.74 a (1.50-1.87)
control	1.63 (1.51-1.74)	.58 bcd (.57-.60)	3.79 (3.69-3.86)	.24 bcd (.22-.25)	.84 bc (.82-.86)	2.03 cd (1.95-2.15)

PARTS PER MILLION[1]

TREATMENT	IRON[2]	ALUMINUM[2]	MANGANESE[3]	BORON[2]	COPPER[2]	ZINC[2]
linuron	122 (98-162)	43 (33-53)	31 c (23-39)	34 (24-42)	5 (4-6)	26 (22-31)
pendimethalin	110 (96-132)	42 (37-48)	28 b (26-29)	38 (32-42)	4 (3-4)	24 (23-25)
trifluralin	89 (75-116)	29 (20-42)	28 b (23-31)	46 (43-50)	4 (4)	26 (20-35)
chloroxuron	90 (73-98)	26 (13-45)	27 b (24-30)	39 (37-42)	5 (4-6)	28 (25-30)
nitrofen	77 (65-92)	57 (37-83)	27 b (23-32)	41 (39-42)	5 (4-6)	25 (22-27)
oxyfluorfen	84 (71-93)	24 (18-31)	21 ab (20-22)	30 (13-43)	4 (4)	21 (18-24)
prometryn	94 (50-128)	23 (14-36)	17 a (16-19)	45 (42-48)	4 (3-4)	21 (19-25)
control	114 (72-194)	44 (24-77)	28 b (23-34)	38 (34-42)	4 (4-5)	25 (20-31)

1. Average value over (range).
2. No significant differences exist among treatments.
3. Significant differences exist at the .05% level. Treatments with the same letter are not significantly different at the .05% level.

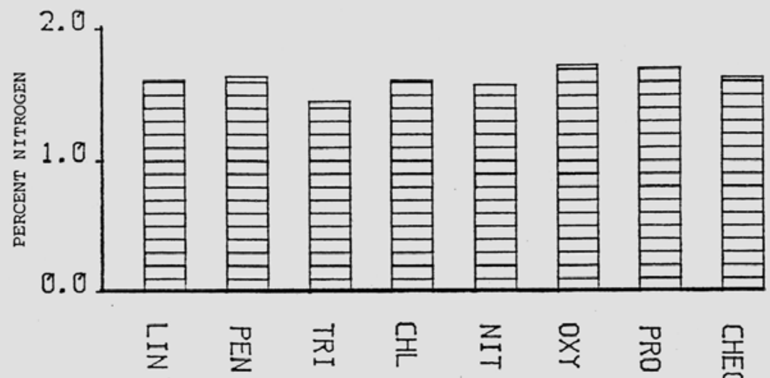

Figure 1. *The percent nitrogen level for celery as affected by seven different herbicides. No significant differences exist between treatments.*

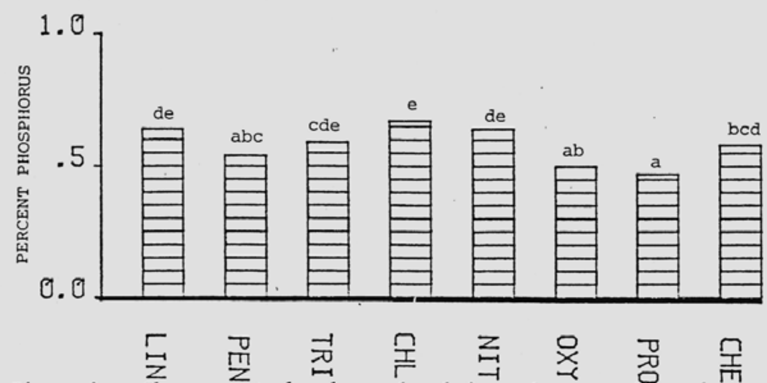

Figure 2. *The percent phosphorus level for celery as affected by seven different herbicides. Treatments with the same letter are not significantly different (.05%).*

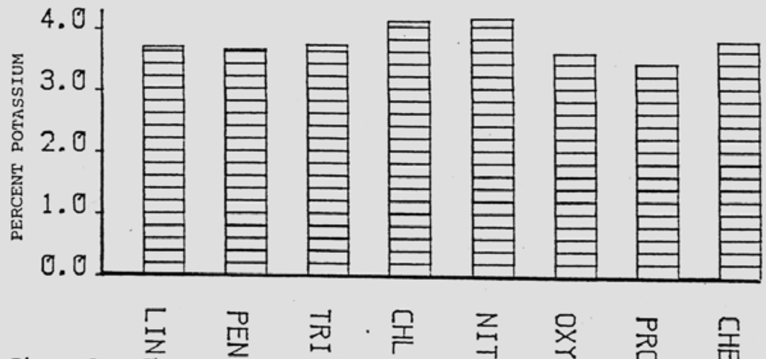

Figure 3. *The percent potassium level for celery as affected by seven different herbicides. No significant differences exist between treatments.*

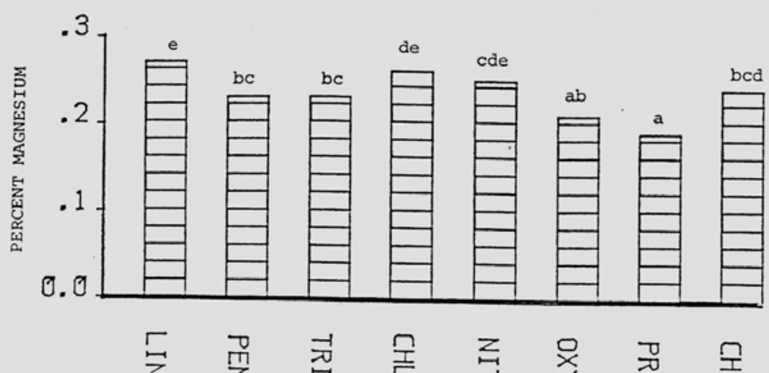

Figure 4. *The percent magnesium level for celery as affected by seven different herbicides. Treatments with the same letter are not significantly different (.05%).*

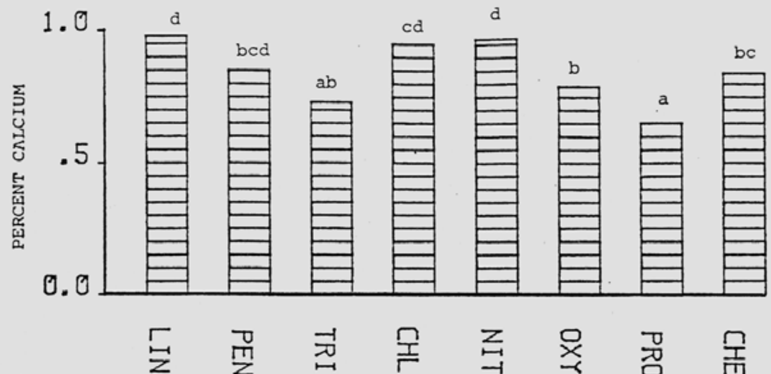

Figure 5. *The percent calcium level for celery as affected by seven different herbicides. Treatments with the same letter are not significantly different (.05%).*

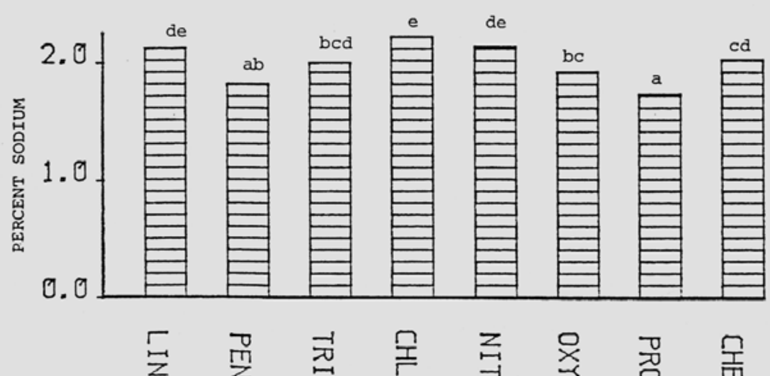

Figure 6. *The percent sodium level for celery as affected by seven different herbicides. Treatments with the same letter are not significantly different (.05%).*

The analysis of sodium displayed three statistically different groups. The low group consisted of prometryn with 1.73% Na and pendimethalin with 1.87% Na. A middle group consisting of oxyfluorfen, trifluralin and the control which had between 1.93 to 2.03 percent Na. The highest Na content was found in the nitrofen, linuron and chloroxuron samples with a range of 2.15 to 2.23 percent Na (see Figure 6).

The analysis of iron displayed no significant differences between any of the treatments. The lowest level was found in the nitrofen treatment at 77 ppm and the highest level was found inthe linuron treatment at 122 ppm Fe (see Figure 7).

There were no detectable differences between any of the treatments when analyzed for levels of aluminum. The lowest level of 23 ppm Al was found in the prometryn sample while the highest level of 43 ppm Al was found in the linuron sample (see Figure 8).

The statistical analysis of manganese level showed three groups. The lowest level of manganese was found with preometry at 17 ppm Mn and oxyfluorfen at 21 ppm Mn. The highest levels were found in the linuron treated samples with 31 ppm Mn. The remaining treatments fell in between these two extremes. This group had values from 27 to 28 ppm Mn (see Figure 9).

The levels of boron found in the different samples were not significantly different. The lowest level of boron was found in oxyfluorfen at 30 ppm B and the highest level was found in trifluralin at 46 ppm B (see Figure 10).

The analysis of copper indicated no statistically significant differences between the treatments. The lowest level of copper was 4 ppm found in pendimethalin, trifluralin, oxyfluorfen, prometryn and control. The highest level of copper was 5 ppm found in linuron, chloroxuron and nitrofen samples (see Figure 11).

The analysis of zinc indicated no significant differences between any of the treatments. The lowest level of zinc was found in the prometryn and oxyfluorfen samples both at 21 ppm Zn. The highest level of zinc was found in the chloroxuron and trifluralin samples both at 28 ppm Zn (see Figure 12).

Conclusion

Seven herbicides were applied to transplanted celery (*Apium graveolens*) in the spring of 1981. The seven herbicides were linuron, pendimethalin, trifluralin, chloroxuron, nitrofen, oxyfluorfen and prometryn. There were no significant differences between any of the treatments in terms of plant population or the weight of plants at harvest. These treatments were analyzed to determine their effects on the nutritional composition of celery. One material, prometryn, significantly reduced the levels of five elements (phosphorus, magnesium, calcium, sodium and manganese). It reduced the levels of four other elements (potassium, iron, aluminum and zinc) even though statistical differences were not shown. Linuron significantly raised the levels of three elements (mangnesium, calcium and manganese). In addition it raised the level of five other elements (phosphorus, sodium, iron, copper and zinc) even though statistical differences were not shown. The remaining five herbicides (pendimethalin, trifluralin, chloroxuron, nitrofen and oxyfluorfen) had no significant effects on the overall nutritional value of the celery plant.

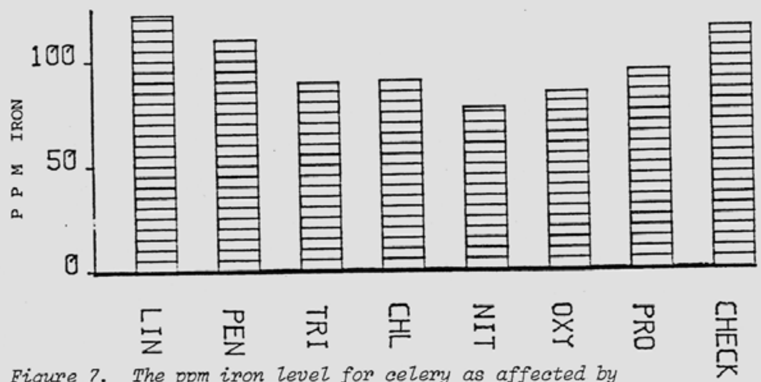

Figure 7. *The ppm iron level for celery as affected by seven different herbicides. No significant differences exist between treatments.*

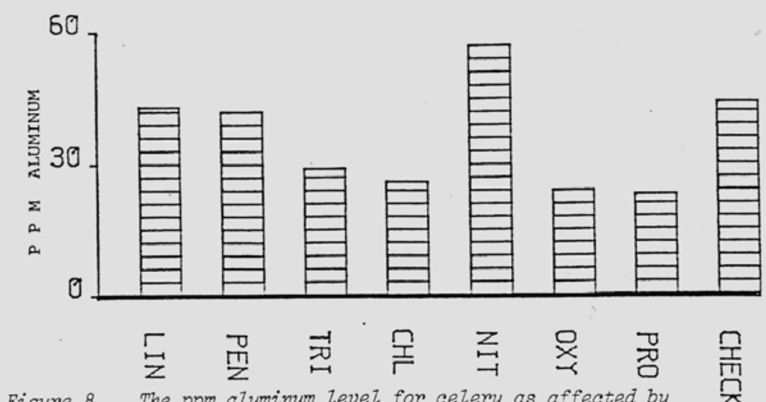

Figure 8. *The ppm aluminum level for celery as affected by seven different herbicides. No significant differences exist between treatments.*

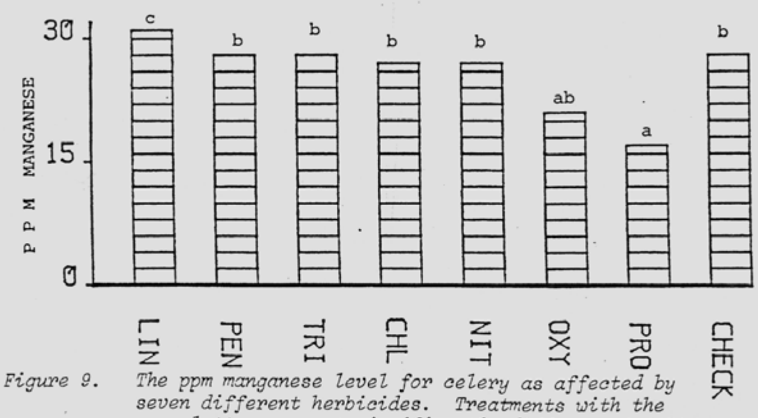

Figure 9. *The ppm manganese level for celery as affected by seven different herbicides. Treatments with the same letter are not significantly different (.05%).*

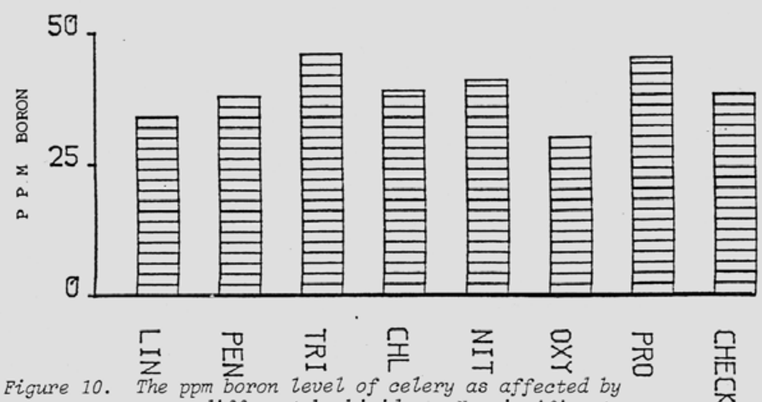

Figure 10. *The ppm boron level of celery as affected by seven different herbicides. No significant differences exist between treatments.*

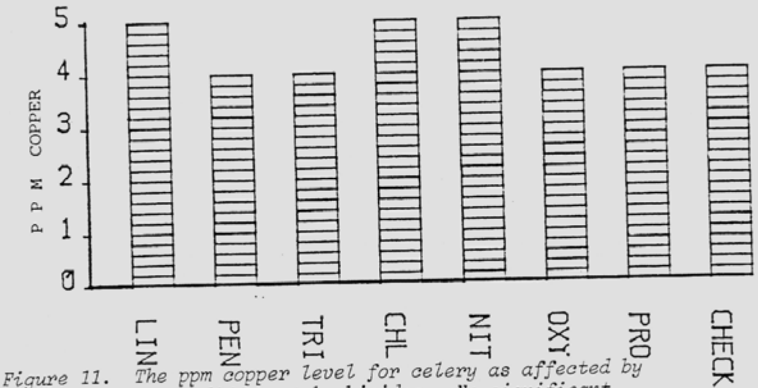

Figure 11. *The ppm copper level for celery as affected by seven different herbicides. No significant differences exist between treatments.*

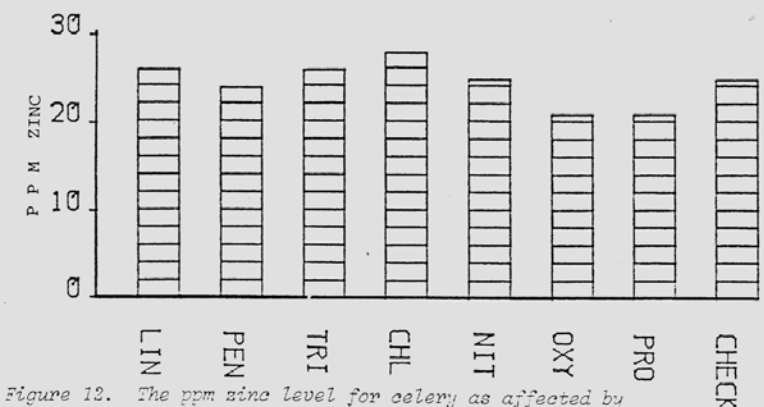

Figure 12. *The ppm zinc level for celery as affected by seven different herbicides. No significant differences exist between treatments.*

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POST-BLOSSOM APPLICATIONS OF OXYFLUORFEN TO TREE FRUIT AND NUTS

L. D. West, R. C. Hildreth, and J. T. Schlesselman[1]

Abstract: Oxyfluorfen (2-chloro-1-[3-ethoxy-4-oxyfluorfen]-4-[triflouromethyl] benzene) has been registered for non-dormant applications to trees and vines in California since 1981. A cut-off date of February 15 was imposed to prevent treatment of registered crops in blossom. This study was done to evaluate the effects of oxyfluorfen applications after blossom in tree fruit and nuts. The objectives of this work were twofold: 1) to determine the tolerance of treefruit and nuts to oxyfluorfen when applied after blossom and 2) to determine the effectiveness of oxyfluorfen, both alone and in combination with other herbicides, in controlling summer annual weeds.

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[1]Rohm and Haas Co., Fresno, CA 93710

Tests were established in almonds, stone fruit, walnuts and pistachios throughout the San Joaquin Valley in the spring and summer of 1982. Single-tree treatments were applied 30, 60 and 90 days after petal fall.

In our studies, oxyfluorfen was quite safe when applied 30 days or more after petal fall to the tree fruit and nut crops tested. Oxyfluorfen plus either glyphosate or paraquat provided excellent short-term broad-spectrum control of summer annual weeds.

POSTEMERGENCE HERBICIDE DRIFT ON POTATOES

L. C. Haderlie, P. W. Leino, and S. W. Gawronski[1]

Abstract: Drift rates of dicamba (3,6-dichloro-*o*-anisic acid), 2,4-D [(2,4-dichlorophenoxy) acetic acid], glyphosate [N-(phosphono-methyl) glycine], bromoxynil (3,5-dibromo-4-hydroxybenzonitrile), and MCPA [(4-chloro-*o*-tolyl)oxy] acetic acid, were applied separately and in combinations to potato (Solanum tuberosum) vines at early flower (8 July 1982). Dicamba was applied three weeks before planting to simulate carryover from treating grain the previous year.

Potato vines had dicamba symptoms from dicamba carryover soon after potato emergence. Dicamba symptoms were apparent all season and included rolling and cupping of leaves and bending of the stems. Yields were decreased from all carryover rates and up to 64% at highest rate (Table 1) but tubers had few or no external abnormalities.

Foliar symptoms from drift became apparent between 1 and 3 weeks after application depending on rate and remained throughout the season for each herbicide. The high drift rates used for each herbicide were not too far below low rates used for weed control. One of the first foliage symptoms from dicamba drift was a quicker flower drop and greater fruit development. Dicamba symptoms on potato foliage from spray drift were stem bending, leaf cupping and leaf veins appearing parallel. Higher rates of dicamba drift decreased yield and percentage No. 1's (Table 1). The highest two dicamba drift rates (0.06 and 0.11 kg/ha) caused 66 and 88% of the tubers, respectively, to have an ulcer or elephant hide appearance on the skin and/or creasing or folding character of the tuber. Dicamba + 2,4-D also caused some of this same type of malformation up to 40% of the tubers harvested. The elephant hide appearance was definitely not as serious on the dicamba + 2,4-D as with dicamba alone at the high rate. Also dicamba + 2,4-D (0.03 plus 0.11 kg/ha) caused a malformation of tuber eyes which resembled a target bull's eye on 38% of the tubers from these plots on the bud end of the tuber. Foliar symptoms of 2,4-D were parallel veins, slight leaf cupping and stem curling (epinasty). Tuber yields were slightly reduced for 2,4-D drift but only at the highest rate was the percentage of No. 1's decreased. In fact, percentage No. 1's for the low 2,4-D rate were slightly greater than the untreated. Foliar symptoms from glyphosate drift were yellowing (chlorosis) on the newest leaves. Veins remained green longer than interveinal leaf tissues, such as was found in iron deficiency sumptoms. Glyphosate foliar symptoms were somewhat similar to leafroll symptoms except that leaf rolling is less distinct at drift rates and the newest leaves, rather than

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[1]University of Idaho, Research and Extension Center, Aberdeen, ID.

Yield and percentages (of total in each grade) from herbicide carryover or drift to potatoes at Aberdeen, Id in 1982 (Data are means of four replications)

Herbicide	Post Kg/ha	Pre-Plant kg/ha	Total cwt/A	Yield t/ha	U.S. #1's cwt/A	U.S. #1's %	Percent <4 oz	Percent 4-10 oz	Percent >10 oz	Percent Mal-frmd
1. Untreated			334	37.4	155	46	20	28	18	34
2. Dicamba		0.06	267	29.9	130	47	25	35	11	28
3. "		0.11	248	27.8	102	41	28	30	11	31
4. "		0.60	121	13.5	45	38	38	31	7	25
5. "	0.01		342	38.3	171	50	24	39	11	26
6. "	0.06		249	27.8	24	9	33	9	1	58
7. "	0.11		284	31.7	52	19	40	18	1	41
8. " +2,4-D	0.03+0.11		281	31.5	76	27	24	24	4	50
9. " +2,4-D	0.06+0.11		262	29.4	39	15	43	15	0	42
10. 2,4-D	0.01		310	34.7	166	53	22	35	18	25
11. "	0.06		286	32.0	133	47	25	37	10	28
12. "	0.11		312	34.9	129	41	28	34	8	30
13. "	0.22		280	31.3	73	27	31	21	6	42
14. Glyphosate	0.01		324	36.3	137	42	19	28	14	39
15. "	0.06		244	27.3	89	38	28	28	10	34
16. "	0.11		289	32.3	72	25	29	20	5	46
17. "	0.22		167	18.7	10	5	40	5	0	54
18. Bromoxynil	0.01		298	33.4	144	48	21	30	18	31
19. "	0.06		293	32.8	131	45	22	31	14	33
20. "	0.11		250	28.0	118	48	24	30	18	28
21. "	0.22		249	27.9	93	37	22	28	9	41
22. " +MCPA	0.01+0.01		324	36.2	157	49	22	35	14	29
23. " "	0.06+0.06		329	36.8	129	38	26	31	8	35
24. " "	0.11+0.11		239	26.8	63	27	27	23	4	47
LSD 0.05			57	6.4	42	12	10	10	6	14
C.V.			15	14.9	29	24	25	28	45	28

oldest leaves, are the first to yellow in glyphosate. Vines sprayed with glyphosate were the first to die in the fall. Glyphosate caused tuber yield reduction at all rates except for the lowest, or the .01 kg/ha. The highest rate decreased yields 50% from that of the untreated, and the tubers were smaller and had greater malformations. At the high rate, 88% of the tubers in the glyphosate-treated plots had a folding or creased character. At the next highest rate, only 14% had this creased character, and the lower rates had none. Bromoxynil caused leaf burning (or necrosis) particularly on the leaf margins, and tuber yields were decreased 25% at the highest rate. Bromoxynil plus MCPA gave stronger foliar symptoms than with bromoxynil alone and included some 2,4-D-like symptoms. Yields were only reduced at the highest bromoxynil plus MCPA rate which was nearly 30%. Except where mentioned, no external tuber malformations were observed. Further evaluations will be made on stored potatoes looking for tuber dehydration, internal qualities, and seed quality.

COMPETITION OF ANNUAL WEEDS IN BROCCOLI

H. S. Agamalian[1]

Abstract: The economic impact of annual broadleaf weed competition with direct-seeded broccoli (*Brassica oleracea* L.) has increased due to limited herbicidal treatments.

Several studies were established using cheeseweed (*Malva parviflora* L.), black nightshade (*Solanum nigrum* L.), sowthistle (*Sonchus oleraceus* L.), and common groundsel (*Senecio vulgaris* L.). These field trials were conducted during winter-spring and summer periods of production.

Natural weed densities were used and weed removal was obtained at three stages of broccoli growth. Crop yield losses were assessed on total units of production and reduced broccoli spear quality based on marketable criteria.

Cheeseweed populations of 3 and 8 weeds per square meter reduced yields 25 and 52 percent respectively, when left to full broccoli maturity. Similar populations of black nightshade reduced broccoli yields 33 and 50 percent respectively in tests conducted during summer growing periods. Competitive relationships of sowthistle resulted in 28 and 40 percent reduction in broccoli spear weights at 3 and 8 weeds per square meter. The shorter growth stature of winter-sown hybrids has increased the competitive ability of common groundsel. This weed species caused broccoli yield reductions of 18 and 30 percent respectively, at the above densities.

Reduced individual spear size was measured in all densities when competition was retained throughout crop maturity.

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[1]U.C. Cooperative Extension, Salinas, CA.

POSTEMERGENCE BROADLEAF WEED CONTROL IN ONIONS WITH OXYFLUOROFEN

J. Klauzer[1]

Abstract: Oxyfluorfen [2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene] has shown promise for controlling many broadleaf weeds found in onion fields of the intermountain area. Rohm and Haas Company has evaluated oxyfluorfen as a postemergent herbicide in onions, at rates of .125, .25, and .5 lb/A. Excellent control of hairy nightshade, redroot pigweed and venice mallow was provided with oxyfluorfen, when treated at 1 to 2 true leaf stage of the onions. Multiple applications of oxyfluorfen, 7 to 10 days apart, were needed to achieve good control of kochia, common lambsquarters and common sunflower. Crop stand counts were taken and no irregular reductions were observed where the oxyfluorfen was applied after the first true leaf of the onions. Excellent crop tolerance was shown in direct-seeded bulb; transplanted and seed onions.

[1]Rohm and Haas Company, Boise, ID.

A SIMPLIFIED KEY TO IDENTIFICATION OF WEEDY PLANT FAMILIES

R. L. Chase[1]

County agents and other weed workers often have had no taxonomic training and, therefore, often have difficulty in identifying weeds. To thumb through an identification manual just isn't very effective. As a result, many plants are sent to weed specialists every year to be identified. If weed workers could identify plants down to family, they could then thumb through that family section of an identifiction manual or manuals and likely identify the plant.

The simplified key that follows is for identification of major weedy plant families. The key utilizes floral characteristics, and it is, therefore, necessary to locate floral parts of the plant to be identified.

Workshops have been held for the last two years with County Agents, Weed Supervisors, and District Agricultural Inspectors to teach them use of the key. Plants representing the major weedy plant families were collected prior to the day of the workshop and stored in an ice chest. General botany was reviewed, then participants were given plants and the whole group went through the key together. After that they worked in pairs. At the end of the workshop, most expressed satisfaction at their ability to identify several plant families.

[1]Plant Science Department, Utah State University, Logan, UT.

WEEDY PLANT FAMILIES

Simplified Key

Monocots

Cyperaceae - sedges
Gramineae - grasses
Juncaceae - rushes
Liliaceae - lilies

Dicots

Corolla absent

Amaranthaceae - pigweed
*Caryophyllaceae - pink
Chenopodiaceae - goosefoot
Euphorbiaceae - spurge
*Ranunculaceae - buttercup
Urticaceae - nettle

Dicots

Corolla present

I. Petals not united

A. Ovary inferior

*Portulacaceae - purslane
Umbelliferae - carrot

B. Ovary superior

*Caryophyllaceae - pink
Cruciferae - mustard
Geraniaceae - geranium
*Leguminosae - legume
*Malvaceae - mallow
Polygonaceae - buckwheat
*Portulacaceae - purslane
*Ranunculaceae - buttercup

II. Petals united

A. Stamens more than 5

*Leguminosae - legume
Malvaceae - mallow

B. Stamens 5 or less

1. Ovary inferior

Compositae - composite
Cucurbitaceae - cucurbit
Rubiaceae - madder

2. Ovary superior

a. Corolla irregular

Labiatae - mint
Scrophulariaceae - figwort

b. Corolla regular

Asclepiadaceae - milkweed
Boraginaceae - borage
Convolvulaceae - morning glory
Plantaginaceae - plantain
Solanaceae - nightshade

* found elsewhere in the key.

WEEDY PLANT FAMILIES

Simplified Key

Monocots

Cyperaceae - sedges
Gramineae - grasses
Juncaceae - rushes
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Dicots

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Amaranthaceae - pigweed
*Caryophyllaceae - pink
Chenopodiaceae - goosefoot
Euphorbiaceae - spurge
*Ranunculaceae - buttercup
Urticaceae - nettle

Dicots

Corolla present

I. Petals not united

A. Ovary inferior

*Portulacaceae - purslane
Umbelliferae - carrot

B. Ovary superior

*Caryophyllaceae - pink
Cruciferae - mustard
Geraniaceae - geranium
*Leguminosae - legume
*Malvaceae - mallow
Polygonaceae - buckwheat
*Portulacaceae - purslane
*Ranunculaceae - buttercup

II. Petals united

A. Stamens more than 5

*Leguminosae - legume
Malvaceae - mallow

B. Stamens 5 or less

1. Ovary inferior

Compositae - composite
Cucurbitaceae - cucurbit
Rubiaceae - madder

2. Ovary superior

a. Corolla irregular

Labiatae - mint
Scrophulariaceae - figwort

b. Corolla regular

Asclepiadaceae - milkweed
Boraginaceae - borage
Convolvulaceae - morning gl
Plantaginaceae - plantain
Solanaceae - nightshade

* found elsewhere in the key.

POISONOUS EXOTIC PLANTS

M. C. Williams[1]

Abstract: Toxicological studies were conducted on the following exotic plants that cause poisoning in livestock: mother-of-millions (*Kalanchoe daigremontiana* Hamet & Perrier), palo santo (*Bulnesia sarmientii* Lorentz), and horsechestnut (*Aesculus hippocastanum* L.). The plants were examined for toxic compounds and toxicity to two-week-old Leghorn chicks.

Mother-of-millions, a succulent of the Crassulaceae, contained a poison that caused drowsiness, muscular incoordination, nervous twitching in the neck, trembling in the legs, paralysis, and death. The poison, not yet identified, was soluble in ethanol, slightly soluble in water and acetone, and insoluble in benzene, chloroform and ether. The dried leaves produced visible toxic signs when fed at 6 mb of plant/g of body weight and were fatal within 24 hours when fed at 16 mg/g. Stems produced toxic signs but no deaths when fed at 20 mg/g.

The palo santo tree, a member of the Zygophyllaceae, produces an abundance of seeds that contain a toxic saponin. Toxic signs included torpor, paralysis, and death. The toxic and lethal doses for chicks were 6 mb and 13 mg of plant/g respectively.

The seeds of horsechestnut contain the glycoside aesculin. This ornamental tree of the Hippocastanaceae is often confused with the edible chestnut but is not related to it. Toxic signs include torpor, sudden collapse, and death. A dose of 12 mg of dried seed/g of body weight killed 80% of the chicks and a dose of 16 mg/g was uniformly fatal.

[1]Poisonous Plant Research Laboratory, Utah State University, Logan, UT.

WILD OAT IN CALIFORNIA: A REVIEW

L. W. Mitich[1]

"Youth ne'er aspires to virtues perfect grown
Till his wild oats by sown." --Thomas Nashe, 1600.

Wild oat (*Avena fatua* L.) is an ancient weed. Archaeological evidence shows that wild oat infested cereals from the Early Iron Age (700 to 500 BC) (14). The place of origin was probably Southwest Asia, especially the Pamir, from where it moved both westward and eastward, initially through the activities of Neolighic man (14). In more recent centuries, the migration of Caucasian peoples carried wild oat far and wide. Holm et al. (13) reported that wild oat is now a weed of more than 20 crops and listed the 56 countries in which it occurs. They also ranked the countries according to the importance of the weed as shown in Table 1.

[1]University of California Cooperative Extension, Davis, CA.

Table 1. The importance of wild oat as a weed and the number of countries affected, Holm et al., 1979.

Category	Number of countries
Serious weed	8
Principal weed	14
Common weed	9
Present as a weed[a]	25
Present in flora[b]	3
Total	59

[a]Rank of importance is unknown.

[b]The species is known to be present in the flora of the country, but confirming evidence is needed that the plant behaves as a weed.

The major areas of wild oat distribution are North Africa, North America, South Africa, and most parts of Europe. Hay (9) calls wild oat the number one weed in the world in wheat and cereals; it is one of the three most important weeds in cereals in the U.S. Wood (15) reported that of 45 million hectares of wheat in the prairie provinces of Canada and northern U.S., wild oat was present in 23 million hectares, 12 million hectares being seriously infested.

Georgia (8) in 1914 wrote: "Sowing wild oats is proverbially a bad thing to do, but the wide distribution of this weed is almost entirely due to the practice of allowing it to enter the soil with its betters." Indeed, a drill box survey revealed that 54% of the seed stock in Canada and the U.S. contained wild oat seed (12). The awn on wild oat seed is hygroscopic and twists and turns with changes in moisture to bury the seed, thus enhancing its chance for survival.

There is no record of the year that wild oat first appeared in California but apparently it was introduced prior to 1800. Wild oat has been found in adobe bricks from the pulpit stair of Mission San Juan Bautista, San Benito County, which was constructed between 1805 and 1813 (10). Wild oat was also found in bricks from Vallejo Rancho near Petaluma, Sonoma County, which was erected 1834-1845 (10).

Bryant (5) wrote in 1848 that the hilly country between Livermore's ranch (near present day Livermore) and Mission San Jose was covered to the summits of the hills with wild oat and bunch grasses which provided sumptuous grazing for the cattle.

Bigelow (4) reported in 1856 that "from Cajon Pass to the sean, at San Pedro, is a distance of about 80 miles through a beautiful valley... grass and wild oats are abundant in the valley from one end to the other."

Since wild oat was an introduced species and had become abundant, what species did it replace? Barry (2) points out that the original appearance of California is not known and, hence, not a matter of historical record. The early accounts by Spanish explorers only mention that the prairie provided excellent pasture. Native perennial bunchgrasses are believed to have been far more abundant in pristine times but tended to disappear under the stress of competition from introduced species, heavy grazing, and cultivation (3). Barry (2) believes that purple needlegrass (*Stipa pulchra* Hitchc.) and nodding needlegrass (*S. cernua* Stebbins and Love) dominated the vast expanses of the Central Valley prairied in pristine times.

As agriculture developed in California, wild oat became a weed of major importance. Two million acres of wheat and barley are grown annually in the state and wild oat infests most of this acreage (11). Wild oat also is an important weed in cultivated grounds and waste places.

Allard (1) states that wild oat is one of the most successful colonizers of grassland, open woodland, and chapparral communities in California. The criteria for success in colonization are abundance and worldwide distribution in many diverse habitats. In fact, Allard lists wild oat as one of the 12 most successful colonizers in the world among the noncultivated plants. A major feature shared by a great majority of the notably successful colonizers, according to Allard (1), is a mating system involving predominant self-fertilization. Cytologically, wild oat in California is highly uniform and stable but it shows wide differences in morphological appearance and physiological behavior between populations and within populations.

Holm et al. (12) reported that 16,000 hectares of wild oat are used for hay in the interior and coastal valleys of California and that wild oat has 90% of the food value of cultivated oats. In addition to *Avena fatua*, slender oat, *A. barbata*, also is an important component of the range flora in the foothills of California (6).

Barley is more competitive with wild oat than wheat. Thus, the increased wheat acreage in California in recent years has resulted in a less competitive cereal crop as a whole (11). The introduction of semidwarf wheat and barley varieties has lead to increasing problems with wild oat and other weeds.

Various cultural methods are used to control wild oat and other grass weeds. Prior to the introduction of wild oat herbicides in the early 1960's, cultural methods were the only means of combatting the weed. The practices employed in California were used of clean seed, dryland fallow, cultivation after preirrigation or first rains, and planting to moisture under a thin dry mulch (11).

Barban and triallate have been used for controlling wild oat in California for about 20 years. Difenzoquat was introduced in the mid-1970's and diclofop received state clearance in 1982. However, Hill (11) reported that only a small portion of the California cereal acreage is treated with wild oat herbicides.

Carlson et al. (7) studied the effects of varied crop and weed plant densities on the yield of spring planted Anza wheat at Tulelake Field Station. The data were used to formulate a model of projected wheat yield reduction due to wild oat competition and to evaluate the economics of wild oat control with difenzoquat. The relative proportion of wild oat in the total plant stand was found to best describe the plant density relationships of wild oat competition. If wild oat is not controlled with a herbicide, increasing the rate of wheat seeding to decrease yield losses from wild oat competition is economically sound. Under average conditions, the economic threshhold for difenzoquat application in terms of the relative proportion of wild oat is about 2.5% wild oat in the total weed-crop stand.

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GENOTYPIC VARIATION AMONG YELLOW STARTHISTLE POPULATIONS

R. L. Sheley, B. F. Roche and R. H. Callihan[1]

Abstract: Yellow starthistle (*Centaurea solstitialis* L.) biotypes representing 34 populations in the western states were studied under uniform garden conditions at Pullman, Washington to provide a comparative basis for determining genetic, morphological and phenological variation between populations. Seeds were collected in August, 1980 and 1981 from populations in Oregon, Washington, Idaho and California. Thirty individuals from each population were sown in a completely random design, spaced at 4-foot intervals. During the 1981 growing season, observations and measurements of leaf area, growth form, leafiness, rosette width, timing of bolt initiation, plant height, number of flower heads, number of flowers, and number of seed type were taken at slected intervals to assess phenological and morphological variation.

Significant differences were found with respect to all characteristics, but no significant correlations either with location or precipitation were found. Principle components analysis was used to group similar genotypes.

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[1]University of Idaho, Moscow, ID.

A REVIEW OF EARLY INTRODUCTIONS OF FIELD (CANADA) THISTLE (*CIRSIUM ARVENSE* (L.) SCOP.) TO NORTH AMERICA AND ITS PRESENT DISTRIBUTION

L. C. Erickson[1]

A more dramatic and imaginative title to this paper could be "From Henderson to Halifax." Surprise is the essence of getting audience attention! However, this is not a speech. It is a brief presentation of a weed science research paper. Aristotle, some 2300 years ago said, "To know a subject well you must know it from the beginning." I learned that quotation from the Vice President of the University of Idaho who was given an Honorary Degree on his retirement about 15 years ago then said, "I served under three different Presidents, and never had any serious disagreements with any of them, but I frequently had very fast changes of mind." He deserved that Honorary Degree.

We shall begin at the beginning. L. F. Henderson, the first professor of botany at the University of Idaho, wrote Bulletin Number 14 in 1898. It was titled, Twelve of Idaho's Worst Weeds (10). I quote from it, "The weed (Canada thistle) is known to the write only in two localities in Idaho, one about Boise and one at Sondpoint." "The fact that it is flourishing in both these widely separated regions (500 miles apart and precipitation ranging from 15" at Boise to 40" at Sandpoint), adds to the reputation it bears of being the worst pest in many sections of the Unites States, should give us cause for alarm."

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[1]Emeritus Professor of Weed Science & Agronomy, University of Idaho, Moscow, ID.

He then discussed the work of Professor Burrill, Botanist at the Illinois Agricultural Experiment Station at Urbana published in 1894. Here are his recommendations for control of eradication:

1. Cut when in full bloom (July) as close to the ground as possible.
2. Plow 3" deep and sow heavily to millet and harrow.
3. In September plow under and sow liberally to winter rye.
4. Plow under in May and sow to millet.
5. Harvest and continue clean cultivation. According to Burrill, this experiment covered 2.5 acres, and the work cited cost $26.25. Henderson concluded, "I think, therefore, that all the thistles thus far found in Idaho could be destroyed for less than one hundred dollars."

Henderson also saw the dire need for a State Pure Seed Law, a seed analysis laboratory, and market for pure, clean seed.

Who of you, in this audience, have discussed weed prevention, seriously, in the last 3 or even 4 decades? In fact, that subjects demise occurred in 1945 with the advent of 2,4-D. There was the attitude, "to hell with prevention. We will handle the problem with the new selective herbicides." The old proverb, "one years seeding is seven year weeding" is still biologically true. But far too conservative.

The question, where did this species come fromand when? Freda Ditmers (7) after reviewing 56 references wrote, "All authorities agree that it is indigenous to Western Asia and Northern Africa, and that Europe is the source of dessemination to Australia (18) and (8) North America.

History books suggest two prime sources of introduction, one by the Franciscan Fathers who came to teach Christianity and a method of more dependable food supplies for the Indians, via the introduction of cereal grains from Europe. The second suggested source was via Burgoynes Army (16, 17) in feed from England or France for the horses moving the cannons, war supplies or artillery. In so doing, he left a trail of the thistle from Quebec to Ontario down the east shore of Lake Champlain to Saratoga, New York."

There can be some credence to this story, because the first pure seed law passed by a legislature in the now United States was in Vermont in 1795 (2). This law prohibited and "only" prohibited seeds of _Cirsium arvense_ in grass seeds. Summarily, other New England States followed, then turned westward to Ohio, Nebraska, and to Idaho finally in 1913.

Ditmers (7) noted that no one had reported the presence of Canada thistle in Ohio until 1859 although its Legislature has enacted the law, "To Prevent the Introduction and Spreading of Canada Thistle", in 1844. Ditmers map of the distribution of the weed in 1926 shows that ca 80 of Ohio's 90 counties were infested, and that 30 of the 48 contageous states were also infested. The map looks very similar to one if it were compiled in 1983. Thus, by 1926 this species had already largely reached its ecological limits. The great difference today would be in increased density within the infested states.

Our prime interest being this needs present status in North America lets go to Canada for a more complete view. On last September 3, Mrs. Erickson, she as my secretary-recorder, and I set out to get a more complete and modern view of theproblem. We returned 2 months and 3 days and 10,519 miles later. In which time we traversed seven Canadian Provinces and 17 States from Maine westward. Obviously, the report must be briefed and condensed and replete with omissions.

My first observation is that the Weed Science Departments in all provinces were better scientifically equipped than the equivalents in the United States, (9, 12, 16). Their personnel are well trained and tremendously knowledgeable on their respective subject. I shall just cite two from the Regina Research Station, they are titled, "Some effects (12, 13) of the nitrogen supply on growth and development of *Cirsium arvense*", 1978, and "Effect of shoot decpitation on the translocation of 2,4-D in *Cirsium arvense*", 1978.

At the University of Manitoba in Winnepeg, Dr. Morrison was in the process of completing a new bulletin on this species and also completing a historical sketch on that great original Canadian Weed Ecologist, Dr. T. K. Pavlychenko (3, 15).

Directly south of Winnepeg is the fruitful Red River Valley of Minnesota and North Dakota. In visiting the Branch Agricultural Station at Crookston, Minnesota I learned of new soil residue problems from products hereto never exhibited elsewhere.

The next call was an appointment with Dr. Behrens at the Institute of Agriculture, University of Minnesota, St. Paul, Campus. The discussion centered around a "Canada thistle symposium" report (2) produced by selected scientists primarily within the North Central States Weeds Science Society, January 1982, pages 152 to 182.

Environments of upper Minnesota, Wisconsin, and Michigan are similar to those of southern Ontario. The tour included a very significant visit to the Biosystematics Research Institute, in Ottawa (16). It is also known as Canada's Central Research Station. The latter is very fitting, for it was the first research station and it is located in the center of Ottawa. Two names are foremost in weed science at this station, Dr. B. J. Moore (14), who contributed the article on Canada thistle and Dr. Gerald Mulligan (16), Editor and compiler of the Biology of Canadian Weed Plublication 1693 in 1979.

Canada thistle dominates among the weeds (note maps) at 49°N latitude, i.e., the Canadian-U.S. Border. It gradually dissipates itself at 59°N northward and 40°N southward on the North American continet. This approximates 700 miles northward and 600 miles southward from the 49°th N, or a total of 1300 miles south to north and 2900 miles fromthe shores of the Atlantic to the shores of the Pacific Ocean. Canada thistle thereby infests a total area of 3,770,000 square miles and possibly one-half or 1.8 million square miles potentially capable of sustaining this species.

The map of the distribution of this noxious weed in Canada shows the more heavily infested area inthe darker shade. If the same idea were applied to Ditmer's map it would show that the ecological center of adaption in North America is the 40° parallel. In Europe this "ecological center shifts several degrees northward (8). The infestation of this thistle in Australia (17) at 38°S we would regard its persistence on a survival basis, although it competes well along the cooler southern coast in east Victoria. Dr. Moore (14) suspects that this species was introduced in the 1600's into both the New France and the New England settlements independently.

Work in biological control is in progress under the direction of Dr. Alan Watson (20). Significant progress has been slow and discouraging. However, the vast size of the problem encourages enlarged efforts in this field.

On the tour of the Quebec Province an effort was made to verify the story of the introduction of this thistle via Burgoyne's Army. There appeared to be some inconsistencies in this possibility as cited by Moore (14). The French speaking Candians of Quebec (9) had never heard of the reported Bargoyne incident. However, Rousseau (19) reveals that C. arvense was first found in Quebec province in 1777. This species is rare in the vicinity of Quebec City. Little industrial agriculture prevails in the area. Dr. Gilles and his staff (9) at the Institute had much basic work in progress and only limited interest in C. arvense because of its limited economic insignificance. Their larger problems were weed control in strawbeery beds, and many small fruit crops.

On leaving Quebec, the Crops Departments at the Universities of Maine and New Hampshire were visited. I had to conclude that field weeds are of no major economic significance in the New England States. At the University of Vermont, Burlington, we discussed agricultural development and redevelopment. I was informed that the high point in agricultural development in that state had come in about 1880. Only specialized phases had survived and prevailed since. Dr. W. A. Way, Extension Specialist in Crops and Soils (21) had a broad view of the highly diversified agriculture of that State.

It is probable that General Burgoyne and his army came past the place (Burlington) where the University of Vermont now stands. He then proceeded south along the east shore of Lake Champlain, then prepared to turn west to Saratoga, New York. At this juncture he chose to send a contingent of soldiers to Bennington to take the Yankee stores and supplies for his army. This venture (17) cost him a thousand men and large losses in supplies and horses. His army was quickly defeated by General Meade's Army at Saratoga. It is recorded as the largest battle of the Revolutionary War. Believe it or not, no thistle trail remained as of October 1982.

The next stop was a refreshing change of pace. Cornell University had actual weed research in progress. Dr. D. L. Linscott, Professor Weed Science (11) guided me through and around their facilities. The Liberty Hyde Bailey Horatorium is still expanding. It was in this environment that I was shown the Cirsium arvense mounted specimens taken from Sandpoint, Idaho by Professor Henderson and submitted to the Cornell University. My mission was complete!

Two more visitations were made, one at the University of Nebraska, Lincoln, Nebraska to discuss their new development in weed science and at the University (1) of Wyoming, Laramie, Wyoming to review the results of past season.

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WEEDS - 1ST CLASS THIEVES (A SLIDE SERIES TO TEACH LOSSES DUE TO WEEDS)

R. L. Chase[1]

Abstract: Unfortunately, many do not realize the many losses caused by weeds. That's because weeds are 1st class thieves. The rob crop plants without leaving much evidence of their thievery. Unlike insects and diseases, weeds do not leave any telltale damage one can readily see and attribute to weeds. It is difficult to "see" a reduction in yield. Weeds

[1]Extension Weed Specialist, Utah State University, Logan, UT.

compete with crops for water, light, and nutrients. A 50% loss is not uncommon if weeds are allowed to grow. Some weeds produce alleopathic substances which inhibit the growth or germination of other plants. When we try to control weeds, ofttimes crops are damaged or killed by cultivation or herbicides. Many weeds act as hosts for insects, which not only cause physical damage, but many are vectors of disease. Quality is reduced in many ways: weedy alfalfa, damaged tubers, and dockage of cereals for example. Many cattle die each year from eating poisonous plants. Weeds impede irrigation canals and reduce water quality, not only for farmers, but for sportsmen, swimmers, skiers, boaters and campers. Weeds interfere in the harvesting of many crops. Weeds also cause hay fever, are one eyesore, obstruct vision on highways and roads, contribute tothe death of wold animals on highways, and are a general nuisance. In many areas of the world, because of weeding chores, many children are unable to attend school. Weeds - 1st class thieves, rob us of everything from food to fish to school.

THE MONTANTA WEED FAIR

B. H. Mullin[1]

Abstract: Individuals involved in weed control efforts in Montanta, especially those associated with weed districts, have become increasingly concerned with the public's view of weed control and the need for the use of herbicides. Another area of concern included coordination of efforts between state and federal land agencies when controlling noxious weeds on their land. In 1981, a group of concerned citizens, including weed district personnal and the Montana Weed Control Association, the Montana Department of Agriculture and the Cooperaitve Extension Service employees, and many farm group representatives, organized Montana's first Weed Fair. The purpose was to show citizens that weeds cause problems to all Montanans, not just the farmer and rancher. A location, in central Montana was chosen where several research plots involving leafy spurge control were already set up. Farm and ranch orgainizations, government agencies, chemical companies, and equipment representatives provided displays of general weed control information. A weed identification contest was held and prizes were awarded. The general public was invited to attend to learn more about Montana weed problems, current research efforts, and research needs for the future. Personal invitations were issued to representatives of state and federal land agencies and to Montana's congressional and legislative delegations. Response was enthusiastic. Most participants felt that they left with useful informtion and a clearer grasp of weed problems in Montana. The concept of the Weed Fair has grown in the state. Each year another area of the state plans to host the Weed Fair and target weed problems specific to their area. The 1982 Weed Fair was held in western Montana and the 1983 Weed Fair is planned for southcentral Montana. Enthusiasm continues to grow as each Fair adds a unique feature to the success of the proram. In Montana, this has been a successful tool in highlighting weed problems and possible solutions.

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[1]Montana Department of Agriculture, Helena, Montana.

WSWS BUSINESS MEETING MINUTES
March 10, 1983
Las Vegas, Nevada

President Wayne Whitworth called the meeting to order and requested the approval of the 1982 business meeting minutes. The minutes were unanimously approved as outlined.

Reports were presented as follows:

1. Research Section: Harvey Tripple noted that the 1983 sessions were well attended this year. Also, the following individuals were elected as project chairmen for 1983-84:

   Project 1: Perennial Herbaceous Weeds
   Chairman/Rodney Lym, Chairman-elect/Lloyd Haderlie

   Project 2: Herbaceous Weeds of Range and Forest
   Chairman/Tom Whiteson, Chairman-elect/Terry Pederson

   Project 3: Undesirable Woody Plants
   Chairman/Jim Budzynski, Chairman-elect/Mike Newton

   Project 4: Weeds in Horticulture Crops
   Chairman/Linda Willits, Chairman-elect/Robert Parker

   Project 5: Weeds in Agronomic Crops
   Chairman/Russ Schneider, Chairman-elect/Sam Stedman

   Project 6: Aquatic, Ditchbank and Noncropland Weeds
   Chairman/Randal Stocker, Chairman-elect/Carlyle Tennis

   Project 7: Chemical and Physiological Studies
   Chairman/Lloyd Haderlie, Chairman-elect/Dave Gealy

2. Finance Committee Report: Mark Winkle noted that the society was in excellent financial condition. A financial statement was presented as follows:

interest	=	$2,136.92
operational	=	4,193.87
net profit		6,330.79

   savings certificates - 1982 total $12,500.00
   1983 total 16,000.00

   Members of the 1983-84 committee include Vern Stewart, chairman and Sheldon Blank. The financial committees report unanimously approved by those in attendance.

3. Business Managers Report:

Financial Statement
March 1, 1982 - March 1, 1983

Income		
Registration, Denver Meeting (304+23)	$7,545.00	
Dues, members not attending annual meeting (98)	490.00	
Extra luncheon tickets	120.00	
1982 Research Progress Report sales	3,896.14	
1982 Proceedings sales	4,329.93	
Sale of back issues of publications	359.13	
Payment of outstanding invoices from 1981	184.00	
Guest speaker travel refund	504.76	
Advance order payments	197.50	
Fiscal year deposits	$17,626.46	$17,626.46
Preregistration, Las Vegas Meeting		6,068.50
		$23,694.96
Interest on checking account	295.72	295.72
Interest on savings certificates	1,841.20	
Fiscal year receipts	$19,763.38	$23,990.68
Assets, March 1, 1982		
Savings certificates	12,500.00	
Checking	261.48	261.48
Cash on hand	50.00	
	$32,574.86	$24,252.16
Expenditures		
1982 Annual meeting incidental expenses	402.18	
1983 Annual meeting incidental expenses	97.85	
Luncheon, 1982 annual meeting	2,820.43	
Guest speaker expenses	450.97	
Graduate Student room subsidy	663.93	
Business Manager honorarium	500.00	
CAST dues	522.00	
1982 Research Progress Report publication cost	4,402.12	
1982 Proceedings publication cost	1,973.00	
Postage	724.80	
Newsletter printing costs	233.26	
Office supplies	145.20	
Refunds	31.50	
1983 Program printing costs	465.35	
Total 1982-1983 expenditures	$13,432.59	$13,432.59
Assests		
Savings certificates	16,000.00	
Checking	9,160.77	
Cash on hand	50.00	
	$25,210.77	25,210.77
		$38,643.36

4. Student Papers: Robert Zimdahl noted that 13 students participated in the 1983 student speaking contest. There were three winners who were as follows:

first place - D. L. Somura, University of Idaho

second place - Stott Howard, Utah State University

third place - K. G. Beck, University of Idaho

First place winner receive $75.00, second place $50.00 and third place receive $25.00.

5. Constitution and By-laws: Alex Ogg moved the proposed changes be approved as presented. It was seconded and unanimously approved. Constitution and By-laws as ammeded are printed following these minutes.

6. Resolutions: Neil Humberg presented the following resolutions:

RESOLUTION NO. 1: LOCAL ARRANGEMENTS AND PROGRAM

WHEREAS, the facilities and arrangements for the 1983 annual meeting of the Western Society of Weed Science are of excellent quality and well organized; and

WHEREAS, the organization and content of the program are excellent and vital to the Society,

THEREFORE BE IT RESOLVED, that the membership of the Western Society of Weed Science in conference assembled expresses its appreciation to Chairman, James Krall and members of the 1983 Local Arrangements Committee, to the Chairman, Gary Massey and members of the Program Committee, and to the Project Chairman.

RESOLUTION NO. 2: HERBICIDE APPLICATION

WHEREAS, herbicides for improving efficiency of crop production are available; and

WHEREAS, proper application is critical to the performance and safe use of herbicides; and

WHEREAS, all private and custom applicators would benefit from improved methods of application,

THEREFORE BE IT RESOLVED, the the Western Society of Weed Science urges university, research and extension personnel and U.S. Department of Agriculture personnel to increase basic and applied research directed for the improvement of herbicide application technology and safety and to increase their efforts to improve educational programs concerning herbicide application.

It was suggested to direct resolution number 2 to land grand and industry groups interested in the application of pesticides. It was moved that resolution number 1 and number 2 be passed. It was seconded and unanimously approved.

7. Site Selection: Dean Swan reported the following sites selected for future meetings:

   1984 - Spokane Sheraton, March 12-15, 1984

   1985 - Phoenix, Arizona

   1986 - San Diego, California

   1987 - Boise, Idaho - Riverside Red Lion Inn, March 9-12, 1987

8. CAST: Lowell Jordon announced that CAST was celebrating its tenth anniversary. CAST has published more than 100 task force reports. CAST is publishing a magazine Science and Food in Agriculture. The purpose is to get every science teacher and school to have access to the magazine.

   Lowell requested that names of key science high school teachers and names of local libraries be sent into CAST, in order that they might receive the magazine. Further, the names of prominent scientists in the area should be sent in for possible inclusion in the magazine. Lowell also noted the need of new members at an annual cost of $15.00.

9. WSSA Representative Report: Clyde Elmore reported that the 1983 (twenty-third) meeting of the Weed Science Society of America was held February 8-10, 1983 at the Stouffer's Riverfront Towers, St. Louis, Missouri with approximately 1,050 members attending from 1,989 members total.

   There were 270 papers scheduled to be presented at the 1983 meetings plus a special International Weed Science Socity - Weed Science Society of America symposium on communication of weed science technologies in developing countries.

   Papers for the General Session centered aroung the theme "Agricultural Challenges in the Eighties". The General Session included the Presidential address by T. J. Sheets, a presentation by Shooichi Matsunaka, recipient of the Honorary Members Award for 1983 and President, International Weed Science Society, and Secretary of Agriculture J. R. Block on "USDA and Agriculture in the Future".

   The Poster Session and new developments from industry included 19 poster displays.

   The Board of Directors of the WSSA met with incumbent president T. J. Sheets on February 7, with the final board meeting held with the new president C. G. McWhorter on February 10, at which time the new board members assumed their duties.

   New 1983-84 officers and board members of the WSSA are as follows:

President	- C. G. McWhorter	
President Elect	- J. D. Nalewaja	
Vice President	- J. D. Riggleman	
Secretary	- D. L. Linscott	
Past President	- T. J. Sheets	
Treasurer	- G. R. Miller	
Members-at-large	- J. Antognini	H. M. LeBaron
	M. G. Merkle	R. A. Peters

ECWC	- G. Stephenson
NEWSS	- S. Pruss
NCWCC	- R. Fawcett
SWSS	- H. D. Coble
WSWS	- C. L. Elmore
Editor-in-Chief	- J. L. Hilton
Executive Sec.	- C. J. Cruse

Major actions of the Board are as follows:

1) WSSA continues to be financially strong. The current net worth is $391,164.09, and for the year, the Society had a gain of $6,004.66 in net worth down from $38,425 for 1982.

2) No further action on a logo change is contemplated.

3) The fifth edition of the Herbicide Handbook is being printed. The Adjuvant monograph was published, two others on reduced tillage and leafy spurge lack critical chapters, and three others are being prepared.

4) Work will be started on the development of the first "Review of Weed Science".

5) Meeting sites 1984 - February 10-12, Hyatt Regency Hotel in Miami, Florida.
1985 - February 5-8, Shraton Hotel, Seattle, Washington.

A future meeting is being planned for Mexico City, Mexico in recognition of the need to encourage greater participation in WSSA activities of weed scientists from Central and South American countries.

6) Changes in Dues for 1984 (January 1)

Sustaining members	$200		$200
Active regular membership	15	to	25
Active student membership	7.50	to	10
Subscription fees	25	to	35

Registration fees for WSSA meetings

Active regular members	15	to	20
Non-members	20	to	30

7) Weed Science Journal - In 1982, 238 manuscripts were received, 21% were rejected, 781 pages were published in six issues and one supplement. C. Y. Swanson completed his three year term as editor and D. E. Davis accepted editorship.

8) Weeds Today - Only three issues of Vol. 13 in 1982 were published due to a drop in advertising income. Recommended selling (a) paid announcement sapce and (2) subscriptions to non-members for $8.00/year on a survival mode.

9) North American Directory of Federal, Provincial, State and Industrial Weed Scientists be merged with the WSSA membership directory and published on a 2-3 year basis.

10) A 4-person team of weed scientists will visit the People's Republic of China. They would be expected to give 2 series of 10 day lectures.

11) A Weed Science Careers in Industry leaflet is to be published (100,000 copies).

12) Eight resolutions were accepted by the Board for submission and vote of the membership.

13) WSSA members honored as fellows were: Robert N. Anderson, Will D. Carpenter, John E. Gallagher, Dean L. Linscott and Larry W. Mitich.

Shooichi Matsunaka was awarded the Honorary Member and gave the major address at the general session. Dr. T. Monacco, North Carolina State University received the Outstanding Teacher award; Dr. Arnold Appleby, Oregon State University receive the Outstanding Research award; Dr. Ronald E. Doersch, University of Wisconsin, Outstanding Extension Worker's Award; Ray A. Evans, D. A. Easi, D. N. Book and J. A. Young the outstanding article in Weed Science; H. Gordon Bethards, Outstanding article in Weeds Today; David McAuliffe, Oregon State University and Laura S. Quackenbush, University of Minnesota, Outstanding graduate students; Dr. Steve Radosevish, Outstanding Young Scientist.

10. Other Business:

A. Alex Ogg presented a proposed policy agreement between the Western Society of Weed Science and the Western Chapter of The Aquatic Plant Management Society. Four major points regarding the proposed policy agreement are as follows:

1. The WC-APMS propose to meet following and at the same location as WSWS whenevery possible.

2. Each society will have their own local arrangement committees and they will coordinate the two meetings, but financial arrangements for the two meetings will remain separate. WC-APMS will contact the hotel directly to reserve their meeting rooms.

3. Each society will reciprocate in announcing in newsletters the other societies meeting.

4. WSWS will schedule their Agquatic, Ditchbank and Noncrop Weeds Project Session Thursday morning to allow for a smooth transition into the WC-APMS meeting on Thursday pm and beyond.

A motion was made to accept the proposals. It was seconded and unanimously approved.

B. President Wayne Whitworth relinquished the presidency to the new WSWS President, Gary Massey.

C. Gary Massey encouraged more student papers in the future.

D. It was noted that the poster session was not very successful even though good facilties were available.

WESTERN SOCIETY OF WEED SCIENCE

CONSTITUTION AND BY-LAWS

With revisions and additions as adopted
by the membership on March 10, 1983

CONSTITUTION

ARTICLE I—Name

Section 1. The name of this organization shall be the "Western Society of Weed Science," hereinafter called the "Society." The Society area shall include the states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

ARTICLE II—Objectives

The objectives of the Society shall be:

Section 1. To foster cooperation among state, federal, and private agencies in matters of weed science in the Society area.

Section 2. To support the Weed Science Society of America and foster state and regional organizations of persons and agencies interested in weed control.

Section 3. To aid and support commercial, private, and public agencies in the solution of weed problems.

Section 4. To foster and encourage education and research in weed science.

Section 5. To support legislation governing weed control programs and weed research and education programs.

Section 6. To assist in the development of uniform weed control and eradication legislation and weed seed quarantine legislation and regulations.

ARTICLE III—Membership

Section 1. Membership shall be open to anyone interested in the objectives of the Society. Two types of membership are provided (a) active and (b) honorary.

Section 2. Active members are individuals who are interested in weeds or their control and who have paid their annual dues to the treasurer. Active members may attend all Society meetings, vote on Society matters, hold office, and receive official notices of all meetings.

Section 3. Honorary members are members selected from outside the Society who have significantly contributed to the field of weed science, and who are elected by two-thirds majority of the Executive Committee. Honorary members shall receive all publications and announcements of the Society but will not be eligible to vote or hold office.

ARTICLE IV—Officers and Executive Committee

Section 1. The officers of the Society shall be:

(1) President
(2) President-elect who serves as Program Chairperson
(3) Secretary

Section 2. The Executive Committee shall be composed of:

The President
President-elect
Secretary
Immediate Past-President
The Representative to WSSA
Chairperson of the Research Section
Chairperson of the Education and Regulatory Section
One member chosen at large by the President with the consent of the Executive Committee.

Section 3. The President, President-elect, and Secretary shall begin their duties at the close of the regular business meeting at which they are installed and shall remain in office until the close of the next regular Society business meeting. Other members of the Executive Committee shall begin their term at the close of the meeting at which they are installed, except the Representative to WSSA whose term is described in ARTICLE IV, Section 5 of the Constitution.

Section 4. The Chairperson of the Research Section and Chairperson of the Education and Regulatory Section shall serve a one-year term beginning at the close of the business meeting at which they become chairpersons.

Section 5. The Society Representative to the Weed Science Society of America shall serve three years beginning at the Weed Science Society of America Business Meeting in the year following the WSWS meeting at which the election is announced.

Section 6. The Executive Committee may elect a Treasurer-Business manager to serve as they may direct.

Section 7. The Executive Committee may select a Society Representative to the Council for Agricultural Science and Technology (CAST) to serve as they direct. The Representative to CAST shall serve 3 years, beginning after the CAST winter meeting at which the election is announced.

ARTICLE V—Society Sections

Section 1. In promoting a full exchange of ideas and information on weed science and to facilitate programming of meetings, there shall be two general sections as follows:

(1) The Research Section, and
(2) The Education and Regulatory Section

Section 2. These two sections may have sectional programs, project meetings and informal discussions of research reports and other pertinent information. Such meetings shall be at the regular meeting at a time designated by the Program Committee.

Section 3. The Chairperson of each of these sections shall be a member of the Society Executive Committee and shall be elected as stated in Article VI, Section 3.

ARTICLE VI—Election of Officers

Section 1. The Nominating Committee shall be appointed by the President, with the advice and consent of the Executive Committee. They shall present their nominations for each office to be filled to the Executive Committee for approval before presenting the nominees to the membership for election by ballot. No member's name shall be placed on the ballot without that member's consent. All candidates for office shall be selected from the Society membership and shall be elected by the majority of the members voting. In case of a tie vote, the winner shall be determined by flip of a coin in the presence of both nominees or their representatives at a meeting of the Executive Committee.

Section 2. The terms of office shall be as follows: The officer moving through the office of President-elect, President, and Past-President shall be a member of the Executive Committee for a three-year term, the Secretary shall serve a one-year term but shall be eligible for renomination as a secretary or as any other officer.

Section 3. The Chairperson-elect of each of the two sections shall be elected by the Society and serve a one-year term. Following this, they shall succeed as Chairperson of their section for an additional one-year term. The Chairperson-elect shall serve as Chairperson if the Chairperson is unable to serve his/her term.

Section 4. If an elected officer cannot serve the full term, the vacancy shall be filled for the interim by appointment by the President with the advice and consent of the Executive Committee, unless otherwise provided for in this constitution. The President-elect shall serve as President if the President becomes unable to serve. This service shall not constitute his/her term as President. In case both the President and President-elect are unable to serve, the most immediate Past-President who is willing to serve shall serve as interim President until new officers are elected by the members.

ARTICLE VII—Standing Committees

Section 1. There shall be nine standing committees: Program, Finance, Resolutions, Local Arrangements, Nominations, Public Relations, Placement, Nominations of Fellows and Honorary Members, and Site Selection appointed by the President with the advice and consent of the Executive Committee.

Section 2. The Program Committee shall consist of the President-elect as Chairperson, the two Section Chairpersons, and such other members appointed by the Program Committee Chairperson as required to give all phases of weed science adequate representation.

Section 3. The Finance Committee shall consist of a Chairperson and two members. Term of office of this committee shall be three years, established to expire alternately so that at least two members continue over each year. The member serving his/her second year of the term shall serve as Chairperson.

Section 4. The Resolutions Committee shall consist of a Chairperson and two additional members. Terms of this committee shall be as in Section 3 above.

Section 5. The Local Arrangements Committee shall consist of a Chairperson and others as needed.

Section 6. The Nominating Committee shall consist of a Chairperson and two members. Terms of this committee shall be as in Section 3 above.

Section 7. The Public Relations Committee shall consist of a Chairperson and others as needed. Terms of office of this committee shall be at the discretion of the President.

Section 8. The Placement Committee shall consist of a Chairperson and two additional members. Terms of this committee shall be as in Section 3 above.

Section 9. The Committee for Nominations of Fellows and Honorary Members shall consist of the three most immediate Past-Presidents of the Society. Term of office of this committee shall be as in Section 3 above.

Section 10. The Site Selection Committee shall consist of a Chairperson and two additional members. Terms of this committee shall be as in Section 3 above.

ARTICLE VIII—Dues

Section 1. The amount of dues and the method of collecting such dues shall be determined by the Executive Committee.

Section 2. In the event of the dissolution of the Western Society of Weed Science, the physical assets shall be sold and after payment of all debts, money possessed by the Society shall be given prorated on a membership basis without let or hindrance to agricultural education institutes in the states listed in ARTICLE I, Section 1, by the Executive Committee holding office at the time of dissolution.

ARTICLE IX—Meetings

Section 1. Meetings shall be held at such times and places as may be determined by the President in consultation with the Executive Committee.

ARTICLE X—By-Laws

Section 1. The Society may adopt By-Laws.

ARTICLE XI—Amendments

Section 1. The Constitution and By-Laws may be amended by majority vote of the members present at any regular meeting.

BY-LAWS

ARTICLE I—Duties of Officers

Section 1. The President shall be the executive officer of the Society. He/she shall act as Chairperson of the Executive Committee, carry out the spirit of the Constitution and the decisions of the Executive Committee, appoint designated officers and committees, and perform other usual duties of that office. He/she may confer if, in his/her opinion, a member of the Society has demonstrated distinguished service, the Presidential Award of Merit. Presentation of this award must have majority approval of the Executive Committee.

Section 2. The President-elect shall perform the duties of President if he/she cannot serve; serve as Chairperson of Program Committee; develop program outlines of the Society meetings; assign responsibilities to Program Committees; issue calls for papers; advise Executive Committee of program status one month before the meeting; and present a copy of the program to the Business Manager for publication.

Section 3. The Secretary shall prepare minutes of Society and Executive Committee meetings, prepare and maintain an up-to-date list of officers including Executive Committee, all standing committees and special committees, and perform other duties when designated by the President.

ARTICLE II—Duties of Treasurer-Business Manager

Section 1. The Treasurer-Business Manager will receive, manage, and disperse monies of the Society in accordance with prescribed policies and instructions of the Executive Committee, maintain financial records and records of property, prepare records for annual audit and meet with designated auditors, maintain supplies of Proceedings and Research Progress Reports, receive and fill orders for above publications and collect payments for same, maintain standing orders and mailing lists for distribution of publications, and arrange for and consumate publications for the Society. The Business Manager may be financially compensated for services rendered as decided by majority vote of the Executive Committee.

ARTICLE III—Duties of WSSA Representative

Section 1. The WSSA Representative shall serve on the Executive Committee of WSSA and shall act as liaison between the Society and WSSA. He/she will keep WSSA informed of all activities and actions of the Society and will in turn keep the Society informed of all activities and actions of WSSA.

ARTICLE IV—Duties of Member-at-Large

Section 1. The Member-at-large shall maintain liaison with the President and other officers of the Society and shall bring to the attention of the Executive Committee the various concerns of the members of the Society. The Member-at-large shall perform other duties delegated by the President and the Executive Committee.

ARTICLE V—Duties of CAST Representative

Section 1. The CAST Representative shall represent the Society, present ideas and proposals from the Society to CAST, and recommend persons from the Society for participation in CAST activities.

ARTICLE VI—Duties of Immediate Past President

Section 1. The Immediate Past-President shall serve on the Executive Committee and on the Committee for Nominations of Fellows and Honorary Members, and shall maintain close liaison with the President in an advisory capacity.

ARTICLE VII—Duties of Standing Committees

Section 1. The Program Committee shall develop the program for the meetings of the Society. The President-elect, who is Chairperson, shall delegate duties to members as he/she deems advisable (see duties of President-elect).

Section 2. The Finance Committee shall analyze the financial conditions of the Society and recommend, if needed, immediate and long-range plans for sound growth of the Society, recommend budget policies, recommend policies regarding registration fees and prices of publications, audit the financial accounts at least annually, and make a report to the Society.

Section 3. The Resolutions Committee shall develop resolutions and recommendations regarding the general field of weed science within the Society area and put into writing important recommendations that the Society would promote and encourage; they shall report to the annual meeting.

Section 4. The Local Arrangements Committee shall make arrangements for the conduct of an efficient Society meeting. They shall work in concert with the Program Chairperson in designating meeting rooms for each section, and arranging for an Executive Committee meeting room, Placement Committee headquarters, and space and tables for registration. The Committee shall be responsible for providing or arranging typewriters and personnel for registration, projectors, screens, microphones, and other equipment as designated by the Program Chairperson.

Section 5. The Nominations Committee shall nominate candidates for the offices of President-elect, Secretary, Chairperson-elect of the Research Section, Chairperson-elect of the Education and Regulatory Section, and WSSA Representative when necessary. Such candidates shall be contacted and cleared as set forth in ARTICLE VI of the Constitution.

Section 6. The Public Relations Committee shall take every feasible opportunity to inform the scientific community and the general public of the activities and benefits of the Society and of weed science in general. Any statement which may be construed as reflecting policy of the Society should be approved by the President before release.

Section 7. The Placement Committee shall provide at each annual meeting of the Society a registration service to make information available to potential employees and employers in cooperation with the Weed Science Society of America.

Section 8. The Committee for Nominations of Fellows and Honorary Members shall prepare nominations for these awards under the provisions of ARTICLE III, Section 3 of the Constitution, and ARTICLE X, Sections 1 and 2 of the By-Laws. They shall prepare biographical data for publication in the Proceedings and shall work with the Public Relations Committee in preparation of news releases concerning the award recipients.

Section 9. The Site Selection Committee shall make all arrangements in all matters pertaining to the reservations of facilities for future meetings. They shall select the city and hotel and, after receiving approval from the Executive Committee, they shall finalize business agreements between the Society and the hotel management and transfer the records of these agreements to the Local Arrangements Committee for the site at the earliest possible date.

ARTICLE VIII—Duties of the Section Chairpersons

Section 1. The Chairperson of the Research Section shall organize sectional and project meetings of those engaged in research in the Society to exchange information and ideas and for improvement of research in weed science. He/she shall solicit and assemble papers for the Research Progress Report from research workers for publication by the Society each year. The Chairperson may delegate to the Chairperson-elect part of his/her duties as may be wise.

Section 2. The Chairperson of the Education and Regulatory Section shall organize sectional meetings of those engaged in this phase of weed science in the Society for exchange of information and improvement of the work. He/she shall solicit program reports of education and regulatory work in weed science for publication in the Society Proceedings. The Chairperson may delegate part of these duties to the Chairperson-elect.

Section 3. The Chairperson-elect of each of these Sections may attend Executive Committee meetings but cannot vote.

ARTICLE IX—Publications

Section 1. Proceedings and The Research Progress Report shall be published annually. Proceedings will consist of reports and papers given at the meeting, reports of the Standing Committees and special committees, minutes of the business meeting, and reports from the Research and the Education and Regulatory Sections. Research Progress Reports shall be available at the annual meeting. Other publications may be authorized from time to time by the Executive Committee.

ARTICLE X—Fellows and Honorary Members

Section 1. Fellows of the Society are members who have given meritorious service in Weed Science, and who are elected by two-thirds majority of the Executive Committee. Not more than two Fellows shall be selected each year. A cumulative list of Fellows shall be published each year in the Program and in the Proceedings.

Section 2. Honorary Members shall be selected as set forth in ARTICLE III, Section 3 of the Constitution. A cumulative list of Honorary Members shall be published each year in the Program and in the Proceedings.

Section 3. All Fellows, upon retirement, and Honorary Members shall receive publications of the Society and complimentary registration and luncheon privileges at all Society meetings which they attend. Persons selected as Honorary Members prior to 1974 shall be listed annually in the Program and in the Proceedings under the heading, Fellows (formerly Honorary Members).

ARTICLE XI—Rules of Order

Section 1. Business at all regular meetings of the Society shall be conducted according to Robert's Rules of Order.

ARTICLE XII—Quorum

Section 1. All members of the Society in good standing who are present at any regular meeting shall constitute a quorum.

ARTICLE XIII—Authorization

Section 1. The adoption of this Constitution and By-Laws shall render null and void all previous rules and regulations of this Society.

1983 Honorary Members and Fellows

At the annual meeting luncheon L. E. "Jack" Warren, Chairman of the Fellows and Honorary Members Committee, announced the election of Virgil Freed as an Honorary Member and Richard Comes and Clyde Elmore as Fellows of the Western Society of Weed Science.

Virgil H. Freed

Virgil H. Freed was born in Mendota, Illimois. He attended Oregon State University and received his B.S. in Agriculture in 1943 and his M.S. in Plant Physiology in 1948. Virgil received his Ph.D. in Biochemistry from the University of Oregon in 1959.

In 1944 Virgil joined the Departments of Agricultural Chemistry and Farm Crops at Oregon State University. He is now Head of the Department of Agricultural Chemistry and Director of the Environmental Health Sciences Center at Oregon State University.

Virgil was President of the Western Society of Weed Science in 1948. He has served as major professor for many M.S. and Ph.D. candidates. He has published many manuscripts on weed control and the behavior of herbicides in plants and soils.

Dr. Freed is widely recognized for his expertise on the behavior of herbicides and other pesticides in the environment. He has served on many national level committees for the National Academy of Sciences, National Research Council, Environmental Protection Agency, World Health Organization, and many other organizations concerned with pesticides. His expertise in biochemistry and biophysics has led him into a reasonable and knowledgeable defense of the use of pesticides.

Virgil is an extremely hard-working researcher and administrator.

He has played a major role in the development of Weed Science, not only in the Western Region, but also nationally and internationally.

Richard D. Comes

Richard D. Comes was born in Nisland, South Dakota, but spent most of his early years at Shoshoni, Wyoming. Dick attended the University of Wyoming and graduated with a B.S. in Agriculture in 1958 and a M.S. in Plant Science in 1960. He received his Ph.D. in 1971 from Oregon State University, specializing in Weed Control in the Farm Crops Department.

Between 1960 and 1965, Dick worked at Laramie, Wyoming, for USDA-ARS as a Research Agronomist developing new and improved methods for controlling aquatic and ditchbank weeds. in 1965 he transferred to Prosser, Washington, and continued his research on aquatic and ditchbank weeds as a Plant Physiologist for USDA-ARS. Dick is recognized regionally, nationally, and internationally as an expert on aquatic and ditchbank weed control.

He has authored or co-authored over 60 publications on weeds and their control. His research contributed significantly to the data supporting the registration of 2,4-D, dalapon, and glyphosate for weed control on ditchbanks and diquat, dichlobenil, fenac, endothal, and copper sufate in ponds and lakes. Recently, he has developed the "dangler" rope-wick applicator for applying herbicides to weeds on ditchbanks. He is a leader in discovering and developing technology to use desirable grasses for replacement of weeds on ditchbanks.

In 1979 and 1981, Dick travelled to India and Pakistan where he served as a technical advisor on aquatic weed control.

Between 1975 and 1979, he served the Western Society of Weed Science as Research Chairman, Secretary, Vice-President, and President. Dick has also served on numerous committees and chairmanships for the Weed Science Socity of American and is currently a member of the review board for the Weed Science journal.

Clyde L. Elmore

Clyde L. Elmore was born in Oklahoma and raised on a cereal and livestock farm. Clyde attended Oklahoma State University and received his B.S. and M.S. degrees in Agronomy in 1959 and 1961, respectively. He received his Ph.D. from the University of California at Davis specializing is Weed Control in the Botany Department.

In 1962 Clyde joined the Agricultural Extension of the University of California at Davis as an Extension Weed Specialist. Initially he worked in weed control in turf, ornamentals, tree fruit and vine crops, and agronomic crops. At the present time, he works on weed control extension in turf, ornamentals, and tree and vine crops, as well as serving as Assistant Program Director for Cooperative Extension Pest Management. Clyde is recognized regionally, nationally, and internationally for his expertise on weed control in turf, ornamentals, and horticultural crops.

Clyde has been an active member of the California Weed Conference, Western Society of Weed Science, the Weed Science Society of America, and the American Society for Horticultural Science. From 1975 to 1977, he served the Western Society of Weed Science as Chairman-Education and Regulatory Section, President-Elect, and President. Clyde has served on numerous committees and chairmanships for the Weed Science Society of America. Recently, he has served as weed science consultant in horticulture to the AID-University of California project in Egypt.

HONORARY MEMBERS OF WSWS

*Dick Beeler, 1976
Dale H. Bohmont, 1978
R. Phillip Upchurch, 1982
Virgil H. Freed, 1983

FELLOWS OF WSWS

Robert B. Balcom, 1968
*Walter S. Ball, 1968
Alden S. Crafts, 1968
F. L. Timmons, 1968
D. C. Tingey, 1968
Lambert C. Erickson, 1969
*Jesse M. Hodgsen, 1969
Lee M. Burge, 1970
Bruce Thornton, 1970
Virgil H. Freed, 1971
W. A. Harvey, 1971
*H. Fred Arle, 1972
Boysie E. Day, 1972
Harold P. Alley, 1973
K. C. Hamilton, 1973
William R. Furtick, 1974
*Oliver A. Leonard, 1974
Richard A. Fosse, 1975
Clarence I. Seely, 1975
Arnold P. Appleby, 1976
J. LaMar Anderson, 1977
Arthur H. Lange, 1977
David E. Bayer, 1978
Kenneth W. Dunster, 1978
Louis A. Jensen, 1979
Gary A. Lee, 1979
W. L. Anliker, 1980
P. Eugene Heikes, 1981
J. Wayne Whitworth, 1981
Bert L. Bohmont, 1982
Lowell S. Jordan, 1982
Richard D. Comes, 1983
Clyde L. Elmore, 1983

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*deceased

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