Agricultural Pesticides Short Course

Use Pesticides Safely

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HOW I SOLVE SPECIAL WEED PROBLEMS

Kenneth Clambey
County Agricultural Inspector
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DESCRIPTION OF OTTER TAIL COUNTY

Otter Tail County consists of 62 townships and is one of the largest agricultural counties in our state. The west and southwestern parts of our county are suited for large scale farming. Most of the land is planted to small grains and row crops, and there is very little wasteland. As we move to the north and east, the farming changes to smaller farm operations consisting mainly of dairying and beef cattle. This part of our county also has a large number of lakes which adds another phase to the economy of the area.

WEED PROBLEMS IN VARIOUS AREAS

In the west and southwestern parts of the county our biggest weed problems are mustard and thistles in the increased acreages of soybeans. The weed problems change with the type of farming in the north and eastern section of the county. Here we find dairy and beef cattle requiring large acreages of pasture. Our biggest problem in pastureland is Scotch thistle. The large number of cattle in this area necessitates the planting of large percentages of these farms to alfalfa and other hay crops. In the eastern part of the county this creates a serious problem because of the infestation of hoary allyssum. In the lake area our weed problems are steadily increasing as the lake property becomes more heavily populated.

SOLVING WEED PROBLEMS

When a weed problem is brought to my attention, I check with the town board to get the history of this particular weed problem. In my discussion with the townboard I also inquire as to the type of person we are dealing with. I ask the townboard to contact this person and attempt to solve the problem. If for some reason they cannot take care of the problem, I then go with them. When we meet with the person, I identify the weed, explain the damage the weed can do and instruct him how to take care of it.

In that section of our county having the large grain and row crop farmers, we do not have many problems. These farmers are very weed conscious, and large fields make spraying much easier. Mustard and thistles are problems in the soybean fields of this area. I have recommended that the farmers do a thorough job of spraying and digging both spring and fall while the land is in small grain, before it is planted to soybeans.

In the north and eastern parts of the county Scotch thistle is a serious problem in the pastureland. Most of the farmers have tried spraying with 2-4D but have had little success. The best results I have found have come with the use of brush killer. However,

where there are dairy cattle this creates another problem because cattle have to be kept off seven days after such spraying. I have tried to convince townboard members to do a good job of controlling their Scotch thistles, thereby setting a good example for their neighbors. This has proven effective in many instances. Although alfalfa is a good crop to control sow and Canadian thistle, it does bring a problem with hoary allyssum. I have found the most effective way to control hoary allyssum is to get the townboard to spray the township roads first. After this is done we begin working with the farmers convincing them this weed can be controlled.

The increased number of lake property owners is causing an extra problem. Many of these people have had no past experience with weed problems. In the past much of this lake property was owned by one man where now there are probably 50 owners. My most serious problem this past year came as a result of leafy spurge on lakeshore property. This resort, having 29 acres of leafy spurge, had been recently purchased. The assistant inspector and I talked to the lady who had bought the property. I identified the weed and told her which chemicals to use to control or eradicate it. At the time she seemed very cooperative. When I arrived home, I thought the information I had given this lady was perhaps too much for her to remember, so I went back that evening and talked to her husband. I gave him the same information I had given her. He agreed the problem would be taken care of. The township inspector and I returned 10 days later, and the spurge had not been taken care of. We went to talk to the lady to see why it had not been taken care of and she ordered us off her property. We served a Form 1 on her and she still refused to take care of it. We served a Form 4 to give the sprayer permission to spray the spurge. She ordered him off her property. I then called the District Inspector and he instructed me to call the sheriff. Two deputy sheriffs, the custom sprayer, the township inspector and I went to her property and had it sprayed. This is one method we have to resort to at times, but to me it is not the most effective or constructive method.

In summary, I believe a good educational program and good public relations with our town board members, assistant inspectors, and the people with whom we work will solve many of our special weed problems.

HOW I ORGANIZED MY PROGRAM

Koene A. Brouwer
Chippewa County Agricultural Inspector

In my work as county agricultural inspector I have found that in order to carry on a successful program of seed sampling; sprayer inspection and weed control, it is very beneficial to plan what is and how it is to be done.

I shall try to give a brief outline on organizing my program for the year.

In order to sample seeds you have to locate the seeds. To do this I subscribe to the newspapers published in the county and others. I also check elevators and other places where there may be bulletin boards with items listed for sale.

Farm calls have to be made although it has been my experience that the season to find seeds on farms is very short. Most seed bought by farmers from seed dealers or elevators comes in very shortly before seeding time; and seed delivered by truck is very often delivered to the farmer the day the elevator or seed dealer received it. A large amount of seed delivered to farmers is sown the day the seed is delivered or shortly thereafter. This makes it rather difficult to get a great number of samples on farms. We have quite a number of seed growers in my county but rather than be bothered by bagging and properly labeling seed for sale they sell it in bulk for a premium to a processor or seed dealer and no samples are available on those farms. In sampling seeds I make sure that all bags are in the same good condition after samples are taken as before. If necessary to move bags I try to put them back where they were.

I appreciate the inspection stickers for county inspectors furnished us by the Department of Agriculture; Section of Seed Inspection; this year. This shows that a legal inspection was made and by whom and helps to promote better public relations between inspector, seed handler and his customers.

I help Clifford J. Boss, my district inspector, sample seeds in elevators and at seed dealers. I try to get seed samples to the State office once a week.

As far as a weed program is concerned we have the annual weed meeting for all township boards, village mayors and appointed inspectors. Beside that the Extension Service puts on a program of weed control where reports are given on results of chemical weed control at the experiment stations and test plots put on by county agents. In Chippewa County we have a one day program with possibly four speakers at two meeting places in the county. Two speakers at each place and they exchange during the noon hour. We get fairly good attendance at these meetings.

Having been a county agricultural inspector for several years now my program for 1969 began as early as August of 1968.

No matter how hard you try to help get all weeds controlled there are always some weed problems in my county that have either been neglected or have not been called to a town boards' or my attention. It may be that a certain field has been sprayed at some time before and for some reason the chemical used did not work as expected. This may be due to time of application; amount of chemicals

used or some other reason. Be that as it may, you have a problem which cannot always be remedied in that year.

Then it is good to have a list of these problem fields and discuss them with the farmer concerned and alert the township chairman to these problems and begin making plans how to avoid a similar situation the following year.

I generally suggest drawing up a Form 41 and giving it, in person, to the farmer involved. On this Form 41 the weed problem is stated; the method of control or eradication is stated and specific crops to be planted are mentioned. With the Form 41 we generally give a copy of Extension Folder 212 for the farmer to read. When it becomes necessary to present a Form 41, I always make it clear to the farmer that the purpose of this Form 41 is not in the first place a legal notice to control weeds, but it is a plan which we would like to see him follow in order to get better weed control, but also for him to get bigger crop yields. With all The trial plots carried on by the University of Minnesota at various Experimental Farms and others carried out by the county agents and results secured by them for certain years and also for periods of succeeding years; we haveconvincing data and facts that weed control is possible and pays off in dollars and cents. The farmer is more interested in dollars and cents than any legal terms you may present concerning weed control so in most cases it is fairly easy to get him to go along with the plan presented.

There may probably be one or more farmers in a county that will not go along with this program, even after indicating that it is a good idea for them to follow. Then I visit these farmers and if necessary I ask my district agronomy inspector who happens to be Clifford J. Boss, to go along and see what can be done to get cooperation. If they still do not cooperate I see the township chairman and if they see fit to serve a Form 1, we give them a reasonable time to comply and if they do not, the work can be ordered done and the cost applied to the real estate taxes. If a renter is involved, a Form 1 is also sent to the owner of the land for if the whole legal procedure of weed control has to be followed the cost will be paid by the owner either willingly or applied to his real estate tax. Generally if an owner gets a Form 1, the matter is soon taken care of.

I have had occasion where the owner tells me he has a contract with the tenant and he has nothing to do with weed control. I do not argue with the owner but do try to explain the weed law, and as long as we have not gotten cooperation from the tenant, the final step is with the owner. I have found it very helpful to give the booklet, "Legal Procedure for Control of Noxious Weeds In Minnesota", to owners who think they have no responsibility toward weed control when they have a contract for lease with someone else. This helps to get the weeds taken care of, once they realize that in the final end they will have to pay for work done, chemicals used and that other costs such as inspectors perdiem and necessary expense may be placed on their taxes for the parcel of land involved. In most cases my town board members or village inspectors do the weed work except in some cases where I feel it is better for some reason for me to do it. I try to discuss weed problems with town board members before proceeding with anything. This serves as a sort of governor for both of us and avoids a lot of misunderstanding. Sometimes town board members may want to serve a Form 1 when it is better not to or I may think it should be done and they have good reasons for not doing so.

Here is one place where communication can solve or prevent problems which could be more difficult to solve than the one at hand.

Follow up work is necessary in all cases where weed problems arise and are not taken care of. Follow up work consists of making repeated calls to find out the reason why they continue to exist. It is here where I get all kinds of excuses such as, the sprayer pump broke, a flat tire on the sprayer, the hoses leaked and hose clamps broke, I didn't feel good or the wife had to be taken to the hospital to have a baby and many more. Of course, these are all valid reasons, but I try to establish the nearest date when it can be done now, and then call again to see if it is done when that day arrives. No arguing, but just follow up and I very seldome have to do this the second year.

It is not only farmers that have weed problems, although the most acreage in my county is farm land, railroads, state highways, county and township roads also have weed problems.

To help weed control on railroads right away , my district agronomy inspector Clifford J. Boss with the county inspectors in his district concerned with a certain railroad visit the roadmaster early in the spring and discuss weed control and weed problems in our counties where the railroad happens to be located.

We always receive a good reception and it helps a lot to get better understanding as to how the railroad plans their weed control and what we think should be done and where we feel they have problems. This accomplishes much to get a good start on weed control.

We also meet with the district engineer of state highways in charge of the roads in our county. They too are willing to cooperate in weed control. I find however, that the actual work is not done by the roadmaster or district engineers and weed work is only as good as the men down the line that do the work take pride in doing it.

Visits with workers can also be a great help to get better understanding as to what is expected of them by their superiors.

People in charge of wet lands are also contacted early in regard to weed problems they may have. In my own county I am in charge of all county roads and property as far as weed control is concerned. Township roads are a problem and should all be sprayed but not all townships do so. However, more interest is shown each year and in the not too distant future I expect to see all township roads sprayed.

I try to have a general knowledge of weed control chemicals but when recommendations for chemicals to use are to be made I refer farmers and property owners to our county agent or his assistant as they are experts in the field of chemical weed control in crops etc.

I meet with the county agent at various times to discuss weed congrol problems, In this way he knows who may come in to see him and how to handle the problem.

If some difficult problems regarding weed control come up it may also be wise

to inform the county commissioners as to the problem and what is being done. I have found that it can be very helpful at times if they have been informed, even though they expect me to take care of weed control in the county.

I try not to make a nuisance of myself to anybody. It takes diplomacy and tact to carry out a successful weed program. I try to remember the golden rule at all times and try to make sure I am right before I go ahead with any measure of weed control.

SOME OF THE PROBLEMS OF WEED CONTROL IN THE VALLEY

Art Paquin
Polk County Agricultural Inspector
East Grand Forks, Minnesota

Most of the farmers in the Valley are aware of weed problems and do a good job of taking care of them.

We do have some problems such as the Red River of the North overflowing its banks every Spring. This river is about 200 feet wide and separates North Dakota and Minnesota. The land on both sides of the river is called river bottom. It is very heavy with trees and brush for a quarter to half a mile wide on each side. There are good farmers on both sides of the river. Following the river during the month of June and looking across into North Dakota you see a solid mass of leafy spurge, Canada thistles and field-bindweed. Every Minnesota county from the Canadian border to Breckenridge along the Red River has the same problem. A lot of money for chemicals and labor is spent every season to keep these weeds under control. The North Dakota farmer spends a lot of money fighting leafy spurge on his cultivated land, but none in the river bottom because they do not have to.

Then we have the sugar beet plants. They are located at Drayton, East Grand Forks, Moorhead and Crookston. About 50 per cent of the farmers haul sugar beets to these plants every fall who are from North Dakota. Every farmer hauls his dirt back home and dumps this dirt in a low spot in his field. If a farmer, for example, has 100 to 500 pounds of dirt to bring home from each load, this dirt may be all North Dakota dirt. The Minnesota farmer has no way of knowing. I know that in many of the sugar beet fields on the North Dakota side throughout the Valley, a leafy spurge plant can be found during the summer months. I don't mean to blame the young North Dakota farmer if a plant is found here and there in his fields. He is really fighting this weed especially in his grain fields where he can spray early and again spray the stubble after the harvest. In a row crop such as beets, potatoes and sunflowers, his hands are tied. Weed plants are bound to ripen and the seeds fall to the ground before harvest. One young North Dakota farmer told me that he knew he was farming on top of leafy spurge and field-bindweed roots. He gets fairly good crops because he spends a lot of money on chemicals and wishes his neighbors would do the same. He hoped that some day North Dakota would have a compulsory weed law like Minnesota has.

Then we have thousands of large trucks hauling grain to Duluth following trunk highway No. 2 through Polk County for 85 miles. This has been going on day and night for the past six and seven years. Along that highway in ditches and shoulders, in the past several years, we have been finding spurge, jenny, tall buttercup and hoary alyssum.

The farms are large in the Valley. Much of it is row crop. Here is a grain field which needs spraying for thistles and wild mustards; along side is sugar beets; on the north end the neighbor has a potato field; to the south another neighbor has potatoes or tame mustards and a field of sunflowers on the east side. How can that field be sprayed without injuring some

row crop?

Some parts of the Valley are lower than others. In wet years weed problems occur in these areas because spraying cannot be done with ground equipment. Planes can be used providing the weather permits and the surrounding crops are such that they will not be affected by the spray.

These are some of the weed problems we have in the Red River Valley.

WHY GOOD PUBLIC RELATIONS ARE NECESSARY IN OUR WORK

Vincent Goihl
Wabasha County Agriculture Inspector

Mr. Chairman, Supervisor of the Department of Agronomy Services, County Agricultural Inspectors, and guests:

First, let me express my appreciation for the opportunity to be with you at this County Agricultural Inspectors' Short Course, and to have a part in this panel discussion on weed control and seed inspection. The subject which I will discuss and try to impress upon you is, "Why Good Public Relations Are Necessary In Our Work."

After only two years of experience as a County Agriculture Inspector of Wabasha County, I firmly believe that good public relations are the key to what we wish to accomplish. We have all heard our supervisors at the meetings which we attended tell us and stress the importance of public relations. If I remember correctly, it was about 80% diplomacy and 20% firmness. In my experience so far I find that by going to about 98% diplomacy, no firmness was necessary.

In my opinion all persons or people are good people unless they prove themselves otherwise. I never let a person's neighbor influence me, or try to create a hate, no matter what problem exists. Hating people is like burning down your own house to get rid of a rat. I like to find out for myself. It is a challenge. It is good for you and very satisfying to find that he reacts favorably to good common-sense talk. It is always possible that he had never been approached in a way such as you or I would like to be approached.

I do not believe in quoting the law or showing or telling any person the authority we do have. There is a lot of satisfaction in having that for a reserve if all other tactics fail. The person you are dealing with usually knows what the law is, but he may try to see how much he can get by with. In other words, it is easier to lead than it is to push. A story is told to describe what I mean about a policeman who stopped a drunk at three o'clock in the morning, who was dragging a chain down the street. His question was, "What are you pulling that chain for?" The drunk looked up bleary-eyed, and said, "Did you ever try pushing one?"

I received a telephone call early one morning from a farmer in my county, wanting to know if I could come out to his farm that morning, which I did. I was there in less than twenty minutes. He was talking to me before I got out of the car, complaining that the A.S.C. Committee was after him to cut the weeds in his soil bank land and the township board was after him to cut the weeds on the road which went through his farm. He said he really didn't have time to talk because he had to replace a reel on his combine. I told him we were wasting time because I could help him replace the reel and he could keep on talking. I asked him to really unload because usually some good comes from it. We went at the job, and he soon started to grin and even ended up by saying, "You know, I really have been slack the last couple of years." I find that you should never detain a

farmer when he is busy. If it is really necessary, try to make it short. The person will appreciate it.

Possibly the thing that has helped me most since I have been appointed County Agricultural Inspector is that I farmed all my life, up to five years ago, and weeds are something that I never let go to seed on my farm. Herbicides were used the last three years. Many times when I am out on my work these last two years people have told me that I had done a good job on weed control. Little did I realize then that what I did in those years was going to help me now.

I was elected to the board of directors of the Farmers Co-operative Elevator and was on this board for eighteen years, or until I sold the farm. The experience of being chairman of the board for fifteen years has helped me know how to get along with people. The problems that came up on jobs such as I just mentioned are similar to what we encounter on the job of County Agricultural inspector in that most of them are solved with common sense and good public relations.

Another good experience for me which possibly made me qualified for this job is that I married a girl out of a family of seventeen children. This, of course, was thirty-five years ago, and by now I am related to a large percentage of the people in this county. I have had no problems with my relatives. So if this is possible, I sure can get along with the few strangers that are left.

Good public relations are necessary in our work because it is in actuality the fine art of shaping public opinion. It has been practiced previously, but its importance was not really recognized until the early 1930's, and now it is an important part of our daily speech, our daily lives. It is used in whatever we are trying to accomplish. It is a continuous, not an occasional practice. It is contageous, just like a smile. Good public relations, if properly practiced, would do away with all inequalities and injustices. It would clear the air for the truth and promote good will. Good public relations are used to solve your promblems and work much better as a preventative than a cure.

The finest public relations policy ever formulated lies in the Ten Commandments. If practiced, they would make life on earth an utopian existence.

Let us use it in our daily lives for the benefit of all.

THOUGHTS ON SEED INSPECTION BY SEED RETAILER

Burton R. Peterson
Peterson North Branch Mill, Inc.
North Branch, Minnesota

As you drove to this meeting today, did you notice the conifers, the bare limbs of the oaks, birch and elm trees? You passed many beautiful homesteads, most of them so well kept with various plantings now dormant to be sure. Sure you did, but did you realize all of this comes about because of seeds? Seeds are ever a positive and creative force. Seeds are the germ of life, a beginning and an end, the fruit of yesterday's harvest and the promise of tomorrow.

The study of seeds is fascinating and often unbelievable. Take common rye seed. Did you know scientists measured the area of the roots and hairs of a single plant of Winter Rye and found that they had a surface one hundred times greater than all the parts that grew above the ground? Even more unbelievable was the speed with which they lengthened. This single rye plant grew three miles of new roots per day. Those are the regular roots, the brown stringy ones; added to them are billions of microscopic white root hairs that slide through spaces between grains of soil. With these added, the rate of root travel of this single plant of Winter Rye averaged the astounding total of 53 miles per day.

It is unbelievable; I have always held we have not appreciated the potential of Winter Rye as a soil builder and as a crop. Yields in our North Branch area are fast approaching a 40 to 50 bushel average yield. Top yield, not estimated, but weighed from a measured field, was 64 bushel per acre, most of which has been brought about by new varieties, fertilizers, and better cleaning of seed stocks.

What I have just said about rye is true I'm sure of many other crops and their seeds. A single Red Clover plant turns out approximately 500 copies of itself. The weed, Crab Grass, makes 90,000 seeds on each plant; is it any wonder it is such a problem, especially when we have just about gained control of its biggest competitor, Pig Weed, with Atrozine? A single seed of Pig Weed produces a plant that moves into our real estate with over a million seeds. Much the same holds true with Rag Weed and our current arch-enemy, Giant Fox-tail.

Gentlemen, I was to give you a Seedsman's view-point on the value of seed inspection at farm and retail points. The facts I just gave you indicate what potential there is hidden in all seeds. Lots of seeds are offered for sale that had these potentials at one time but through improper storage and improper handling, it is now gone.

Maybe the dealer doesn't know it as he offers this seed to his customers. You inspectors come in, sample it, test it, and hopefully get the information back to take all poor seed off the market. Here, fellows, is the hitch. It's too slow. Wouldn't it be better if you fellows were better instructed and had equipment that you could use in the field to inspect suspected lots and take them off sale immediately. Impossible? No, I believe you all are capable of detecting insect infestation, storage fungi, germ damage and often improper storage in the sample probes you take. Wouldn't that be a lot better than taking lots of seed off sale for such as a number missing on the tag or a seed tax missing.

From the 1961 Yearbook of Agriculture I read the following statement about a situation which is sure to be a problem after this past harvest-season's weather: "Spores of storage fungi occur in small numbers on the outside of seeds at harvest time. There also maybe some slight and superficial infestation of the outer parts of the seeds. Even when plants are subjected to continued moist weather at harvest, however, the fungi do not invade seeds sufficiently to cause any reduction in germination. Damaging infection occurs later, after the seeds have been stored and only if the conditions of storage are such as to permit the inoculum naturally present to grow."

I'd like to relate an incident that happened to me a couple of years ago. We made a practice of picking up samples of farm lots of known varieties of grain early in January of each year to get a germination test prior to taking a lot in to clean for seed. This lot happened to be Soy Beans; the sample the farmer had brought in had a good germination test, 90% or better, and it was put on our list of good lots. The time came when we wanted this particular lot to clean so we called the farmer to haul them in. I did not happen to be in the driveway when the first pickup load was delivered, so it went directly to the cleaner and processed and bagged that very afternoon and some of this lot was sold. The next pickup load came in and, as luck would have it, I waited on the producer and prepared to unload. As a force of habit I ran my hand into the load and squeezed the grain. Fellows, you can't imagine how much a grain or seedsmancan learn from just a "squeeze." The beans felt rubbery, indicating a problem of moisture, also had a slight musty odor which is always indicative of activity of storage fungi. Needless to say, I was shocked to realize some of this seed was already in the hands of a grower. We promptly called him, preventing the seeding of this seed, which had tested good, but had been improperlystored, stored on concrete without proper moisture barrier. Now we corrected this problem to some extent by having our personnel probe the samples on the farm but even then spoilage can take place before the seed is taken in to be cleaned.

So, fellows, don't judge us too harshly because I firmly believe all good seedsmen feel as I do that when we sell a customer seed that he is placing his trust in us that the seed he buys will produce the best possible crop, also he is betting a whole crop year of his life on our integrity. That, gentlemen, is an awesome responsibility that you as inspectors must share with us. As you know, when you draw a sample of seed, you take the analysis tag and replace it with a yellow copy. This used to bother me, but now I point out to my customers with enthusiasm and pride that this particular tag on the bags indicates that he is doubly protected when he buys that seed. It has been doubly checked. When we, in the seed trade, do that we not only indicate our cooperation with inspectors but elevate him in the eyes of the person he is to protect.

Because of the nature of our place of business where we clean and process seed, warehouse seeds for Northrup King and other seed houses, it is always a prime target for the inspectors. Elmer Moe and Charles Brasser collected more samples from our place, I believe, than any other single place they call on. Sure he's called on us about several things but always with a spirit of helpfulness and very often for our own good. He has been extremely helpful in indicating new laws and regulations. It is in this spirit of cooperation with the department that I always want to work and hope that the department gets the same cooperation from most seedsmen.

The very nature of your work prevents the very people you try to protect from seeing the true value of the tremendous job you and your department are doing, and the job is constantly getting bigger. I would like to see better labeling being placed on seed tags than just germination, purity. Why not viability, the vigor of the seed, moisture content? Why not indicate seeding instructions such as, if Soy Beans are planted deeper than 2-1/2 inches, 90% of the germination can be lost, which is also true of many other seeds.

As a seed salesman I get carried away by the potential of new varieties. Modern day seeds are produced to crash through all the ceilings of the past. Constantly we must throw out the window every prior guideline about what seeds can accomplish. It is going to take some doing to stay ahead. We cannot guess what the distant future will ask of its inspectors but perhaps we can step far enough into the future to see what our farmers already need. The fast changing agriculture dictates that like in many other ways even the most sacred "fact" maybe or is strictly tentative. To go back to standards set in the past may sound like good advice, but modern agriculture demands and will get better standards which must be maintained.

It is your job to see that the purity and germination is maintained in these seeds. I would think it is also your job to be aware of the many products that affect the performance of seeds. We cannot risk ignorance of herbicides, insecticides, fertilizer, soil amendments and a host of other items on seed storage and the failure to produce a crop after planting. I believe that the realization is growing that one who plants seed is less interested in seeds as such, than in the hoped-for outcome of planting the seeds--a good crop.

You will see the seed trade of the future as a hybrid of Agriculture and Commerce that will revolutionize seed production and one that is moving very fast to greater specialization and much greater merchandising of seeds. But seeds are many things. Above all else they are a way by which embryonic life can be almost suspended and then revived to new development even years after the parents are dead and gone. The skill of the plant breeders has already wrought miracles in hybrids of many varieties of crops. I firmly believe they are on the threshold of a great many break-throughs that will dwarf those with which we are acquainted today.

Modern day seeds will have to be watched much closer by both the dealer and the farmer, and consequently be studied by your department. As outstanding varieties are developed, there will be those unscrupulous promoters who will falsely misrepresent an older variety as "the new". I also believe that all seed bought should be bought with a growers declaration as to variety. Even now you will be surprised as how many good lots of oats, wheat, rye and other seeds are offered where the farmer doesn't even know the variety he planted, but it looks good and he feels it would make good seed. Often when we are looking for a particular seed grain, a lot is offered as that "variety" that we actually can tell it is not. A "grower declaration" would certainly prevent the dealer from being held responsible for any misrepresentation as to variety.

What can be done about "Proprietor Blends"? New ones are coming very fast. All we have now to go by is the integrity of the proprietor. Blends are also a problem to seed salesmen. What can be done about them? Blends are offered by most seed houses, often

to match a rival blend and we know darn well they haven't had or taken the time to prove them out. This I'm sure is also true with many proprietary "Brands" as well. As I understand, the Federal Seed act provides that "the originator of a new variety has a right to name that variety", but if the variety can be reproduced from seed it may be produced and sold by anyone. If it's outstanding how many proprietary names will it come out under?

As you probably already suspected that speaking is not my line, but with the opportunity to talk to so many inspectors at one time, I couldn't resist what a chance to get even! As an example, an employee of seed house was discharged for being discourteous to customers. A month later the manager spotted him walking through the plant in an Inspector's uniform, "I see you've joined the force, Olson," he said. "Yes", replied Olson, "this is the job I've been looking for all my life. On this job the customer is always wrong." Right or wrong, I believe we of the retail seed trade and your department should "strengthen our ties", and with all the possible strength improve our separate services to compliment our greatest industry--Farming.

And in parting, to you I say go on learning, go on sharing that learning with others, it may well be considered worthy of being our greatest goal.

WEED CONTROL AS SEEN BY A CHEMICAL MAN

John P Schuller
President, Minnesota Agricultural Chemical Ass'n.
Vice President, Barzen of Minneapolis, Inc.

My first work in weed control started by the hand pulling of wild mustard in my father's farm in Rice County. I then graduated to the use of the hoe in mother's garden - then on to the hand scythe cutting thistles in the pasture. Then started my mechanical control using a field cultivator on quackgrass before planting corn and throughout the summer on fallow land. The seat of the one-row horse cultivator seemed to be the answer to ultimate control until I graduated to the 2-row, then 4-row tractor cultivator.

After an interruption by F.D.R. for a tour of Europe, the hard way, I returned to theold never ending battle of the weeds. It seemed, at the time, we had the answer and would soon have our battle with mustard and Canada Thistle won. Instead of pulling or cutting, we just sprayed the tops with 24D using a 2 1/2 gallon hand sprayer.

The advancements made in chemical weed control since the 50's have been many. Millions of dollars are spent every year for new and better chemicals along with more sophisticated methods and equipment for their application.

The use of chemicals is not the total answer to weed control so we must still rely on a combination of chemicals and cultural practices to have a sound program.

According to USDA figures, the average yield of corn per acre from 1931 to 1935 was 23.5 bushels. This yield was almost doubled by 1952 when the average hit an astounding 40.7 bushels per acre. This was primarily due to hybrid seed corn being developed. The first commercial production of hybrid seed corn started in 1926 with many more companies being formed in the early thirties. The 1967 U.S. estimted corn yield was 76.6 bushels per acre and yields continued to climb with an average of 100 bushels in sight. Some scientists are even claiming that 500 bushels per acre yields are possible. These steady increases since 1960 are due primarily to the use of agricultural chemicals including fertilizer, herbicides, insecticides, etc.

No chemical is permitted a label unless it is tested and retested to assure it will do, for the user, that for which it is registered. Many times due to variations in temperature, moisture, soil conditions or composition, stages of growth, rates or methods of application may result in less than complete weed control or too much control causing damage to crops placed in rotation.

It is here we must all become 'Chemical Men' or specialists. We must try to understand why or how to make this product work for us, OR realize that our particular condition, the product rates, or application methods do not adapt for this use in our area.

No chemical yet developed is a cure-all or panacia to weed control. Until that chemical is discovered and released to us, we must continue to use and realize the limitations of our recommended chemicals. We must continue to try new products; varying rates of present and new products; combinations and application methods in our never ceasing search for better and more useful products.

Industry will keep up their search for better chemicals and combinations of chemicals and they will always be looking for those of use with enough interest, courage, knowledge and ambition to help them in sponsoring or doing research and/or test plots so that field evaluations can be made. Only those of us who keep up with the ever advancing techniques of weed control can expect to be in the parade instead of on the sidelines as our industry and opportunities march on.

To obtain the best weed control and produce the highest yields, we still must rely on both agricultural chemicals plus cultivation or tillage in our cultivated crops. Most of you are called upon at times to give advice for crop weed control practices as well as roadside, rangeland, or pasture weed control.

Only if we continue our efforts to control the weeds in our marginal areas can we expect to obtain and maintain maximum weed control in our crop land. These so-called 'non-productive' areas are the ones most commonly neglected and it is here that we have some of the most effective herbicides available for both control and tolerance to the ground cover.

To get our noxious perennial weeds under control we must establish an annual control program which at first may be costly in time and chemicals, depending on the problem weed species. Then a program of annual spot treatments to control the seedling weeds will maintain our areas free of weeds.

As a man who has spent most of my life in the battle of weeds and agricultural chemicals in general, let me remind you that Federal laws today require that all manufacturers of pesticides must prove the effectiveness of their products; must label their products to show what pests are controlled, and in what crops they may be used. They also must give on the label, warnings and cautions as to their use or handling and state how they must be applied.

Millions are spent testing for residue, if any, that may be left on the crop at harvest and the toxicity that that residue may have to warm blooded animals or humans. The USDA has men scattered all over the country who check pesticides at retail levels. Samples are sent to laboratories to be analyzed for label adherence. The chemicals may also be tested for effectiveness. A safe and legal tolerance is then established by the Federal Pure Food and Drug Administration. Thus today we enjoy foods that are freer from pest damage or contamination than ever before. In no other nation on earth do so few farmers produce so much food to feed so many people such high quality diets and at such reasonable prices. This task could never be accomplished without agricultural chemicals. Federal and State Food & Drug inspectors continually check all foods for residue. Only those foods that are completely safe are allowed to get to the tables of the consumers.

The chemical industry look to you, the inspectors and dealers, to help in the dissemination of information to the user as to the proper selection, use and safe handling of chemicals. It is through proper use of chemicals that the American farmer can continue to make this the land of plenty. Chemicals alone hold the key that will make the difference between starvation and survival of millions of people in the world today as well as the future.

Our growing population takes over 1 million acres of farm land a year for homes, roads, airports, etc. The American farmer must become more efficient to survive. To help him, you in weed inspection must do more to see to it that weeds not only are controlled along our roadways, railways and other public land, but in cropped and non-cropped land if our never ending battle is to be won.

Minnesota, one of the finest summer vacation states in the U.S., welcome travelers from all over the U.S. as well as many foreign countries. You, as inspectors, can make us all proud to have these visitors tour our countryside and cities. Who wants to see or tour a state that allows noxious weeds to grow and spread without cause of concern. Most of you do a tremendous job of weed control and your greatest thanks comes from knowing that you have done your job. Those of you that have not been able to get your job done, due to lack of interest by your county or local representatives or citizens should seek help from the State, industry, or neighbors who have a sound program. Arrangements to acquire your chemicals from a local dealer or applicator can always be made. Your local supplier is always ready to assist you in your job if and when you ask him. By working together, both of your jobs can be made easier. Your local agent and dealer in most instances will secure and stock any special material or equipment that you may need. The first step is to let your dealer know you would like to have him work with you in getting your area cleaned up.

Any program is only as good or as successful in direct proportion to the enthusiasm and work you are willing to put into it and the interest you can generate in others. Your local newspaper or radio station will help you sell your program by informing the public of the consequences of a properly controlled program and encouraging the public to do their own weed control where possible. Let the public know you are always ready to help in identification of the weeds as well as advise them what, when and how to control them. As a last resort you always have certain legal rights and means in putting your control program in motion.

Every chemical takes from 3 to 5 years to develop at a cost up to 2.5 million dollars. This money may all be lost if you as inspectors fail in your job. The American public as well as the farmer demands that you carry out the trust we have put in you.

These are some of the thoughts I would like to pass on to you today as a chemical man. Thank you.

SOME OF OUR WEED PROBLEMS IN NORTHERN MINNESOTA

Elmer Moe
Agronomy Services Inspector
Minnesota Department of Agriculture

The weed problems in northern Minnesota are many and varied, and exist for a number of reasons.

The physical and economic characteristics are such that the control of weeds often become difficult, and expensive. In these parts of the state where agriculture plays a lesser role in the economy we tend to have more people who are apathetic toward weeds. Possibly this is because of the simple fact that they do not live as close to nature as do farmers, and are less aware of the plant life about them.

The main attempt to control weeds in this area has been the approach of helping those trying to keep farming operations going. There is the stockman who is buying up tracts of abandoned farm land and swamp land for the purpose of beef production, and finds himself confronted with poisonous weeds which can harm, or kill his cattle, such as the water hemlock, bracken fern, black nightshade, and the horsetail. The seed producer is confronted by weeds such as the mustards, yellow and green foxtail, dodder, quackgrass and others which are often hard to clean out of seeds.

Another must is the control of weeds which have a detrimental effect on people such as the poison-ivy, stinging nettles, ragweed, and tansey. We must also help create an image of our state as being a comparatively weed free state, thus enhancing its beauty so it can continue to be appreciated by tourists.

Where there is a problem there is always a reason. The physical characteristics previously mentioned can fall into two categories, the natural, and the man made.

In the natural we have the rough rocky terrain, the large acreage of swamp, or peat bogg, heavy brush and timber growth; these make the weeds hard to get at. There is the climatic condition, average rainfall being high, and cooler temperatures which create ideal growing conditions for weeds. The fluctuating water level on many lakes thereby creating ideal weed growth areas along miles of shoreline. Great many rivers and creeks which can transport weed seeds from one area to another. Soil type is adaptable to several hardy perennials which are difficult and expensive to control such as the tansey, buttercup, and orange-hawkweed.

Then in the man made we have the piles of low content iron ore, and the vast acreages of trailing basins found on the iron range, access to weeds here is virtually impossible. The large areas of cut over timber lands now harbor weeds because of sunlite entry, and the large acreages of vacated farm land. Miles of railroad bed which are no longer in use because of the economic evolution of the area. In places the railroads, and the highway departments have found it necessary to maintain large ditch systems to control the water to prevent erosion of their road beds, and these ditches and remaining soil banks are

proving themselves as ideal spots for weeds to grow. Large acreages of tree plantings harbor weeds until such time as the tree's growth becomes rank enough to shade the ground, thus preventing weed emergence.

As previously mentioned, the economic characteristics contribute to our problems. The more important of these would be that weed control costs are high in relation to land value, when land is worth from $10.00 to $20.00 per acre and producing nothing, there is little incentive to spend $5.00 per acre for several years to remove weeds. Some counties report that only 18 to 25% of their lands are on the tax rolls, the remainder of the lands are owned by the State, Federal, Municipal, or County Governments, Indian lands, schools and churches, and therefore are tax exempt. Most of the counties and local governments are working austere budgets because of the loss of tax base, and large welfare expenditure. Large transient population, and absentee land ownership present problems as these people do not, for the most part, tend to possess pride of ownership, and all too often retain a "don't care" attitude. Weed control equipment is at a minimum in these areas, and often must be brought great distances when needed.

These are the problems on weeds and their control in northern Minnesota.

The weed control program in northern Minnesota is dictated by its economy, therefore weeds are controlled when their presence become a threat to the health, and livelihood of its people.

As long as the township, and village governments operate in the belief that they are the roots of our democracy, and the County Agricultural Inspector has a devotion to duty, we will continue to do what is possible to solve -- SOME OF OUR WEED PROBLEMS IN NORTHERN MINNESOTA.

THE WEED PROBLEMS IN WEST-CENTRAL MINNESOTA

Arthur Millerbernd
Agronomy Services Inspector
Minnesota Department of Agriculture

It would be nice to live in a district that had no weed problems. I think that most of us will agree that this is a very elusive goal. West Central Minnesota is no different than any other section of Minnesota. We do have weed problems. We are trying to make progress toward this goal. Our degree of success has been varied. In some areas we have been quite satisfied and in other areas somewhat displeased.

In the western part of our district, wild sunflowers have been a very difficult problem. In one area, hundreds of acres were very heavily infested with wild sunflowers. The township boards, with the assistance of the county Agricultural Inspector, served form one's to all the farmers in this area. These form one's were served early in the spring, well ahead of spring planting. These forms specified that no soybeans or flax could be planted on these wild sunflower infested fields. Before these forms were served, the County Agricultural Inspector called on most of these farmers. He explained the seriousness of this problem and the procedure that was to be employed. As this is primarily a small grain area, it was suggested that cereal grains be planted on these lands and that they be sprayed with 2,4-D and plowed early in the fall, immediately after harvest. Each year these forms are served on these same farmers. The fact that the soil of these fields are heavily infested with wild sunflower seeds, makes this follow-up procedure necessary. Additional form one's are served in the surrounding area each year when necessary. In these surrounding areas the wild sunflower infestations are not as concentrated. Many farmers in these areas, after observing the results of our program, are setting up their own programs of control of wild sunflowers. We freely admit that we still have a wild sunflowe problem, and that we will have one for some time to come. We do feel, however, that a good degree of progress has been made and we hope to continue this rate of progress. In another county the wild sunflower infestation was more of a scattered nature. Here a program of personal contact was used. The County Agricultural Inspector and the township board members together called on the problem farmers. This was done early in the spring before planting time. In every case a realistic program was set up and carried out. The Board of County Commissioners of this county sent a letter to each township board requesting that this type of program be started. I am certain that the active support by the County Commissioners did contribute a great deal to the success of this program.

Weed problems on some Federal Wetlands has caused us some concern these last two years. There are some Federal Wetlands that have no weed problems, some that have the weed problem well under control, and still others that have left much to be desired. In 1967, many complaints were received in one county by the county commissioners, county Agricultural Inspector, and myself. Inspection of these areas proved these complaints to be well founded. These complaints were received too late to allow for realistic correction that year. The local authorities for the Federal Wetland Areas were contacted by county and state weed control personnel on an individual basis. These contacts led to a better understanding of this weed problem by all concerned. The end result was that these weeds

were taken care of in 1968, and in such a manner that not one complaint was received from this area. In two other counties we did receive complaints in 1968. Investigation of these complaints revealed that these complaints were justified and received in time for corrective action. The local authorities for this Federal Wetland Area were contacted. In my opinion, we did not receive the cooperation from this local office of the Federal Wetland Area that we had from the previous one. It was decided to hold a meeting to try to solve this problem. This meeting was moderated by the County Attorney. Attending this meeting were the County Commissioners, Auditor, Agricultural Inspector, two Township Board members, two representatives of the Minnesota Department of Agriculture, St. Paul Office, an observer from an adjoining county, two local officials for the Federal Wetland Area, and myself. Everyone who attended this meeting expressed his opinion on this problem. This meeting concluded with assurance from the Federal Wildlife Authorities that this weed problem would be corrected next year. It is regrettable that time lapse did not allow corrective action this year. The summer of 1969 will prove whether or not this meeting was a success.

At one time county lines have been somewhat of a problem. This has been partly solved by having County Agricultural Inspectors from both sides of the line inspect these weed problem areas jointly. This united, organized, type of inspection seems to obtain good results.

Our success in solving weed problems in West Central Minnesota has not always been what we desired. We will try to obtain progress in solving these problems in the future.

WEED CONTROL ON STATE HIGHWAYS IN 1969

W. S. Ekern
Assistant Commissioner
Engineering Standards Division
Minnesota Department of Highways

I. Review of new standards for mowing.

   A. Effect on costs.

II. Expenditures for 1968.

   A. Labor.
   B. Equipment.
   C. Materials.

III. Responsibility of highway department.

   A. Right-of-way.
   B. Temporary easements.
   C. Adjacent properties.

OUR EXPERIENCE ON WEED CONTROL BY MOWING AND SPRAYING

David L. Kill
Acting Agricultural Engineer
Minnesota Highway Department

I. Our philosophy of weed control.

- A. Policy.
- B. Broadcast.
- C. Spot treatment.

II. Equipment.

- A. Sprayers
  - 1. Conventional.
  - 2. Invert.
- B. Mowers

III. Chemicals

- A. Commonly used.
- B. New ideas.
  - 1. Research
  - 2. Economics

IV. New construction.

- A. Weed problems.
  - 1. Topsoil.
  - 2. Mulch.
  - 3. Seed.

V. Fertilization.

VI. Cooperation.

- A. Maintenance Engineer.
- B. County Agricultural Inspectors.
- C. Communication.
- D. Education.

WEED CONTROL ON RAILROADS

V. C. HANKINS, Great Northern Railway

Mr. Chairman and members of the Minnesota Agricultural Pesticide Short Course.

I am the Engineer of Maintenance of Way for the Great Northern Railway Company with headquarters in St. Paul.

Part of my duties is the responsibility of maintaining adequate weed and brush control on this right-of-way which traverses nine states. Needless to say, this involves dealings with nine different sets of rules, nine different groups of people and various climatic and soil conditions. You can imagine the varieties of weed and brush species that we encounter on our property.

Our 10,000 mile strip farm consists of approximately 120,000 acres which represents a considerable investment and of which we are very proud. We are quite a taxpayer and because of our public image we endeavor to keep our farm unit in good condition.

In the early days weed and brush control on the railroad was accomplished through the use of hand labor. At that time the railroad employed many unskilled laborers and there were times when they were available to cut or scalp weeds and brush. As mechanization progressed less unskilled labor was available for weed control, so our railroad began to look to chemicals to eradicate weeds and brush. Some of our early results with chemical weed killers were fantastic. So we began to spray the whole system, building up to 6 spray cars to accomplish this purpose. It appeared as though we had eliminated a problem.

You men are familiar with mother nature and know what happened. Either some weeds became resistant to the chemicals or species which we hadn't noticed before were resistant to the herbicides and they began to multiply rapidly when other competition was removed.

Other railroads ran into the same situation. So in 1950 the Research Division of the Association of American Railroads launched an extensive research program into chemical weed ontrol on railroads. Besides conducting their own testing program, they are doing extensive work with various universities, chemical companies and the railroads themselves. Out of this have come valuable guidelines and recommendations for railroads to follow. In fact, they have a permanent standing committee that oversees this work and keeps it up to date. As I recall your former leader, Mr. Sig Bjerken, was a frequent participant in the various seminars conducted by the AAR to bring railroad personnel up to date on all aspects of weed control.

In spite of our own efforts and the efforts of our industry, Gentlemen, we need your help. When you look at a publication dealing with herbicides you realize that there are hundreds on the market today. New ones are coming out all the time and many of them for a specific use. We cannot keep on top of all the current developments in herbicides, also we are basically engineers not agronomists. This is why we depend on men like you plus college people

and chemical suppliers to keep us informed as to the most effective herbicides for our problem weeds.

The foregoing has been mainly concerned with vegetation control on our roadbed section, later on I will give you some reasons why this is important to us as a railroad company. Now I want to get down to the thing that is closer to your heart, noxious weed control.

From time to time, through leakage of box cars and through drift from adjoining land our right-of-way becomes infested with undesirable or noxious weeds. While these weeds are not a serious problem for us as a transportation company they do by their existence, have a detrimental effect on our neighbors and customers. Cost prohibits us from spraying the entire right-of-way but we do want to control patches of noxious weeds as they are brought to our attention. We have purchased some portable sprayers that are available to our forces to do this work when possible.

In this mechanized computer age most everything is programmed and our work is no different, so sometimes the timing on our weed spraying may not be just right. Also, our work force is programmed and we do not have men available to treat patches of noxious weeds on short notice. This is when we depend on you. Many times, especially when small patches are involved, we would prefer for the weed inspector to have it treated and bill the railroad. Of course, we ask that you not do this without our prior knowledge and approval. I suggest that each one of you become acquainted with the roadmaster in your area and work out a simple procedure with him. We would also request that we be asked to spray only when our neighbors do likewise (actually we feel fortunate in this respect in Minnesota because of your excellent organization), and if an applicator uses new or hazardous chemicals, Tordon for example, that he assume liability for them. If and when you do find patches of noxious weeds on our property it would be appreciated if you would also recommend, to the roadmaster, the best current chemicals for their eradication.

We are fortunate in Minnesota in having worked up an arrangement with Mr. Sig Bjerken and his successor, Graham Fuller, whereby we attempt to make treatment within ten days after notification. In the event we are unable to follow through with this schedule we would appreciate your contacting either the local roadmaster or my office for other arrangements. It is our policy to cooperate to the fullest extent with the various Weed Control Districts for elimination of noxious weeds and we ask that you notify us of any meetings in this regard so that one of our Supervisors or myself may be present to discuss how best to handle noxious weed control on our property.

I will now explain the purpose of weed control on our railroad: First and foremost, a stable track is dependent on a dry roadbed. This is one of the reasons we use ballast. Any foreign materials, such as weeds and their roots, which tends to foul the ballast causing it to hold water is undesirable. Not only do weed roots clog this drainage field, the weed itself acts as a stop for blowing soil thereby contributing to the retention of moisture causing a detrimental affect, not only on the life of our cross-ties, but resulting in a pumping and shifting action of the roadbed.

Secondly, there is a safety factor involved. Traction is of vital importance to the movement of trains and weeds on the rail act as a lubricant causing wheels to slip. Obscure signals, hidden obstacles and obstructed visibility

at crossings all contribute to hazardous situations.

Third, vegetation is always a fire hazard to railroads especially around bridges, buildings and communications lines.

Fourth, unsightly weeds do nothing for the moral of our people and the appearance of our railroad.

Fifth, we have a public image to protect and of which we are quite proud.

Sixth, we are a law abiding company and wish to comply with all laws, Federal, State and local.

I may have overlooked some items of importance on the subject of railroad weed control, but these six are primary in our estimation.

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Now, I would like to show you some slides on weed control on railroads.

In conclusion, it has been a pleasure for me to be here and talk to you about some of the problems railroads face in weed control. We appreciate your continued interest and cooperation in this field. If you have any questions, I will attempt to answer them at this time.

If not, thank you for your attention.

THE FEDERAL WETLAND PRESERVATION PROGRAM AND RELATED WEED PROBLEMS

Clair T. Rollings
Staff Specialist, Land Management
U. S. Fish and Wildlife Service

I. The Federal Wetlands Preservation Program.

- A. What is it?
- B. Why is it needed?
- C. Aims and Objectives.
- D. Location and Scope.
  - 1. Entire system.
  - 2. Minnesota.
    - a. Benson District.
    - b. Fergus Falls District.
- E. How are Federal Wetlands managed?

II. Weed Problems on Federal Wetlands.

- A. Origin of weeds.
- B. Principal species of weeds.
- C. Responsibility for control recognized.
- D. Control Methods and Results.
  - 1. Cultivation.
  - 2. Mowing and grazing.
  - 3. Competition with desirable plants.
  - 4. Herbicides.
    - a. Restrictions on use of Federal lands.
    - b. Most successful herbicides.
  - 5. Funds and time spent on weed control in Minnesota.
  - 6. Cooperation with farmers and weed control agencies.

III. Future Plans for Federal Wetlands.

- A. Control of weeds and long range habitat development.
- B. The place of Federal Wetlands in the community future.

EXPERIMENTS IN THISTLE CONTROL

J. R. Gute
Steele County Agricultural Agent
Agricultural Extension Service

Director Abraham and friends. This afternoon I will review briefly with you two phases of our experiments in thistle control in Steele County. One is the experiment to control Canada thistle on roadsides. The other is the control of Canada thistle and sow thistle in fields to be planted to soybeans. The experiments were carried out in cooperation with the County Agricultural Inspector, C. D. Carlton.

In Steele County we look on Canada thistle as a community problem. They spread from fields to roadsides. Thistles on roadsides are a continual source of re-infestation of fields. From our observation mowing does not give effective control. With increased cost of labor, etc. we were looking for an effective way to use herbicides on roadsides. The objective was to help the county board of commissioners and town boards develop an effective way to control thistles on roadsides.

Gerald Miller, extension agronomist, made up Canada thistle control demonstration kits which we used in 1966 and 1967. The plots were located on a township roadside in cooperation with the local town board. The following is a summary of materials used and results for 1966 and 1967:

Herbicide	Rate Per Acre	Date Applied	Percent Canada thistle Kill 1966	1967
Picloram	2 lbs.	In 1966	100	100
Dicamba	10 lbs.	on	100	100
2,4-D amine	2 lbs.	June 15	91-99	91-99
Amitrole-T	4 lbs.		71-80	71-80
TBA	20 lbs.	In 1967	81-90	81-90
Fenac	15 lbs.	on	91-99	91-99
TBP and 2,4-D	16 lbs.	June 8	71-80	71-80

These plots were located adjacent to each other and completely within the same thistle infestation. The plot site was nearly ideal. There was a very heavy infestation of Canada thistle. In part of the infested area the thistles were crowding out the grass. Each year the thistles had good growth and had good broad-leaved surface at the time herbicides were applied.

Some re-infestation has come in to the plots from the untreated areas. The rate of application of the herbicides used did not kill the grass. The bluegrass and bromegrass has filled in very rapidly. The 2,4-D amine plot has maintained control into 1968 nearly equal to the picloram and dicamba. There is a marked difference in cost. A cost comparison of the different herbicides is given in Extension Bulletin 329, "Controlling Canada Thistle."

With this information we started another type of experiment in 1968 with the cooperation of Gerald Miller, extension agronomist. This experiment was to compare 2,4-D amine applied at different rates and time of application.

Herbicide	Rate Per Acre	Percent Kill	Date
2,4-D amine	1 lb.	80-90	6-6-68
2,4-D amine	2 lbs.	over 90	6-6-68
MCPA	2 lbs.	80	6-6-68
2,4-D amine	1 lb.	over 90	6-18-68
2,4-D amine	2 lbs.	over 90	6-18-68
MCPA	2 lbs.	80-90	6-18-68
2,4-D amine	1 lb.	80-90	7-5-68
2,4-D amine	2 lbs.	80-90	7-5-68
MCPA	2 lbs.	80-90	7-5-68

The infestation of thistles was uniform; however, there was a much heavier growth of grass, some broad-leaved weeds and wild rose bushes. To prevent side re-infestation, picloram and dicamba were used at the ends. All thistle plants were not above the grass at the time of application on June 6. Most of the thistles, broad-leaved weeds and rose bushes had very good growth at the second application. The thistles were full-budded at the time of the third application. The MCPA did not show any effect on the rose bushes.

For 1969 we expect to repeat the above treatment. We plan to add dicamba and picloram to be applied in an adjacent area at different times later in the season. Again Gerald Miller will be cooperating by helping to plan treatments and providing the herbicides.

The second phase of our thistle control experiment is in fields to be planted to soybeans. In Steele County farmers want to grow corn and some more soybeans. Thistles, both Canada and sow, have spread rapidly in soybeans with no control other than the mower. In the fall of 1966 the County Agricultural Inspector had required some farmers to mow the worst of some thistle patches in soybeans to keep some one happy. Mr. Carlton returned from the Agricultural Inspectors' Short Course with the idea to use 2,4-D on thistles (both Canada and sow) in the spring before the soybeans were planted.

We felt it was worth a try. In Steele County our program for control of thistles in fields to be planted to soybeans is:

1. Leave the field uncultivated in the spring
2. On or after May 25, spray the thistles with 1 pound of 2-4-D low volatile ester per acre
3. Leave the field at least one-week and preferably 10 days
4. Prepare seed bed and plant soybeans
5. Use a variety of a medium to early maturity

In 1967 the above program was carried out on two farms. There were a few thistle plants in each field. They did not blossom and both farmers harvested a good crop of soybeans instead of mowing down thistles. With this much experience and two happy farmers, the program was expanded to 20 farms in 1968 with the same results. The agent prepared two news releases in regard to the control program early in the spring.

The program on these 20 farms was supervised very closely by the County Agricultural Inspector. He was present when the fields were sprayed. He was also present when the field was worked for planting to be sure the interval of at least seven-days was observed. This was part of the weed program for these 20 farms in 1968. They tried pressure because of the season to deviate from the plan. As the planting season progressed, farmers offered many reasons why they wanted to spray thistles earlier and to cut down on the seven-day interval. We held to the plan laid out. All of the farmers cooperated. They controlled the thistles. As no field was completely harvested at one time in the fall of 1968, our best estimate of yield was 23-30 bushels of soybeans per acre. These farmers are now talking about what they did with their neighbors. Based on this experience, we will be expanding the program in 1969.

I have observed one field sprayed before May 25, and this farmer did not get any where near the same results that the farmers did on these 22 farms in 1967 and 1968.

Apparently there are a couple of fundamentals in this program. The field must be left uncultivated and not sprayed until May 25 or later. After spraying the field must be left at least seven-days. In Steele County the spray used has always been one pound per acre of 2,4-D low volatile ester.

I have reviewed what we have done in Steele County with thistle control in soybeans for two years. My suggestion would be to take just one or two farms in 1969. Arrange to have it supervised very closely as to timing. Based on experience you can expand as the local situation warrants it in future years.

WHY SEED SAMPLING AND TESTING IS IMPORTANT IN A GOOD WEED CONTROL PROGRAM

Donald Hasbargen
Mower County Agricultural Agent

There is an old adage that says "an ounce of prevention is worth a pound of cure". This certainly applies to seed sampling and testing. There are plenty of weed seeds in our fields just waiting to be brought up into a good seed bed, without planting more with the grain seed.

After a harvest season such as we have just gone through there is reason for concern about the germination of the grain this spring. The good seed producer knows how to take care of his seed and will market a good quality product. What about those farmers in your county that back the grain drill up to the granary door and shovel the grain out of the bin? How can he be sure he will have a stand?

Your state agency is known as the Division of Agronomy Service. Through seed sampling you can certainly be of service to the farmers of your county. By publicizing the fact that farms may get up to five (5) free tests from the state laboratory you are underway. I hope you don't stop here.

I would like to describe the program we use in Mower County. About ten or eleven years ago when John Koenigs went on the job as county inspector, we quit handling sample bags at the County Extension Office. Instead we took down the name and farm location of those requesting bags and sent John out to take the sample. One reason for this was so John could get better acquainted with the farmers in the county.

We found a few people reluctant to have him take the sample, because as we suspected, they were hand cleaning a small sample to send in. They were then selling on the basis of this report. In these cases we have protected the buyers. Now we have very little resistance to this program. I believe that the majority of the samples now taken are for farmers to see if their grain is suitable for seed or if they should buy new.

We could cite many examples where this approach has saved many headaches for the farmer and the county inspector. I recall several years ago when a report came back with well below 50% germination.

How do you compare seeds of different quality and price? I recalled several years ago hearing our Extension Agronomists use some formula along this line. I asked Harley Otto if I might include them in my presentation. Here are two formula that I think you will find useful

$$\frac{\text{Price per pound}}{\%\ \text{purity} \times \%\ \text{germination}} = \text{Price per pound of Pure Live Seed}$$

$$\frac{\text{Expected Quality} \times \text{planting rate}}{\text{purity} \times \text{germination}} = \text{Adjusted Planting Rate}$$

Expected Quality=Purity of Good Quality Seed x Germination of good seed

By comparing seed lots with these formula you will find many timess that this 'cheap' seed is more expensive in the long run.

Why do I feel that seed sampling is important?

1. You can head off many problems for your farmers.
2. You are on friendlier grounds when you are performing a service than when you are enforcing the law.
3. You have more time to help a farmer during the winter months.
4. By providing a service you can prove to your farmers that you are not such a bad guy after all.

WHY COOPERATION OF THE COUNTY AGENT AND COUNTY INSPECTOR IS SO IMPORTANT IN A GOOD WEED CONTROL PROGRAM

Warren F. Liebenstein
Rice County Agricultural Agent
and Associate Professor
Agricultural Extension Service
Faribault, Minnesota

In my opening remarks I first want to point out that as County Inspectors and County Agents we represent two areas of responsibility.

1. The County Inspectors responsibility is one of regulatory work and he is responsible to the State Department of Agriculture Division of Agronomy Services and his County Board of Commissioners.

    a. His Duties as prescribed by law state that he is to carry out provisions of the law dealing with weed control and seed inspection and participate in insect, plant disease, economic poison, feed and fertilizer programs or other Agriculture programs requested by the Commissioner of Agriculture with the approval of the County Board of Commissioners.

2. The County Agent's responsibility is one of conducting educational programs and is responsible to the University of Minnesota, the U.S.D.A. and his County Board of Commissioners.

    a. He is charged with the responsibility of furnishing information and developing programs to better help people analyze and understand their problems.
    As an example I might sight acquainting farmers with a herbicide which has been researched by the University of Minnesota or the U.S.D.A.

Now that we better understand what our responsibilities are, let's discuss areas in which we cooperate.

1. We learn from each other by discussing recommended weed control measures; we compare notes on the success or failures we have observed with these measures and look for reasons why.

2. We often work together in establishing test plots where various chemical and cultural weed control methods can be tested and also plots to test crop varieties. These plots are open for public inspection.

3. We work together on weed identification and study growth habits so that we can suggest the best control measures that, where possible, will be compatible with the farmers cropping program.

4. We study crop varieties stressing quality seed through seed sampling and testing and are able to suggest quality seed sources to farmers.

5. We work together in helping with sprayer inspection, calibration and operation.

6. Perhaps one of our most important areas of cooperation is that of meeting with farmers who have special weed problems which they have not been able to control. After making a study of his management and cropping practices, a weed control program is suggested which will allow him to get the greatest return in crop production and at the same time control a weed problem which may have had the potential of infesting an entire neighborhood.

7. We work very closely in analyzing weed and seed problems in the county and to what extent these problems are being taken care of. This information is used in the inspectors annual report and also in developing our extension programs.

8. Another area I feel our cooperation has been mutually beneficial has been in working with town boards, city and municipal councils and, of course, our County Board of Commissioners. We have in many cases been able to acquaint them with problem areas within their jurisdiction and suggest a course of action. For example: weed control on public roads, parks and other property.

9. In many instances the county inspector operates out of the County Agent's office and his calls and complaints are handled through the Extension Office.

10. Many county board of commissioners expect the inspectors and agent to work as a team in weed control and seed inspection work. We appreciate the fact that Mr. Fuller has suggested to the County Boards that the agent assist them in establishing requirements and interviewing applicants when new inspectors are hired.

Minnesota has been known throughout the nation as having one of the best weed control&seed inspection programs; I firmly believe that one of most important reasons for this is the fine working relationships and the cooperation we enjoy between our Division of Agronomy Services, our County Inspectors, our University of Minnesota Agricultural Extension Service and County Agents. As County Agricultural Inspectors we have the utmost respect for you and pledge our continuing cooperation in our combined efforts to make a more efficient agriculture through even better weed and seed programs.

I'm sure we will all agree that education is often a good method of getting compliance with laws and regulations.

HOW CAN WE PROMOTE A MORE THOROUGH WEED CONTROL PROGRAM

Francis J. Januschka
County Agricultural Agent
Stearns County

The hoe and the farmer symbolize the constant battle with weeds. Physical force by the use of his hands and tillage implements were the solution to this problem of weed control.

Herbicides have recently greatly increased the operators ability to solve the weed problem. However we might take a look at how much of our crop was actually treated with chemicals in 1967:

	Total Acres	Acres Sprayed	% of Total
Corn	6,033,000	4,204,410	70%
Grain	5,062,000	3,041,909	60%
Beans	3,591,000	1,398,203	40%

Percent of State Highways sprayed, county highways sprayed and township roads sprayed in Minnesota counties averaged:

State Highways - 46%

County Highways - 56%

Township Roads - 30%

Weeds compete for the same things as farm crops:

1 - Nutrients

2 - Moisture

3 - Fertilizers

We'll have to admit that the acreage sprayed (percentage), the roadsides sprayed (percentage and acreage), and general chemical materials used this past year look quite impressive, and yet as we look across the country and across fields we see weed problems all over the area.

Either our sprayers and chemical users are not applying the right amount or are using the wrong material or are putting it on at the wrong time of year or stage of growth. I'm inclined to think that perhaps it's a combination of all of these.

Education and training for those selling and those using weed chemicals will be more important in the future than it has ever been in the past. Every year new materials, new formulations, new terms, new application and rates will make it necessary to stay current for those using or selling agricultural chemicals. There is some movement underway concerning the misuse of chemicals and rightly so. We hear of pollution of our air, lakes, and streams.

It will be necessary to promote not only the sale of weed chemicals but also the correct useage of these chemicals. There are many ways that this can be done. The chemical dealer or distributor should know his product and under what situations it can be used. The Agricultural Chemical and Pesticide Workshops put on by the Extension Service throughout the state is excellent to give background information for anyone that will be handling and working with chemicals.

I believe the dealer, the county agent, the ag teacher, the district supervisor, and the county inspector should be the first to have this knowledge. They in turn are then responsible and in a position to give positive recommendation for specific situations.

Now there should also be close liaison with the Soil Conservation Service with the tree planting program, as well as the forestry representatives; the A.S.C.S., and their ACP program.

Each county has an annual Weed & Seed Conference early each year. These require township, city and village officials to attend. These people have been elected and are considered the leaders in their community. This meeting can be one of the most important for the entire year concerning the county weed control program or it can be one of the most boring meetings of the year. May I suggest that the district supervisor, county inspector, and the county agent get together and plan this meeting far enough in advance so that a good program can be put together. This will mean that those individuals from the Department of Agriculture appearing on this program should also be in touch with each area of the state and the local planning group to indicate their areas of discussion.

County weed control demonstration plots can be a very effective method of getting information to people in a community. A demonstration trial does little good if no one knows about it. The Extension Service has available each year prepared kits which can be put out in the state for demonstration purposes.

Probably one of the most commonly used methods of promoting a weed control program is by attending special weed control meetings held by Extension, chemical companies, ag departments, dealers and others. Last year the Stearns County Extension Service held seven of these sessions throughout the area with very gratifying response

Demonstration trials on individual farms whereby the farm operator himself makes comparisons on chemicals and rates of application are an excellent way of promoting a weed control program. Seeing is believing on an individuals own farm.

Methods of getting the information out are many if only they would be used. In most cases the news media is most happy to publicize matters concerning weed problems and control methods in their area. These news media include newspaper, radio, T.V., newsletters, 4-H and F.F.A. special projects. Hundreds of people can be reached in this manner and usually a person has to hear it a number of times before trying it himself.

Continued effort with personnel contact with highway department, railroad company, city hall, and power companies will be necessary to promote the weed control program in areas off the production field. This I think has been demonstrated and proven in many areas of the state.

We still have a long way to go despite the figures showing how much acreage was sprayed and how many gallons have been used. Two major areas needing considerably more promotion are pasture weed control and township road weed control. Continued effort needs to be put on obtaining township, village, and city inspectors to get a more complete job done. County inspectors - your job is too big to do it all by yourself - work through your local government units.

THE REGULATORY END OF WEED CONTROL AS SEEN BY THE COUNTY AGENT

Ernest D. Johnson
Redwood County Agricultural Agent

The problem of weeds - plants growing where they are not wanted - has been a threat to profitable crop production since man first tilled the soil. The parable of the sower in the Bible is dynamic testimony that the farmer's survival was threatened by weeds as long as 19 centuries ago. Today, through the application of timely cultural practices and use of specific herbicides, a more successful crop is assured. To be sure, losses from weeds are still a major deterrent to high farm income, but we are well on the road to solving this age old problem.

Losses caused by weeds in the United States are believed to equal the combined losses from insects and diseases and rank second only to those caused by soil erosion. Losses from weeds and costs of controlling them on agricultural lands are estimated to be about $4 billion each year. The weed control problem presents a major challenge to the most efficient farm operator because of the increasing labor and other production costs that help to reduce net income. Weeds hinder complete mechanized production of many crops. They lower crop quality and yield and cause many other losses, such as poisoning of livestock, inducing off flavor in milk, reducing flow of drainage waters and impair human health.

Much of the energy and horse power used on farms is for the purpose of moving more than 250 billion tons of soil each year, much of it several times in tillage and cultivation operations. This amount of soil would make a ridge 100 feet high and one mile wide from New York to San Francisco. This is the world's largest materials handling operation and the energy required to perform this work is enormous. At least one half of this vast tillage and cultivation operation is practiced solely for the control of weeds.

Without specifically developed, carefully tested, and controlled chemicals modern agriculture would be unable to meet domestic and world markets. In today's farming, agricultural chemicals - insecticides, fungicides, herbicides, fertilizer materials and feed additives - are as important to the total scheme of production as the tractor and other machinery, land, labor, and capital. The latter in puts would not be used as efficiently without needed chemicals.

Herbicides have many diverse uses. They are used to control weeds in crops, pastures, orchards, lawns, gardens, roadsides, railroads, recreational areas, forests, lakes, and other areas. Estimates of herbicide use on some of the major crops show that the volume of herbicides used has more than doubled in the last decade.

Using chemicals to ensure the efficient, economic production of high quality food, ornamentals, fiber, and timber and to control public health and nuisance pests is not without some problems. Carelessness and misuse can result in:

1. HAZARDS TO THE USER.

2. HAZARDS TO TREATED PLANTS, LIVESTOCK, CROPS.

3. HAZARDS TO CONSUMERS.

4. HAZARDS TO FISH, WILDLIFE, AND OTHER NON TARGET ORGANISMS.

5. HAZARDS TO SOIL AND WATER RESOURCES.

However, there are safeguards that minimize problems and hazards.

Included in this grouping are:

I. Legal Safeguards

A. The Federal Food, Drug and Cosmetic Act.

1. Major amendments to 1938 law.

a. 1954 Miller Pesticide Amendment.

b. 1958 Food Additives Amendment.

c. 1960 Color Additive Amendment.

B. The Federal Insecticide, Fungicide, and Rodenticide Act.

C. Other Regulations.

II. Research Safeguards

III. Educational Safeguards

I believe our first responsibility is in the area of compliance to these laws. Agriculture receives enough black marks without wanton disregard to this area. The misuse of agricultural chemicals in modern farming can have serious consequences. But experiences for several decades shows that these chemicals are not used promiscuously. The Experiment Station working closely with the Agricultural Extension Service, with the regulatory agencies of State and Federal departments of agriculture, and with the chemical industry is in a position to assess the place of individual chemicals and the concept of chemical use in agriculture.

Education and regulatory programs need to be closely knit. Education is used to create an interest in and a knowledge of good weed control practices. Regulatory steps are taken only where education fails. In most instances it is difficult to tell where education ends and regulatory begins.

The need for education in weed control has increased and the need for regulatory weed control has generally decreased. In the early years much of the emphasis was on regulatory weed control. It was more a matter of compelling him than of educating him. But as the technology of weed control developed the need for education increased for a number of reasons:

1 - The successes brought about by newer and easier techniques has increased the interest in weed control. This has led to a demand for an increase in education. The farmer who finds this success does not generally require any further incentive.

2- There has been a general increase in the basic education at the farm level with the result that farmers are better able to assimilate and use the newer information.

3 - The improvement in communication of all types has had a great impact on the knowledge and understanding of the farmer. Through press, radio and television, he is kept up to date not only by extension agents but by a constant bombardment of advertising. Through this medium he is kept aware of the newer methods and the benefits which can be gained from them. Much of the convincing is done by this publicity but extension and education is necessary to help him make proper decisions.

4 - With the newer methods of weed control many of the noxious weeds are more easily handled.

To understand the role of the regulatory worker we need to take a quick look at basic types of farmers one encounters in weed work. First, there are those who "can and will." These require only good information which can be provided through education. Secondly there are those who "would but can't." They are usually to achieve success because of lack of education, finances, managerial ability or equipment. Enforcement is usually not the answer for this group. They require assistance and if success is to be achieved, programs must be planned to provide this assistance. Many educational programs are available to them. Thirdly, there are those who "could but won't." These are the individuals for whom weed laws are designed. Fortunately they are a small portion of the population, but enforcement is necessary to cope with them. County Agricultural Inspectors have the power to deal with these types when necessary.

The Minnesota Department of Agriculture and specifically, the Division of Agronomy Services, is responsible for the administration of all laws, rules and regulations of the state having to do with economic poisons, custom spray applicators, feed, fertilizer, seed and screening, and weed control.

The purpose of controls is - to protect the consuming public, distributors and producers. Controls which are equitable, practical, understandable, make sense and are fairly administered are important. We must be ever vigilant at state, area and county levels.

Other areas of concern include: coordination, cooperation and communication. We have had good relationships in these areas. Let us hope that we can always look forward to improving them for the benefit of all concerned.

References:

Agricultural and Food Chemicals Today, 1965, Minnesota Agricultural Extension Service

Crafts and Robbins, 1962, Weed Control. Mc Graw - Hill, New York - Pages 1 - 33.

Hueg, W.F. Jr., 1963, Minnesota Farm & Home Science, Vol. 20, No. 3, Page 3.

Klingman, G.C., 1963, Weed Control: As a Science. John Wiley and Sons, Inc. New York, Pages 1 - 8.

DISCUSSION ON WEED PROBLEMS AND CONTROL IN MUNICIPALITIES

Glendon Ehrich
District Agronomy Inspector
Minnesota Department of Agriculture

Weed problems and control in municipalities are vastly different than in the townships of the county. The main reason for weed control in the country is for economic purposes, whereas, in the municipalities the main reasons are health and beautification.

In the country we use chemicals with little danger of damaging neighbors crops, if good judgment is used. In the villages and cities, chemicals often cannot be used, and we must rely on mowing only. In municipalities, we have a situation of absentee ownership of lots, railroad property, and industrial storage lots. These seem to be principle problems.

After working with inspectors in my area, and observing different methods of weed control used, I believe a six-inch grass ordinance is a real asset to city or village weed control. This ordinance has worked very well, both for weed control and beautification of entire towns. But to make this ordinance work, the city inspector must have available, at all times, someone he can hire to do mowing.

In my district, a good example of a six-inch ordinance is the city of Austin. They enacted this ordinance five years ago, and the city inspector, county inspector, city council, as well as the property owners, are well pleased with its simplicity and results. I will not explain the mechanics or forms of Austin's ordinance, because this will be discussed by another member of the panel. An ordinance of this type is a real advantage for city inspectors because of its simplicity.

Last spring, Austin's veteran city inspector retired and a new man was appointed by the mayor, who had little knowledge of weeds and their control, but through this six-inch grass ordinance, Mr. Bennet did a fine job with no serious problems. All the credit for good weed control should not go to weed laws, or city ordinances. In Austin, both last year's and this year's city inspectors were men who used a pleasant, courteous, but firm approach. I believe this also was another reason for their successful weed control program.

WEED PROBLEMS AT WAYZATA

Edmund F. Klapprich
Superintendent of Streets and Parks
City of Wayzata

I was requested by Mr. Charles G. Gaile to come here to discuss weed problems at Wayzata. I think he made a grievous mistake in having me on this program, because, in my opinion, I am the world's worst weed inspector. Confidentially, the only reason they have me as weed inspector is that they were unable to induce anyone else to take it,so I was tapped for the job. I think their line of reasoning being that I would probably be better than nothing--so here I am.

Seriously, and I mean this--if it weren't for our County Weed Inspector, Ira McKown, I really would be in trouble, because any time I have a problem that I have any doubt about, I get on the telephone, call Ira, and he promptly shows up on the scene and irons out my trouble. We are fortunate here in Wayzata that the people we have to deal with are very cooperative, and that we have very little agricultural area to contend with.

It has been several years since we have had to fill out a form of any description. We find that we get the best results by making personal contacts. We go directly to the offending party and discuss their weed problem with them and make our recommendation on how they should handle the situation. We do try to impress them with the idea that they are not only helping themselves, but are also doing the community a service.

Our principal weed problems are Leafy Spurge, Dandelions, and an assortment of other common weeds which are readily controlled with 2-4-D or cutting.

We do have a problem at our bathing beach. Most of you have no doubt been informed,by one news media or another, of our Lake Minnetonka and its pollution problems. Consequently, our weeds in the swimming area have increased considerably. To combat this, we have been using Aquatic 2-4-D as early in the spring as possible, with pretty good success. Perhaps I should tell you that we used 500 pounds of 2-4-D Granular Aquatic Weed Killer on an area approximately 400 feet by 200 feet.

To add to our troubles this past summer, we were invated by blood flukes, which cause "Swimmer's Itch". For this, we treated the area with copper sulphate with very good success. We used 100 pounds of Copper Sulphate (large crystals) on a 400 foot by 100 foot area. We had to repeat this operation again in about two weeks because of drift-in of infective organisms from untreated areas, but after the second treatment we had no more trouble.

WEED PROBLEMS IN MUNICIPALITIES

John J. Koenigs
Mower County Agricultural Inspector

Weed control in a municipality can be a big problem without the proper tools. Among the tools I could list are:

1. Proper Ordinances

   Austin has the six (6) inch ordinance for all growth. Without this ordinance some of the lots with absentee owners would probably grow up into weeds.

2. Have Someone Readily Available To Mow

   This one goes hand in hand with the first tool. Often lot owners claim they cannot find anyone to mow. If I have someone to suggest, I have called their bluff. If they still won't do anything the city inspector can serve the necessary form, have the area mowed, and put the expenses on their taxes.

3. Cooperative City Inspector

   Good cooperation between the county and city inspector is vital. We have been fortunate in Austin to have someone who would go ahead and inspect the lots and follow up on complaints.

4. Cooperative City Officials

   They have to start the ball rolling by passing the necessary ordinances and appoint- a capable person to enforce them.

With these four tools I have listed,weed control in a municipality need not be a big headache.

WEED INSPECTION IN THE CITY OF MINNEAPOLIS

John Murphy
Field Supervisor of Housing Inspections
Assistant Weed Inspector
City of Minneapolis

Weed inspection in the City of Minneapolis is somewhat different than weed inspection in a rural area. Most of the weed complaints in Minneapolis are concerned with industrial areas, boarded up buildings and condemned buildings.

This past year we have had four weed inspectors working for the City of Minneapolis. Their main repsonsibility is housing inspector assigned part-time to weed inspections. They are officed in the Building Inspection Department out of the Hennepin County Court House.

In the previous years we operated for the most part on a complaint basis. We observe weed problems in our areas and very seldom do we issue a weed notice. This is not an optimum situation and we are aiming to correct this situation. The drawback is that time does not permit us to do both jobs, housing inspector and weed inspector, effectively. Therefore, we propose the following solutions:

1. We propose to have all twenty four housing inspectors certified as weed inspectors. They will conduct their regular inspection of buildings along with weed inspections. By having more inspectors and smaller districts we intend to send out Form #1 notices before we receive the complaints.

2. We propose to solve chronic weed complaints by sending notices early in the summer months instructing the owner to spray his property to control the growth of weeds. The spraying will be accomplished in industrial areas and vacant lots adjacent to residential districts. In the past weeds have been controlled by mowing but only after they had gained a height of 2 or 3 feet.

The general policy for the issuance of Form #1 notices of violation are as follows:

1. The property owner is given 5 days to correct a violation notice issued to him by the weed inspector.

2. If the property owner does not comply with this ordinance in 5 days a private weed cutter is contracted to remove the violation. The cost of cutting weeds is levied against the property owner as a special assessment. During the last year the Department of Inspections has issued 298 Form #1 for weed control and of these 48 property owners failed to comply with the ordinance.

The following three political entities of the City of Minneapolis own and operate equipment for the control of weeds.

1. The Engineering Department of the City of Minneapolis spends approximately $60,000 cutting weeds on City owned property and public streets.

2. The Minneapolis Park Board owns and operates weed control equipment in order to maintain City parks, playgrounds and municipal golf courses.

3. The Minneapolis Housing and Redevelopment Authority in and for the City of Minneapolis operates spraying and mowing equipment for weed control on property acquired by local urban renewal plans.

Basically the Inspection Department experiences few problems with weeds on City owned property as long as someone occupies the land. The problem arises when a building is demolished, becomes vacant or boarded up. As vacant land is redeveloped the problem of weeds decreases. There are approximately 550 buildings in the City of Minneapolis which are either vacant or boarded up due to freeway acquisition, condemnation, urban renewal or the homeowner has determined the property uneconomical to repair.

The Inspection Department has experienced fine cooperation with weed control by local railroads and the highway department. Usually all that is required is a phone call to a responsible person informing them of the location of the weeds and they correct the situation.

In addition we keep office records on chronic weed complaints and can easily define the areas of reoccurrence. Eventhough we have considerable difficulty locating new owners we continue to send the notice of violation (Form #1) to the last known taxpayer.

The species of weed known as hemp presents a problem in industrial areas and we intend to place special attention spraying this specie by late spring or early summer.

City Ordinance 782.030 states that no person shall permit or suffer to be or remain offensive, nauseous, hurtful, dangerous, unhealthy or uncomfortable to any persons or for the neighborhood any weeds, stagnant water, sewer or any unwholesome or offensive substance to remain on any land owned by him or under his control. This ordinance relates to persons who suffer from asthma or hay fever. Goldenrod and ragweed are the main causes of asthma or hay fever.

We issue violation tags using the same methods as the local police department. Violators are subject to a $25.00 fine under the Nuisance Ordinance.

Ordinance 672.030 states that any accumulation of hay, weeds, grass, etc. shall not be permitted to remain upon any lot or open space. All weeds, grass, vines or other growth when same endangers property or is liable to be fired, shall be cut down and removed by owner. This ordinance usually applys in the fall when the vegetation dries up and becomes a fire hazard. The City of Minneapolis also maintains an air pollution ordinance which relates in part to weeds and federal funding.

PUTTING THE STATE WEED PROGRAM INTO OPERATION IN MY COMMUNITY

Harry E. Picha
Eden Prairie Village Weed Inspector

Eden Prairie is located in Hennepin County within the Metropolitan District, which has been incorporated into a village with approximately 8000 population, and 36 square miles of land. The topography is level to very hilly. The soil varies from real light sand, clay and loam to a very rocky and coarse gravel. About one third of the area is lake, river and swamp. The village is bordered on the South by the Minnesota River; Edina and Bloomington on the Wast; Minnetonka on the North and Carver County on the West side.

Quite a few sections of land are non-taxable, such as the Flying Cloud Airport, Chicago and Northwestern Railroad; Chicago, Milwaukee, St. Paul and Pacific Railroad; four major state highways; school lands; local park, and municipal lands which contribute much to the local weed problem.

Eden Prairie is changing very rapidly from a once almost one hundred per-cent farm community to a fast growing urban community. The Southwest Sanitary Sewer is being constructed at this time within the village limits. The land is being bought and sold by speculators, sub-dividers and transients which create a problem from one time to another for the local weed inspector in finding the present ownership and boundaries.

The village and surrounding area are or were very heavily infested with Leafy Spurge. This noxious weed was prevalent in this area for about forty or more years. It is said by some of the pioneers that Leafy Spurge was introduced by a pioneer seed and nursery man in some wheat which was imported from Siberia into this area. There are also small areas of Wild hemp in the river bottoms which is said that this weed was introduced years ago from Mexico by migrant workers. Some other troublesome weeds are Canada thistle, White Cockle and Ragweed.

I own and operate a farm in Eden Prairie and also work as a maintenance man with the local highway department. About six years ago, I was appointed as a local weed inspector in connection with my other duties. The community had a very poor local weed program. Many of the land owners and some township officials were very bitter as to how this program was being exercised and the costs which were being assessed against private land owners.

The first thing I did as local weed inspector was to familiarize myself with the infested areas and their owners. I served many Form I's and delivered these in person to the land owners, telling them of the existing weed laws and tried to help them by telling them how to spray or get into some contact with a commercial weed applicator. In my experience, I find most people react very favorably to reason and kind treatment. There is also a small minority who do not react this way. In these cases, I get into contact with the Hennepin County Weed Inspector, who is Ira McKowen; District Agronomy Inspector, Charles Gaile; University of Minnesota Agricultural Department, and the State Weed Inspector, formerly Sig Bjorklund, and now is Graham Fuller, who have given me immediate attention and full cooperation.

This year I served 250 Form I's and 15 Form IV's putting nine land owners on tax assessments. Since making many previous contacts with many land owners, I used certified mail in quite a few instances, thereby saving time and cost to the community. The last three years, since the village has its own village hall, I have been working very closely with the local assessor in familiarizing myself in the change of property and map descriptions.

Eden Prairie's weed problem is by no means solved, but I am being told it has been very much improved.

One suggestion I would like to make to the county and state is that the local weed inspectors be given maps of their areas where they can map out the troubled areas for future references.

CHECK LIST FOR THE SPRAYER OPERATOR

Art Wolcott
Manager, Chemical Department
Farmers Union Central Exchange, Inc.
St. Paul, Minnesota

For the new sprayer operator and the one who has been operating without a definite procedure, a check list has been prepared. A good routine of preparing the equipment, maintenance and operating it is most effective.

The person operating the sprayer is the one who carries out the directions on the label of these effective pesticides. He applies the pesticide properly. He has studied his job. He knows his equipment and how to operate it. His ultimate objective is RESULTS in weed, insect and disease control.

From a wide selection of people, sprayer operators, company managers, sprayer manufacturers and the University agricultural engineers, we have gathered the facts used as a basis to prepare the "Check List for Sprayer Operators." The A B C's and the 1,2,3's give excellent direction to the operator. Once the routine is learned, it is a natural sequence for him to follow. It gives him assurance, he knows the proper from the improper and he has an appreciation for his work.

Here it is:

A. Equipment

1. Check general mechanical condition, also for loose parts and worn hoses. Replace brass tips after 50 hours use.
2. All nozzle tips must be the same size (check the numbers); and spray pattern parallel to boom.
3. Screens in the nozzles must be clean and of proper size: 50 mesh for wettable powder; 100 mesh for liquids and 5 gal/acre tips.
4. Shut-off valve--operate through all positions. Pressure should not change. Shut-off should be positive--no leaks.
5. Pump must put out a volume to supply nozzles and by-pass enough of the volume to the supply tank for thorough mixing of spray in the tank.
6. Pressure regulator accurate through the 20 to 50 lb. range, and responds to adjustment for pressure control.
7. Tank agitator (jet or mechanical). Is it adequate to prevent pile-up of chemical in corners of tank?
8. Tank strainer--50 mesh for wettable powders.
9. Speedometer--must be operating properly and registers hundredths of mile.
10. Calibrate the sprayer to determine the gallons of spray mixture to apply per acre
    A. Broadcast
    Travel 1/8 mile (.125) (660 ft.), measure gallons used.
    $$\frac{\text{Number of gallons used X 66}}{\text{Spray swath in feet}} = \text{gallons per acre}$$
    B. Band
    Travel 1/8 mile, measure gallons used.
    $$\frac{\text{Number of gallons used X 66}}{\text{Band width in feet X number of bands}} = \text{gallons per acre actually sprayed}$$

11. Provide a calibrated measure to determine gallons in spray tank.
12. Adjust boom height to get a full spray pattern across top of weed growth.

B. Select and Mix the Chemical

1. Read the product label.
   A. Precautions
   B. Rate for the crop and for your area.
   C. Check the crop for tolerant stage of growth.
2. Calculate gallons or pounds of chemical for the amount of water in tankful.
   A. $\frac{\text{Gallons water in tankful}}{\text{Gallons applied per acre*}} = \text{Acres per tankful}$
   B. Acres per tankful X Rate of chemical per acre = chemicals for tankful
3. Fill tank 1/3 full of water.
4. Pre-mix wettable powders in bucket of water.
   A. Add chemical
   B. Fill with water to desired level
5. Agitate to get good mixture.
6. Spray entire tankful before stopping, or reagitate after delays--before spraying.

C. The Application

1. Decide the travel pattern to follow.
2. Shut off the sprayer at end of each pass.
3. Observe--(1) Pressure; (2) Spray Coverage; (3) Speedometer reading. Check the speedometer at one acre--measure spray applied.
4. Adjust speed (and possibly pressure) to attain planned gal/acre.
   A. Increase speed to reduce gallonage applied per acre, etc. Increased pressure will increase volume.
   B. Recalibrate sprayer if necessary.
5. If excessive foam in tank--reduce with Silicone or salt.
   A. Locate the cause (return hose above tank bottom, other) and correct.
6. Continually watch for plugged nozzles.
7. Watch for drift hazzards--lower pressure or stop if drift is excessive.
8. Clean the sprayer when through. Dispose of unused spray in a safe manner.

30 ft. swath	33.3 ft. swath	40 ft. swath
.275 mile = 1 acre	.247 mile = 1 acre	.206 mile = 1 acre
.550 mile = 2 acres	.494 mile = 2 acres	.412 mile = 2 acres
1.1 mile = 4 acres	.988 mile = 4 acres	.824 mile = 4 acres

KNOW YOUR SPRAYING EQUIPMENT

Art Wolcott
Manager, Chemical Department
Farmers Union Central Exchange, Inc.
St. Paul, Minnesota

As sprayer parts become worn or damaged, the efficiency of the applications of pesticides are reduced. Since we cannot tolerate "less than a good application," we must maintain the sprayer in top condition.

This paper is in two parts. One is the questions and answers on equipment and the other is the visual inspection of the display of worn parts and new equipment. The purpose is to provide awareness to the everyday problems that can arise when using the equipment.

Do you know the prompt solution to spraying problems as they arise? When the nozzles continually plug, do you check the suction strainer, the nozzle screens, the pressure and the possibility of using larger tips? When you use 5 gal tips, do you use 100 mesh screens on suction strainer and nozzles? Do you use 50 to 30 mesh screens when using wettable powders, also 20 gal tips. Well, this is a start on the many questions and problems to reckon with.

Please observe the displays of pumps, nozzles, screens, gauges, sprayers and answer the following questions:

PUMPS

1. Question: What causes shear pin to "shear off?"
   Answer:

2. Question: What causes loss of pressure?
   Answer:

3. Question: What causes cracked or warped end-plate?
   Answer: (a)

   (b)

4. Question: What causes seal to leak?
   Answer: (a)

   (b)

5. Question: Why won't pump prime?
   Answer: (a)

   (b)

   (c)

   (d)

6. Question: What causes excessive pump wear?
   Answer: (a)

   (b)

   (c)

7. Question: List 3 types of pumps suitable for spraying wettable powders.
   Answer: (a)

   (b)

   (c)

NOZZLE TIPS AND SCREENS

1. Question: What causes poor spray pattern?
   Answer: (a)

   (b)

   (c)

   (d)

2. Question: Are all tips of the same size and pattern?
   Answer: (a)

   (b)

3. Question: Will tilting the nozzles to spray forward at 45° angle give better coverage?
   Answer: True _____ False _____
   Explain:

4. Question: Give the gallons per minute per nozzle and the angle of flat spray pattern for the following tips, at 40 lbs. pressure. Also give the gal/acre treated at 30 lbs. pressure at 4 miles per hour.

Answer:

TIP	SPACING ON BOOM	ANGLE °	G.P.M.	G.P.A. @ 30 PSI, 4 MPH
650067	20"			
730077	20"			
8002E	40"			
110015	40"			
Doc 14	19"			

5. Question: How much will the following change the rate of chemical applied per treated acre? In band spraying, a variation in the height of nozzles above ground surface can vary the rate chemical applied per treated acre significantly. A nozzle 6" high will treat a band 10" wide. An 8" height will treat a band 14" wide.

Answer: 5% _____; 10% _____; 20% _____; 40% _____

6. Question: Fill in the names for these terms regarding nozzles.

Answer: PSI

gpa

mph

SS

TT

T

7. Question: What screen mesh size is?

Answer: (a)

(b)

HOSES

1. Question: What damaged the hose?

Answer:

2. Question: Is hose open for full flow?

Answer:

3. Question: Suction hose with pin hole, may not leak, but can cause what problem?

Answer:

SUCTION STRAINER

1. Question: What causes nozzle plugging?
   Answer:

2. Question: Why is wettable powder left in tank?
   Answer: (a)

   (b)

3. Question: Location of by-pass hose causes excessive foaming?
   Answer:

4. Question: What causes poor agitation in tank?
   Answer: (a)

   (b)

PRESSURE REGULATOR

1. Question: Give two causes of poor pressure control.
   Answer: (a)

   (b)

PRESSURE GAUGES

1. Question: Select the proper dial for a custom or farm weed sprayer. Circle the correct ones.
   Answers: 0 to 400 lbs; 0 to 100 lbs; 0 to 60 lbs; 0 to 200 lbs.

2. Question: To avoid damage to pressure gauge, outline start-up procedure of new sprayer.
   Answer: (a)

   (b)

   (c)

3. Question: How can you modify sprayer to prevent surging of pressure gauge?
   Answer: (a)

   (b)

   (c)

THE ANSWERS

Not cleaned after use last season and rotor is now stuck.
Freezing of water in pump
Running dry
150 hours of use
loose suction hose
Not drained and oiled before storage last season
Casing worn
Rollers worn
Pin hole in suction hose
Wrong hook-up of hoses (Suction on discharge side)
Wear from sand and wettable powder
High speed
Bear shaft
Wear on pump housing and end-plate

Centrifugal
Gear
Squeeze
7-Roller
Impeller
Piston
Restrictive valve
Orifice
Air chamber

Start Pump
Adjust pressure regulator
Open pressure regulator
Glass ball chipped
Seat battered or worn
Grimy from poor cleaning
By-pass hose is above bottom of tank.
Pump of low capacity or none.
No jet agitator
Poor agitation in tank
100 mesh screen on suction strainer
Hole in suction strainer

Worn tips
Cleaned with wire
Damaged
Wear against wheel or other moving part
Crushed or cheap soft hose that collapsed
Pump would lose its prime
Gallons per acre
Miles per hour
Stainless Steel
Male
Female
Pounds per Square Inch

Spray patterns not alligned
65°
.15
off center arc
6.3
110°
.077
5.0
7.8
.20
80°
.067
73°
4.9
4.3

EQUIPMENT CHECK LIST

Graham Fuller
State Supervisor Weed Control

We are making some changes on the sprayer inspection sheet this year. Some changes will help make the inspection easier and some will complicate your inspection somewhat but could be helpful to the sprayer operator. In going through the check list you will note the first major change shows up in question 4 where the question asks if the tank is clean or needs cleaning. As you will notice there is a margin on the right of the page where you can enter any comments on that particular question.

In question 5 we have asked if the boom can be adjusted up or down.

In question 6 we ask for the tip number used and the number of nozzles on the boom, also if all tips are the same number. We also ask the question how many G.P.M. (gallons per minute) will be required at 40 P.S.I. (pounds per square inch). If the nozzles has the 8002 number we know that at 40 pounds pressure the one nozzle will put out .20 of a gallon per minute, so if we have 13 nozzles on the sprayer we multiply 13 x .20 and we find these nozzles will put on 2.6 gallons per minute.

In question No. 7, it would be wise to find out the rated capacity of the pump on the rig. In most cases this will not appear on the name plate so you will find out by using your pump catalog or asking the spray operator.

Number 8 asks about agitation, which is so important for some herbicides such as Atrazine. If the agitation is by jet action be sure and indicate if there is a special line rather than on the end of the bypass line.

The question on hoses is about the same as last year.

Very little change has been made in the question on pressure gauges.

When it comes to screens this is something you will learn from experience. Just remember you will need a larger size screen for a wetable powder than you will for a liquid chemical such as 2,4-D. In other words, a 100 mesh screen will be OK for 2,4-D but you would need a 50 mesh screen for Atrazine.

Number 12 is a question that can be interesting to work on if you have the information. It is determined by adding the gallons per minute that the nozzles require plus the gallons per minute the agitator requires and this will determine how many gallons per minute the pump must put out. For instance,

Nozzles put out	2.6	gallons per minute at 40# pressure
Agitation requires	6	gallons per minute at 40# pressure
Total	8.6	gallons pump must put out.

If the pump puts out more than 8.6 gallons everything is O.K. but if it only puts out 8 gallons then there must be some changes made such as bigger pump, smaller jet agitation, etc.

Question 13 is to be of assistance to the operator in helping him determine if he can use a heavier gallonage nozzle or not. Example:

$$\text{Pump GPM } \frac{\text{(10 Gal) Minus Agitation GPM (6 Gal)}}{\text{Number of nozzles (13)}} = \frac{10-6=4}{13\ \ 13} \quad .30 \text{ GPM}$$

A speedometer is very important on a sprayer to help calculate acres. Does this sprayer have one and what kind?

Are controls easy to reach when the operator is in the seat?

Was machine in operation when inspected? It goes without saying that a better job can be done when the sprayer is operating, especially when some of the GPM factors are unavailable.

We realize this calculation procedure will be difficult at first and we don't expect this to be done 100% but we hope you will work on it and after you understand it fully it will be real interesting to you.

Form 710
Rev 12/68

MINNESOTA DEPARTMENT OF AGRICULTURE
Division of Agronomy Services

INSPECTION OF CUSTOM SPRAYERS

1. Name_____ Address_____ License No._____ Class___

2. Is the sprayer high clearance?_____ Self-propelled_____

   Pull type_____ PTO_____ Motor driven_____ Other_____

3. Used for: Herbicides____ Insecticides____Fungicides____ Other_____

4. TANK: Steel____ Aluminum____Fiberglass____Other_____

   Condition_____ Capacity_____ Clean____Needs cleaning_____

5. BOOM: Length_____ Spray coverage_____Is height adjustable_____

6. NOZZLES: Brass___Stainless Steel___Spacing_____ Tip No._____

   Number of nozzles_____Is spacing uniform_____ Are all nozzles the same No._____? Nozzle flow required at 40 PSI GPM_____
   (Yes-No) (Yes-No) (No. nozzles X GPM per nozzle)

7. PUMP: Make_____ GPM_____ Type_____ Good condition_____
   (Yes-No)

8. AGITATION:_____Mechanical____ Jet____ If by jet GPM_____
   (Yes-No)
   If jet agitation is it on separate line?_____
   (Yes-No)

9. HOSES: Rubber___Plastic___Other_____Condition Good___Poor___

10. PRESSURE GAUGE:Easy to read_____ 0-60 0-160 0-300 Where mounted?_____
    (Yes-No)

11. SCREENS: Tank___Size___Line___ Size___ Nozzle___ Size_____

12. PUMP: Capacity required for this sprayer_____GPM
    (Nozzle flow plus agitation flow)

13. Maximum size nozzle that can be used on this sprayer _____GPM

    $\frac{\text{Pump GPM (Minus) Agitation GPM}}{\text{No. of nozzles}}$ = Maximum nozzle size.

14. Does sprayer have speedometer_____ Kind_____
    (Yes-No)

15. Are controls easy for the operator to reach?_____

16. Was check made while machine was operating?_____
    (Yes-No)

_____ Inspector

_____ Licensee or Operator

Date_____

INSTRUCTION SHEETS FOR INSPECTION OF CUSTOM SPRAYERS

1. Show name and address of licensed owner, his license number and class. Class will be whatever the examination covered.

2. Should be self-explanatory.

3. Check kind of pesticides used in sprayer.

4. Indicate the material tank was made from, also capacity and condition.

5. Indicate length of boom and how many feet it covers. The coverage will be wider than the boom. Also indicate if the boom is adjustable up and down.

6. Indicate nozzle material, tip number, the number of nozzles on the boom, also if the nozzle spacing is uniform and if they are all the same number. Determine the gallons required per minute at 40 lbs. pressure. (Number of nozzles X gallons per minute rating of nozzle.)

7. G.P.M. means gallons per minute.

8. Try to find out from operator the gallons required for the agitator at 40 pounds pressure. Also indicate if Jet agitation is on separate line and not on the by-pass line.

9. Self-explanatory.

10. Does the pressure gauge have large figures so they can be read? Is it mounted on the line or in the boom?

11. You will have trouble with this one because there isn't a number on some screens. Try to find out from the operator and in time you will be able to tell by sight.

12. This will help you give the operator some help. The total liquid required to operate the nozzles on the boom at 40 pounds pressure plus the amount of liquid required to operate the agitator at 40 pounds pressure will give you the number of gallons the pump must produce.

13. Is to assist you in helping the spray operator.

14. A simple yes or no with the make.

15. Are controls easy to reach when operator is sitting in the seat?

16. Many times it is necessary to run the sprayer to check on spray pattern, leakage, etc.

SOME IMPORTANT ATTORNEY GENERAL RULINGS

Graham Fuller
State Supervisor, Weed Control

There have been a number of very important rulings made by the Attorney General this past year pertaining to weed inspection. Although this first one that I am going to talk about is not a formal opinion, it is an informal one rendered September 19, 1968. I asked the question: "If a township board will not do their job of weed inspection as the law requires can a county board appoint an assistant weed inspector?" After several sections of the Weed Law were quoted the answer was YES.

Another question we asked: "If one of the county or township weed inspectors serves a Form #1 and obtains a person to mow or spray and the person is injured while doing so, who would be responsible - the state, county, township or the individual himself?" It was further explained that the person was operating his own equipment for a specified fee, which may have been hourly and the county does not withhold tax, social security, or furnish any employee benefit. The answer was, under the circumstances outlined above, the person doing the work is clearly an independent contractor and is himself responsible for any injury that he may incur while doing the work at the request of the county or township weed inspector.

Another question went like this: Two township boards were involved in several trips and considerable time was spent seeing that Form #1 was carried out on a weed problem. The county auditor will accept the charges for work done for mowing, but would not accept the bill for the inspection done by township supervisors. The opinion rendered on October 6, 1967, states that inspectors cannot charge the land for routine inspection and mileage, but that time actually spent on the land by the inspector himself for the purpose of eradicating the weeds thereon is chargeable.

An informal opinion of October 17, 1967--- Can a county board veto the inspection of custom applicators by inspectors? Answer:- "I do not believe it unreasonable to ask the county weed inspectors to make inspections for economic poisons and custom spray applicators equipment. I seriously question whether the county commissioners can veto a request of the commissioner of agriculture when he asks the county weed inspectors to work in the area of economic poisons and custom applicator equipment inspections. The first sentence of 18.231 spells this out very clearly.

On October 6, 1967, an opinion was requested to determine if the county is liable for damages due to drift. The answer: "My research satisfies me that the county or township ordering that spraying of crops be done in order to comply with the Noxious Weed Law sueable, and furthermore, would be liable for negligence if its own agents or employees were doing the application.

However, where an independent contractor is hired, the negligence of the applicator would not carry over to the county or township, provided that

the county or township was not negligent in selecting an applicator. There is also the possibility that if the county or township had an employee present supervising the job the negligence of the applicator would carry over to the county or township.

Very clearly, the custom applicator could be liable for loss occurring to abutting owners due to drift."

On June 24, 1968, an opinion was requested on the following question: "Can a town board appoint one of their own members as the assistant weed inspector?" The answer: "Yes." Question: Can they pay him the going wage for such work? Answer: "Yes". Question: Can they pay him mileage? Answer: "Yes, up to 9¢ per mile." This, by the way, is a formal opinion and very lengthy.

May 23, 1968. Is there a minimum wage law for Minnesota? Answer "No". Does the federal minimum wag law pertain to county agricultural inspectors? "No". The Federal law does not pertain to employees of political subdivisions.

February 8, 1968. Can a county commissioner be paid per diem and mileage for attending a district weed meeting? Answer: He would not be paid per diem but when authorized by the board he may be paid traveling expenses.

October 2, 1968. I would like your interpretation of Section 18.241, Sub. 2. Is this subdivision limited only to the weeds mentioned in this subdivision? Answer: In my opinion noxious weeds, as used in 18.241, subd. 2, means the same as that term wherever used in the sections immediately preceding it. 18.271 - 18.241.

THE INTRODUCTION OF THE MINNESOTA SEED LAW

Frank Fanberg
Supervisor, Section of Seed Inspection
Division of Agronomy Services
Minnesota Department of Agriculture

"A seed bill to 'regulate the selling, offering or exposing for sale of agricultural seeds in this State and providing penalties for the violation thereof' was passed by the Minnesota State Legislature in 1913 and went into effect on July 1 of that year." Since that time, it has been amended several times.

The latest changes are: (1) Two weed seeds were added to the list of restricted weeds. These weed seeds are giant foxtail (Setaria faberii), and wild radish (Raphanus raphanistrum). (2) The net weight of the seed is to appear on the container or on the tag. (3) Fees on cereal grains and oil crops of flax and soybeans and seeds of vegetables grown for processing under the permit system shall be: Cereals - each 100 pounds - 1 cent. Peas, flax, and soybeans - each 100 pounds - 3 cents. Seeds of vegetables grown for processing by licensed commercial canneries are tax exempt.

WHO'S WHO IN SEED CONTROL?

"21.51, Subd. 2. Test Seeds. The commissioner and his assistants, and county agricultural inspectors, as directed by him, shall sample, inspect, make analysis of and test agricultural and tree and shrub seeds sold within this state for sowing purposes at such time and place and to such extent as he deems necessary to determine whether such seeds and screenings comply with the provisions of such sections. He shall promptly notify the person, firm, or corporation who transported, sold or offered or exposed such seed or screenings for sale of any violation of the provisions of such sections, or any rule or regulations promulgated thereunder."

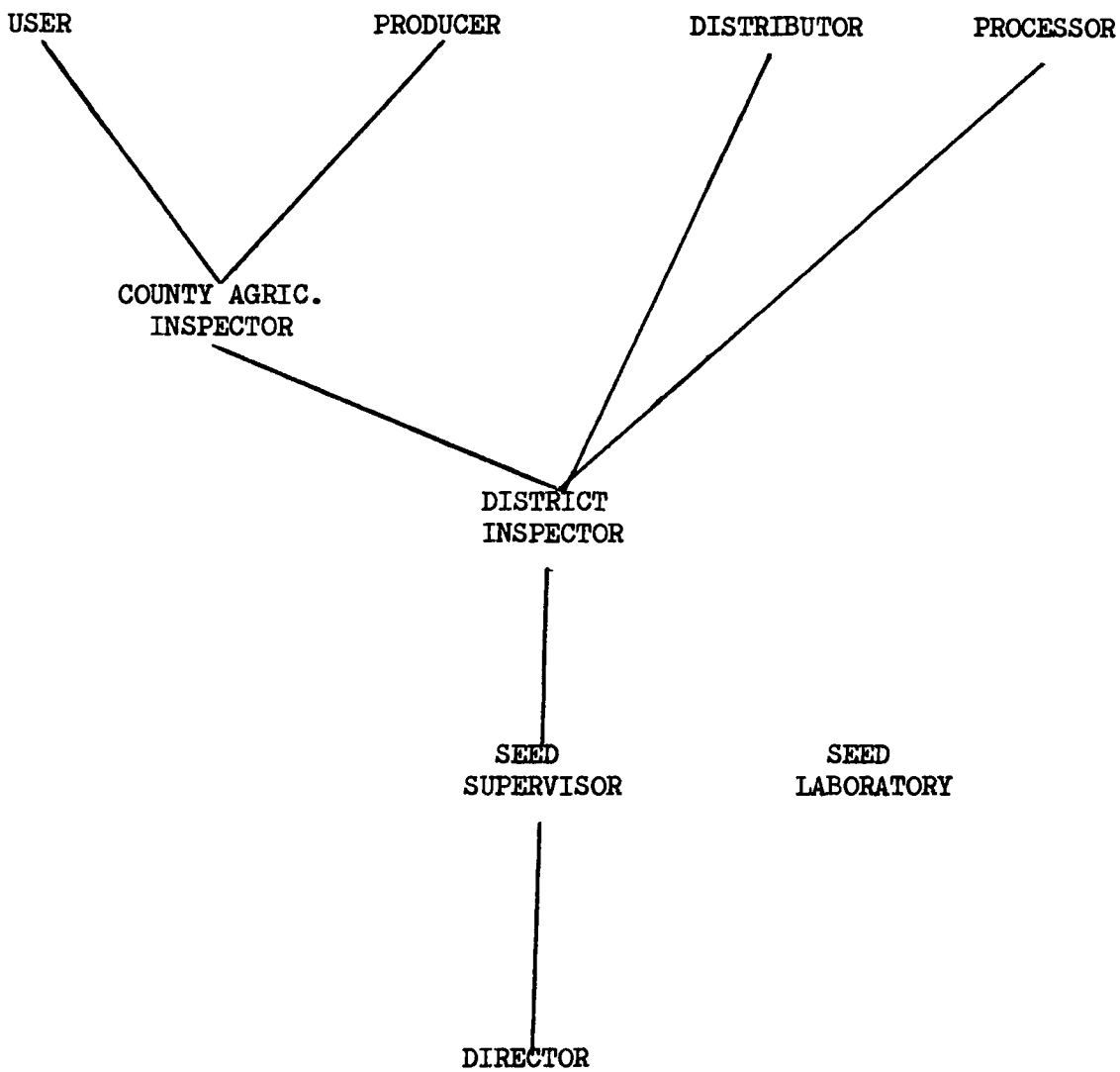
The above chapter from the Minnesota Seed Law names the people assigned seed inspection, sampling, and testing for the State of Minnesota. They are the County Agricultural Inspectors, who are assigned the seed inspection and sampling on the farms in their respective counties, and the District Agronomy Services Inspectors, who are assigned seed inspection and sampling in the towns and cities within their assigned districts under the supervision of the State Seed Supervisor.

The seed testing is done by the State Seed Analysts in the State Seed Laboratory under the supervision of the State Seed Lab Supervisor.

Each of these people are agents of the commissioner, under the direction of the Director of the Division of Agronomy Services and the Commissioner of Agriculture.

S E E D I N S P E C T I O N

COMMUNICATION - RESPONSIBILITY



SEED INSPECTION REPORT

Frank Fanberg

The Minnesota Seed Inspection Program is under the Division of Agronomy Services. The State of Minnesota has eighty-seven counties and is divided into fifteen districts, with an Agronomy Services Inspector serving each district. Each county has a County Agricultural Inspector whose duties are seed inspection and weed control. He also makes inspection of Screenings. The Minnesota Screenings Act is enforced by the Seed Section.

The reports of seed inspection and the Seed Laboratory activities are as follows:

	1966-1967	1967-1968
Seed Inspection calls made by District Inspectors	1737	1909
Seed Inspection calls made by County Inspectors	6236	4938
TOTAL SEED INSPECTION CALLS MADE:	7973	6847
Inspection samples taken by District Inspectors	2115	2210
Inspection samples taken by County Inspectors	4339	3007
Preinoculated survey samples	126	62
County Agent Service Samples	42	21
Service Samples taken by County Inspectors	680	787
Tests made of Stop-Sale lots	21	41
Screenings Samples	58	34
TOTAL SAMPLES OBTAINED:	7402	6161
Screenings and feed grain contacts made	60	37
Screenings and feed grain samples in violation	2	11
Interstate seed samples in violation	79	67
Intrastate seed samples in violation	588	408
Interstate seed lots under stop-sale	26	11
Intrastate seed lots under stop-sale	123	58
Stop-sale orders issued	149	69
Total warnings issued	816	544
KINDS OF VIOLATIONS		
Mislabeled as to purity	7	15
Mislabeled as to crop seed	25	49
Mislabeled as to kind	5	4
Mislabeled as to variety	1	1
Mislabeled as to inert	85	84
Mislabeled as to germination and hard seed	118	67

KINDS OF VIOLATIONS: (continued)

	1966-1967	1967-1968
No lot number shown	6	2
Incomplete or incorrect label	64	66
No label attached	121	74
No germination date	16	10
Old germination date	141	50
Prohibited weed seed	14	5
Restricted weed seed	143	97
Excessive weed seed content (over 1%)	50	10
Purity did not equal 100%	20	15
No tax paid	6	9
Label not legible	3	1
Origin violations		2

Out of 5,217 samples tested, approximately 10% were found to be in violation.

ACTIONS FOR INTERSTATE SHIPMENTS:	1966-1967	1967-1968
Number of complaints	13	5
Federal warnings	5	1
Federal no-action cases	2	1
Federal cases pending	4	3
Citations issued	2	0
Interstate warnings issued by Minnesota	79	82
NUMBER OF SEED TAX PERMITS ISSUED	28	30
NUMBER OF SEED TAX PERMITS IN EFFECT	230	260

HYBRID SEED CORN INFORMATION

HYBRID SEED CORN REGISTRATIONS:

New registrations	234	258
Renewal registrations	918	933
TOTAL REGISTRATIONS	1152	1191
Number of companies registering hybrid seed corn	63	67

VIOLATIONS

Incorrect maturity label on hybrid seed corn	1	5
Hybrid seed corn not registered	10	4

ACTIVITIES OF THE MINNESOTA STATE SEED LABORATORY
CLIFFORD CHRISTENSON, SUPERVISOR

The following tables indicate the source of seed samples, and the number received per month for the last two fiscal years.

Source of Samples

Service Samples	1966-1967	1967-1968
Dealers	4696	4401
Farmers	6843	5605
Drill Box	--	--
County Agents	42	21
County Inspectors	680	787
State Highway & Institutions	231	193
Minnesota Crop Improvement	--	--
Miscellaneous	18	13
	12510	11020

Inspection Samples		
District Inspectors	2136	2210
County Inspectors	4339	3007
Screenings & Feed Grain Samples	58	34

Distribution of Samples by Month

	Service Samples		District Inspection Samples	
Month	1966-1967	1967-1968	1966-1967	1967-1968
July	96	67	--	--
August	157	155	2	21
September	223	167	21	5
October	302	187	--	--
November	481	459	5	2
December	1115	882	2	--
January	2148	1843	31	21
February	3048	3283	84	52
March	3671	3044	598	784
April	870	641	635	1053
May	277	221	524	230
June	122	71	234	42
	12510	11020	2136	2210

BRUSH CONTROL IN PASTURES

Robert H. Schafer
Manager, Oxley Hereford Ranch N. Div.
Mahnomen, Minnesota

In 1956 when I came to Mahnomen County to work for Schermerhorn Farms we had approximately 750 acres of so called pasture that was covered with brush and very low quality timber. These pastures had small open areas where blue grass was the predominate grass but as a whole were extremely low in production. Having grown up and worked in Southern Minnesota I was not acquainted with land clearing methods of Northern Minnesota, and so gave chemical control first thought.

In discussing our problem with Dr. Jensen who was then an Extension specialist in Agronomy, I was encouraged to go ahead with plans to try chemical control and he put me in contact with Dr. Melander of American Chemical and Paint Company. Dr. Melander agreed to furnish the chemical for the first try on 40 acres if we would pay for application.

The material supplied was a brush killer containing 2 2/3 lb. 2,4-D and 1 1/3 lb. 2,4,5-T acid equivalent per gallon. He suggested putting on 2 quarts chemical with 5 gallon of fuel oil per acre in early July. We had trouble finding an operator who was equipped to handle this volume back in 1956. It was August 28 before we finally got the chemical applied and then at only 3 gallons of fuel oil per acre.

On September 2 we had a hard freeze and we thought the whole project had been in vain as most all the plants around the area went dormant. However, the next Spring we were pleased to find that most of the smaller brush did not make foliage and a good percentage of the trees made no foliage and where they did many of the trees put out leaves only from the main trunk.

The more predominent of the many species growing in these pastures were:

Buck brush	Oak
Sumac	Poplar or Aspen
Hazel brush	Box Elder
Prickly Ash	Elm
Canada Thistle	Green Ash
Poison Ivy	Choke Cherry

Before we started this project we were told not to expect complete control with one or even two applications and by the end of the summer it was evident that the Hazel brush, which was the most predominant lower growing brush, the oak and the poplar would not give up easily.

By this time we had acquainted ourselves with the more conventional method of using a bulldozer for land clearing. However, the cost estimates of $60 to $100 per acre were much too high to make it feasible. In fact at that time cleared land could be purchased for less dollars in this area.

As we continued to observe the sprayed area it was evident that as soon as the competition for sun and moisture by the brush and trees was removed, the grass would grow. In areas which had been completely void of grass

previously, blue grass appeared, apparently from seed from grass that had grown there sometime in the past.

In 1958 we decided to respray the 40 acres and spray another 160 acre pasture. This we did in early July. We were also encouraged to try Amino-triazole on another 60 acres. This being a powder the pilot was not very enthused, however, we were assured it was completely water soluable so he agreed to apply it. On the third pass his sprayer and nozzles became completely clogged and that was the end of our efforts with this product. I am told we should have premixed the powder.

Since these first beginnings we have continued to respray some areas and have begun on new areas. Our biggest mistake was in not setting up a definate program and staying with it. We sprayed some areas twice skipping a year and other areas two years in a row and then did no respraying for four or five years.

In recent years the Dow Chemical people have become interested in this project and we have used an industrial brush killer with 2 lb. 2,4-D and 2 lb. 2,4,5-T acid equivilent per acre in addition to the 2 to 1 ratio which we started out with. I have not observed much difference in results from the use of either of these, however, it appears that the Poplar or Aspen is more susceptible to 2,4-D where many of the other large woody plants need the 2,4,5-T to have control. We have tried a small area with water for the carrier instead of fuel oil and feel that the fuel oil gives much better penetration. However, fuel oil is more volatile and in one case the vapor killed annual broad leaf weeds nearly $\frac{1}{2}$ mile away as well as my wifes garden.

Some of the first areas we have sprayed have now been sprayed four and five times and we feel have given excellent results. One 160 acre pasture previously had about 20 acres of open area in it and this contained considerable buck brush. In 1956 and 1957 we pastured 20 to 25 cows with calves on the quarter section with the cows going to grass about May 25. By mid August there was no grass left for them to eat. In 1967 and 1968 we pastured the equivelent of 55 and 60 cows and calves respectively from May 20 to October 10 and a large amount of grass was never touched. In the Spring of 1967 we decided to burn off this pasture and after we bulldozed the perimeter to keep the fire from spreading, we set it afire. It cleaned up a large amount of the dead-falls and dry standing material but in a year or two we will reburn it as there is still much dead material in it.

Some areas have had a large amount of milkweed begin to grow and at this stage we are not sure how to control them, however, one of the last sprayings seemed to give some control and kept them from going to seed.

The choke cherry has given us a kill problem in one area as well as some of the oak and poplar. Each spraying seems to bring more of these under control.

From our experience I feel the following program will give us the best control for the dollars spent. Use chemical containing 2 2/3 lb. 2,4-D with 1 1/3 lb. 2,4,5-T acid equivilent per gallon where poplar is the predominent species of tree and 2 lb. 2,4-D with 2 lb. 2,4,5-T acid equivilent per

gallon where oak or other trees are dominent species.

Year	Amount brush killer per acre	Fuel oil per acre
1	2 quart	2½ gallon
2	1½ quart	2 3/4 gallon
3	skip	
4	1½ quart	2 3/4 gallon
5	skip	
6	1½ quart	2 3/4 gallon
7	skip	
8	1½ quart	2 3/4 gallon

Observation will tell one if spraying is necessary in the eighth year or if any further spraying is needed. These five sprayings will cost approximately $20 per acre or an average of $4.00 per acre per application.

We are still looking for a good way to flag for this type of spraying.

In summing up we have achieved excellent control of buck brush, hazel brush, sumac, prickly ash, poison ivy, box elder, elm and ash. Seventy-five to Eighty per cent control on the oak and poplar. I might add that we normally try to keep cows out of sprayed pastures for at least two weeks after application, however, in some cases have not removed the cattle at all and have had no apparent ill effects.

MIXING AGRICULTURAL CHEMICALS

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Mixing several agricultural chemicals for application can offer savings in time and trips over the field. But when deciding whether or not to mix the chemicals, several factors need to be considered: (a) physical compatibility (b) appropriate placement for optimum time of application for each chemical (d) adequacy of equipment for making uniform application (e) possible synergistic or antagonistic effects of mixing chemicals.

Major interest has been in mixing herbicides and sometimes insecticides with liquid non-pressure nitrogen solutions or other liquid fertilizers. Since atrazine is the major corn herbicide applied as a spray, there has been considerable interest in using fertilizer solution instead of water as a carrier for atrazine before or at planting time. Since Sutan, alone or in combination with atrazine, appears promising for preplant incorporated application, there is also interest in mixing it with fertilizer solution. Since many of the other corn herbicides are most popular in granular form and usually need to be applied to the soil surface, there has not been as much interest in using them with liquid fertilizer.

Use of fertilizer is not as popular for soybeans as for corn. However, there has been a little interest in mixing Treflan and possibly Planavin with liquid fertilizer where fertilizer for soybeans is desired.

There has been some mixing of postemergence herbicides such as 2,4-D with nitrogen solution. This practice has been used especially in North Carolina but has not been popular in the midwest.

When considering herbicide-fertilizer mixtures, one of the first steps is to mix small quantities in proper proportions in a small container to check physical compatibility. Occasionally chemicals are not compatible and a "gunked-up" spray tank can be a real mess to clean up. Some insecticides are formulated as fertilizer grade to help assure compatibility. Planavin wettable powder appears to be more compatible than liquid Planavin with fertilizer solutions. Some additives such as Compex are available to enhance physical compatibility of some mixtures.

If using 25 gallons of spray per acre, physical compatibility can be checked by putting 3 quarts of solution in a gallon container and adding 1/2 ounce of wettable powder for each 1 lb. of wettable powder to be used per acre. For example, if 3 lb/A of product is to be used, mix 1-1/2 ounce in 3 quarts of fertilizer solution.

If using a liquid concentrate with 4 lb. active per gallon and a sprayer set for 25 gal.per acre, mix 10 ml or 1/3 fluid oz. or 2 teaspoons of the concentrate in 1 quart of fertilizer solution to check physical compatibility of the liquids.

Consider optimum placement of each chemical. It is usually considered preferable to incorporate most fertilizers - especially P and K. Soil insecticides are usually incorporated. Some herbicides should be incorporated, some should not be incorporated, and some are effective either way. Each herbicide needs to be considered individually.

Sutan, Treflan, and Planavin should be incorporated. Atrazine can be incorporated shallow but doesn't need to be. Lorox and Ramrod probably should not be incorporated. Herbicides which are relatively volatile or which are rapidly broken down by photodecomposition need incorporation. But incorporation may be detrimental for some herbicides that are quite soluble and easily leached. Incorporation of some, such as Lorox, appears to decrease effectiveness when the herbicide is readily adsorbed onto the soil complex and is then less available for uptake by plants.

Recent studies on site of uptake with some of our major weed species suggest that many of our herbicides can be absorbed by the emerging shoot. As long as sufficient soil moisture is available for shoot absorption, the herbicide need not be placed deep. In fact, it may be less effective deep than shallow. And often, as depth of incorporation is increased, the herbicide is diluted and becomes less effective.

The optimum time for herbicide application is usually at planting time or soon afterward. Atrazine can be applied within two weeks before planting and Sutan can also be applied preplant. Waiting to apply fertilizer at planting time may bunch up operations if a very large percentage of fertilizer were applied then. But application of some herbicides, some insecticides, and at least a portion of the liquid fertilizer is feasible shortly before planting.

The importance of uniform application is more critical with herbicides than with fertilizer. A double application of fertilizer in some areas of a field and a half rate to other areas may not be critical but such variation with herbicides can mean crop injury or poor weed control. If you plan to mix fertilizer solution and herbicide, be certain agitation is adequate for thorough mixing, that the equipment applies the materials uniformly and that provision is made to avoid overlaps and skips.

Conceivably, some chemical mixtures might alter effectiveness. However, in our greenhouse work and in field work for several years, we have usually not seen much difference in weed control whether fertilizer solution or water was used as the carrier for spraying.

The trend toward broadcasting herbicides with liquid fertilizer prior to planting seemed to be increasing rather rapidly until the price margin between non-pressure nitrogen and anhydrous ammonia widened. Presuming that some adjustment in prices will occur, we will likely see increased interest again in preplant mixtures. Even at the present time, some growers consider the advantages of non-pressure liquid sufficient to justify at least a portion of their fertilizer in the higher priced form.

With some of the newer insecticides for resistant rootworms and basal application at cultivation, interest in mixing insecticide with the fertilizer has slackened some.

The legality of certain mixtures of agricultural chemicals and possible need for registration is at present a somewhat "gray area" that needs further clarification.

HERBICIDES IN THE LANDSCAPE

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Herbicides can make two contributions in the landscape: (1) They can reduce maintenance time. (2) They can assist in controlling difficult to manage annual and perennial weeds.

Herbicides can be a source of pollution if not used properly. Problems associated with the abuse are as common as insect and disease. Labelling is designed to prevent and limit the problems but using the herbicide without proper knowledge is too common. Labels state the rate, time of application, toxicity, and what can be controlled.

Problem weeds include dandelions, plantain, chickweed, self-heal, quack grass, giant foxtail, knotweed, purslane, and crabgrass. Chemical control for these weeds should be accompanied by appropriate cultural practice.

Dandelion	2, 4-D
Plantain	2, 4-D
Chickweed	2, 4, 5TP
Self-heal	2, 4, 5TP
Quackgrass	Dalapon, Proper mowing height
Giant Foxtail	Proper mowing height
Sandbur	Fertility program
Knotweed	2, 4, 5TP, Aerate soil
Purslane	2, 4, 5TP
Crabgrass	Dacthal, Fertility program

LEAFHOPPERS AND APHIDS

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Some of our most important species of leafhoppers and aphids are transported to Minnesota each spring on warm winds from the southern states. Reports on insect abundance in Texas and Oklahoma during March and April may indicate some potential problems for Minnesota. By watching the weather patterns, we can find out when to expect these insects from the south. We can watch for their arrival, note their initial prevalence, and observe whether conditions are favorable for their increase. In this way, we can anticipate whether injury to crops is likely to occur and whether or not control measures may be necessary.

The first insects to arrive from the south include the apple-grain aphid (Rhopalosiphum fitchii), the greenbug (Schizaphis graminum), the English grain aphid (Macrosiphum avenae), and the aster leafhopper (Macrosteles fascifrons). The three species of aphids are important pests of small grains and are also vectors of the barley yellow dwarf virus. The aster leafhopper is the vector of aster yellows. These insects usually arrive in Minnesota from mid-April to early May (Tables 1 and 2). Some of them may be already infective with viruses on their arrival in Minnesota. Weather conditions favorable for northward dispersal consist of a high pressure area over the eastern states and a low pressure area over the western Great Plains. With this weather pattern, a strong wind from the south or southwest may persist for one to three days. Insects may be widely dispersed or they may drop out along a stationary weather front. Several periods favorable for the northward dispersal of insects usually occur during April and May. The cereal aphids may increase during cool spring weather when their predators are relatively inactive. The aster leafhopper, on the other hand, increases most rapidly if the weather is warm during May and June.

The potato leafhopper (Empoasca fabae) overwinters in southern Louisiana, southern Mississippi, and northern Florida. This leafhopper usually arrives in southern Minnesota from the middle to the latter part of May and in northern Minnesota during June (Table 3). It causes hopperburn on potatoes, yellowing and stunting of alfalfa and clovers, and severe injury to eggplant, peppers, young apple trees, and a number of ornamentals. The potato leafhopper is likely to increase to injurious numbers if there is a fairly large initial population and if we have warm weather and succulent host plants during June and July.

The corn leaf aphid (Rhopalosiphum maidis) usually arrives in Minnesota during early June. It may cause serious losses in yields of late barley if the barley becomes infested prior to heading. After heading has begun, the barley plants are no longer susceptible. This aphid may become abundant on the tassels and in the leaf whorls of corn, but control on corn is seldom justified.

Table 1. First spring records for four species of cereal aphids in Minnesota.

Year	English Grain Aphid	Greenbug	Apple Grain Aphid	Corn Leaf Aphid
1961	May 28	May 31	June 9	June 4
1962	May 26	May 5	June 7	June 7
1963	May 3	May 24	May 3	June 3
1964	May 7	May 18	July 8	June 9
1965	May 3	May 11	May 7	June 17
1966	May 3	April 28	April 27	June 13
1967	April 15	April 16	April 19	May 30
1968	April 16	April 16	March 29	June 3

Table 2. First spring records for the aster leafhopper at St. Paul, Minn.

Year	First Record	Year	First Record
1954	May 13	1962	April 26
1955	May 4	1963	April 17
1956	May 11	1964	April 16
1957	May 9	1965	May 4
1958	May 15	1966	May 5
1959	April 26	1967	April 14
1960	May 2	1968	April 15
1961	May 7		

Table 3. First spring records for the potato leafhopper in Minnesota .

Year	So. Minn.	St. Paul	No. Minn.
1952	June 2	June 2	June 11
1953	May 25	May 30	June 16
1954	May 25	June 2	July 1
1955	May 21	May 25	June 7
1956	May 22	May 26	June 10
1957	May 23	May 27	June 23
1958	May 23	May 27	June 16
1959	May 12	May 19	June 10
1960	May 17	May 30	June 28

CORN ROOTWORM, EUROPEAN CORN BORER & ALFALFA WEEVIL

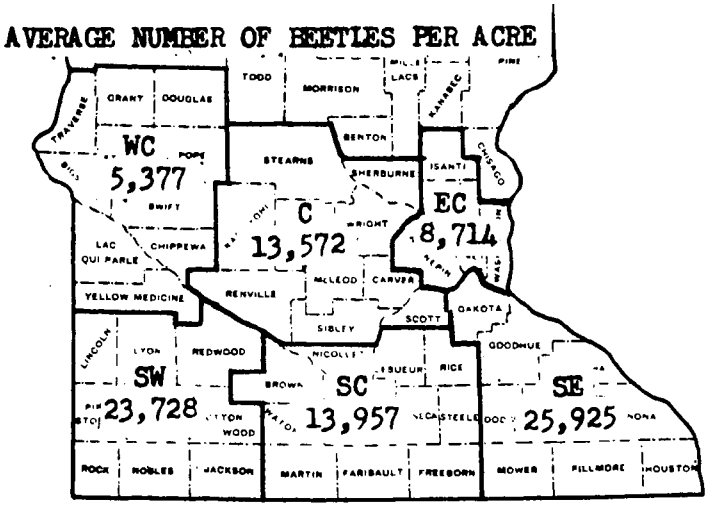
Robert Flaskerd, Survey Entomologist
Minnesota Department of Agriculture
Division of Plant Industry

CORN ROOTWORM SURVEY - 1968

Corn rootworms were again the major insect problem on corn in 1968. This year marked the 5th season that we have conducted an Adult Corn Rootworm Survey. No changes were made in the survey method in 1968 but 7 additional counties were included to increase the coverage in Central Minnesota.

The survey information this year is being reported on a district basis rather than by individual counties. However, comments on population trends or counts in certain counties are included.

POPULATION COUNTS - (Both northern & western species)



Map #1

Southwest District - Counts averaged 23,728 beetles per acre. Six of the 9 counties in this district had population increases over last year. Rock and Nobles counties had the highest counts; however, economic populations were found in all counties in this district.

South Central District - Population counts averaged 13,957 beetles per acre. Five out of the 11 counties in this district had population increases. Martin and Rice counties had the highest counts. Brown, Watonwan, and LeSueur counties had individual fields where counts were high. Other counties in this district had widely scattered rootworm infestations.

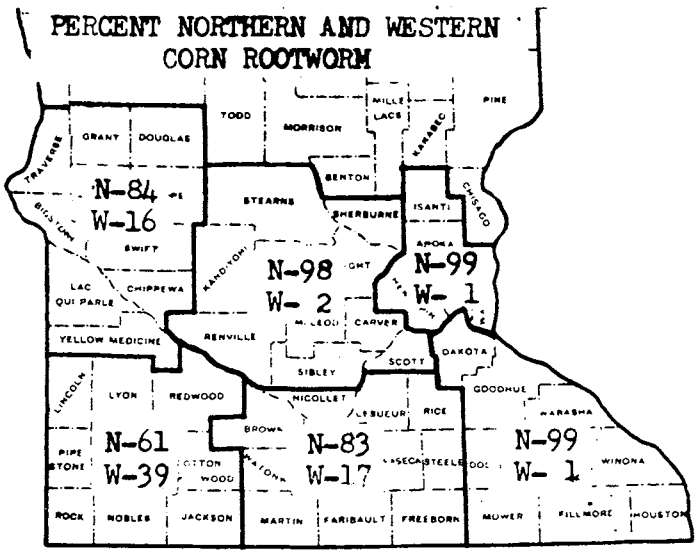
Southeast District - Beetle numbers averaged 25,925 per acre, the highest of all the districts. Only 2 out of the 9 counties had population increases; however, counts remained high in Houston, Olmsted, and Mower counties. Goodhue and Dakota counties had greatly reduced populations over 1967; nevertheless a few fields had severe damage and high populations again in 1968.

West Central District - Counts averaged 5,377 beetles per acre. Stevens county had the highest numbers. Five out of 10 counties in this district had population increases; however, economic numbers were generally widely scattered and found primarily in the southern counties of this district.

Central District - Populations averaged 13,572 beetles per acre. Six out of 10 counties had population increases. Carver county had the highest beetle counts. Economic populations were found primarily in the southern counties in this district.

East Central District - Population counts averaged 8,714 beetles per acre. Hennepin had the highest counts and showed an increase this year. Washington county had fewer problems with rootworm this year.

PERCENT WESTERN AND NORTHERN CORN ROOTWORM BEETLES - In the past the percentages of western and northern corn rootworms were very important. Control recommendations for the western species differed from that of the northern species. The northern species over the years has, however, become more and more resistant to the chlorinated hydrocarbon insecticides. Add to this residue problems with certain insecticides and we find control recommendations now about the same for both rootworm species. We feel that the relative percentages of the two rootworm species is of little practical value at this time. The percentage information is presented this year only for general interest.



Map #2

The percentages of western corn rootworm are lower this year in the SW, SC, SE & C districts; increased in the WC district; and remained the same in the EC district. The northern corn rootworm continues to be the predominant species in Minnesota. Individual fields and counties primarily in the SW and SC districts have high percentages of the western species.

CROPPING HISTORY AND ROOTWORM INFESTATION

Once again this year we recorded the crop history (last 2 years) of all the fields surveyed. This was done to see just where our corn rootworm problems are occurring. The surveyed fields were divided into two classifications: (1) First-year corn; (2) Corn grown two or more years. By relating the number of beetles counted to the cropping history of the fields we found that 98.5% of the beetles were found in the fields that had been in corn 2 or more years. Only 1.5% of the beetles counted were in first year corn fields. Problems with rootworm in Minnesota remain in fields where corn follows corn; no change in this pattern has been observed since we started this survey.

1969 OUTLOOK

The population counts on Map #1 indicates that the SE and SW districts and to a lesser extent the SC and C district, will have most of the economic infestations of corn rootworms in 1969. The WC and EC districts will have fewer, more widely scattered rootworm problems. The district counts indicate on a general basis where most of the rootworm problems will occur. It should be realized that cropping history of a particular field has a great effect on what will occur next season. Farmers should evaluate their own fields based on 1968 populations both locally and by district and the past cropping history of the field going into corn.

EUROPEAN CORN BORER (Ostrinia nubilalis) - Populations increased in the SW, SC, SE, C and EC districts but counts were not high. In the NW district populations dropped but remained relatively high with 99 borers per 100 plants. Very little change occurred in the WC district over last year, with populations about the same in the moderate range with 58 borers per 100 plants. Economic damage to field corn was restricted for the most part to the NW district but an occasional isolated field was found in other districts. The outlook for 1969 is much the same as last year with economic problems most likely in the NW district. If conditions are favorable some corn borer problems could occur in other districts but they should be widely scattered.

District	Number of Borers Per 100 Plants 1967	1968
SW	19	35
SC	16	38
SE	15	32
WC	60	58
C	37	22
EC	18	11
NW	209	99
State Average	53	42

ALFALFA WEEVIL - Insect surveys this past summer failed to find this serious pest of alfalfa. Minnesota remains the only mid-western state where alfalfa weevil has not been found. There was little movement in 1968 eastward in North and South Dakota where infestations are in the western areas. Iowa infestations are still in the middle eastern counties. Wisconsin in 1968 reported alfalfa weevil in Grant County which is located along the Mississippi River. Grant County is about 35 miles from the southeastern border of Minnesota. We can expect infestations to show-up in Minnesota soon, in fact alfalfa weevil maybe present in some fields at the present time.

Alfalfa weevils are snout beetles, 3/16 inch long, brown in color with a broad band down the middle of their backs. Females lay from 600 to 800 eggs in alfalfa stems. The larvae hatch and migrate to the top of alfalfa plants and feed on leaves. Severe infestations cause shredding and drying of leaves and fields appear gray; much like frost damage. The larvae are legless, light yellow to green, up to 1/4 inch long, have a white

strip down the middle of the back and have a shiny black head. The greatest damage from larvae is to the first crop of alfalfa. There is only one generation each year. The larvae pupate in June and July, adults do not become active until fall and then overwinter in the adult stage becoming active again in the spring.

The larval stage, in the spring and early summer, offers us the best chance of detecting this pest. If you find larvae that appear to be alfalfa weevil, collect a few in a vial of rubbing alcohol and send your find to the Minnesota Department of Agriculture, Division of Plant Industry, 670 State Office Building, St. Paul, Minnesota 55101, or your County Agricultural Agent.

GRASSHOPPER OUTLOOK AND CEREAL LEAF BEETLE SITUATION

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GRASSHOPPER OUTLOOK - MINNESOTA

Areas of Minnesota where economic grasshopper populations occurred during the 1968 season were much the same as 1967. However, continuous cool, wet weather over much of the state during May, June, and early July caused some nymphal mortality. As a result, grasshopper populations were lower in most areas. The first nymphs of our earlier hatching species appeared during the first week in May. Egg hatch of a number of our earlier hatching species continued slowly through May and June. Hatch of the red-legged grasshopper, the predominant species in Minnesota, began the latter part of June and continued into August. The peak of the hatch occurred in mid-July, about average for this species. As the season progressed and grasshoppers became larger, economic populations were reported from a number of counties, mostly in central and west central Minnesota.

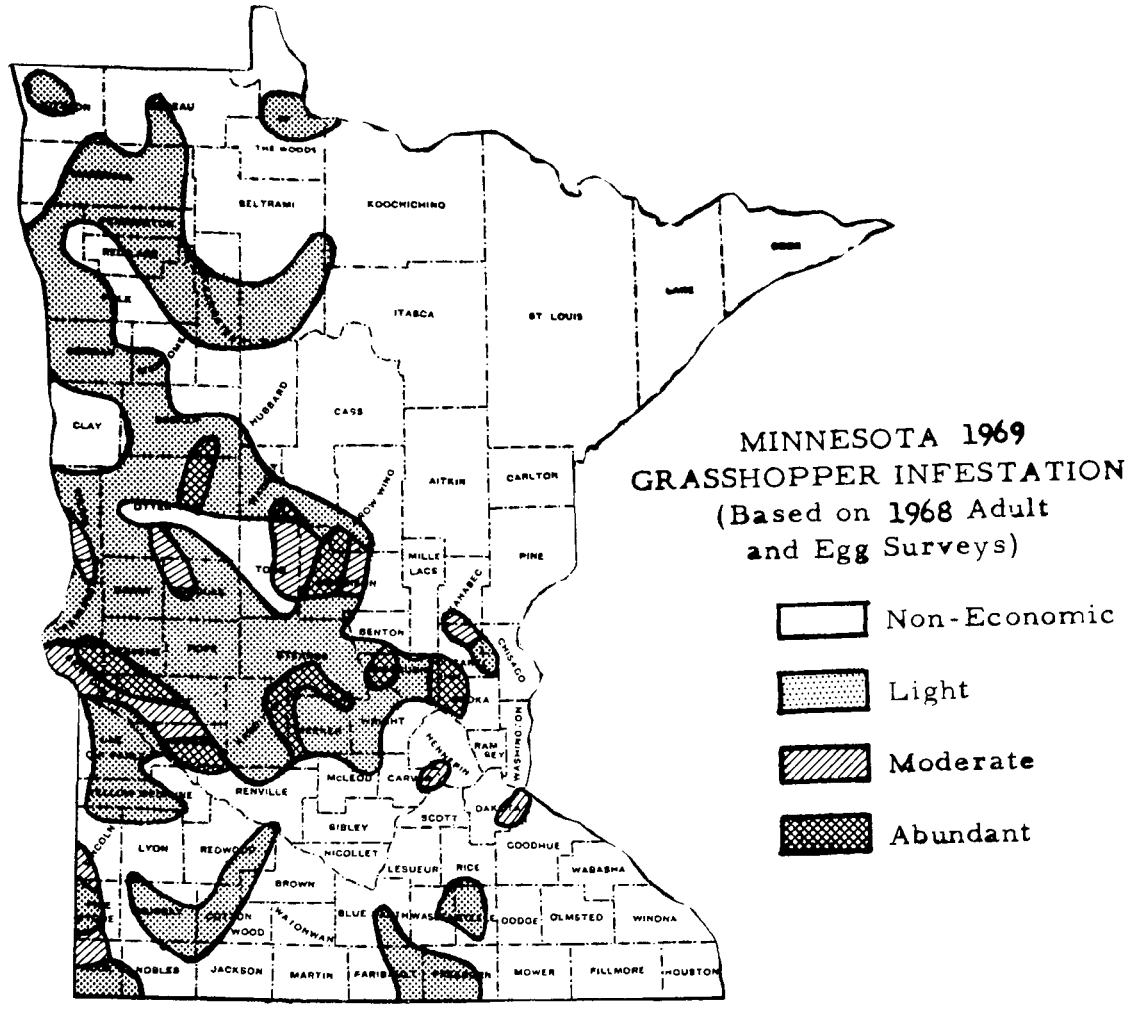
Movement of grasshoppers from roadsides, field margins, and hayfields, into corn, soybeans and flax, was first observed in late July. Feeding damage to these crops was restricted to marginal rows and was generally light. A small number of isolated fields of soybeans was reported to have suffered heavy feeding damage in marginal rows in west central Minnesota.

Grasshopper infestations in 1968 were scattered and localized. Areas of economic infestations with ratings of moderate to abundant occurred mostly in the middle 1/3 of the state, in the west central, central, and east central districts. Highest populations were observed in fields in the sandy areas of Anoka, Sherburne, Stearns, and Kandiyohi counties. In addition, small areas of moderate populations were observed in the southwest district. Light infestations were general over large areas of the western 1/3 of the state.

The red-legged grasshopper continues to be the dominant species throughout Minnesota. This species is normally a problem in alfalfa, red clover, and other small legume crops. A slant-faced grasshopper, Chorthippus curtipenis, has increased the last few years, primarily in western Minnesota. This grasshopper has caused little damage, but may cause problems in grassy areas such as pastures and grassy alfalfa fields. Other grasshopper species were important in only a few isolated fields in 1968.

Results of the grasshopper adult survey and a limited egg survey indicate that 1969 grasshopper populations will occur in much the same areas as 1968. Infestations will be dispersed throughout the central part of the state, and should occur in alfalfa fields, along roadsides and ditch banks. Areas indicated on the map as light and non-economic may have widely scattered

infestations that may cause isolated problems in individual fields. Weather conditions at the critical time of egg hatch and early nymphal growth could modify this outlook to some degree.



CEREAL LEAF BEETLE SITUATION

The cereal leaf beetle, a relatively new and destructive insect to the North American continent, continues to increase in numbers and infest larger areas of the United States and Canada. It was first found in two southwestern Michigan counties in 1962. That same year it was also found in two adjacent Indiana counties.

Since the cereal leaf beetle was found in Michigan and Indiana, annual surveys have shown a steady increase in the area infested. This spread has been mostly to the north, east, and south from the center of the infestation.

The following table indicates the annual increase in area infested:

	Total Number of Counties Infested						
State	1962	1963	1964	1965	1966	1967	1968
Illinois	0	0	0	3	3	6	12
Indiana	2	25	32	38	54	65	71
Kentucky	0	0	0	0	0	0	14
Michigan	2	15	34	43	53	60	60
Ohio	0	1	18	49	63	83	84
Pennsylvania	0	0	0	0	0	4	17
West Virginia	0	0	0	0	0	0	1
Total	4	41	84	133	173	218	259

This insect has a history of causing severe damage to small grains in the old world dating back to 1831. In the United States, damaging populations have been found mostly in southern Michigan and northern Indiana. A decided increase in population occurred throughout the lower peninsula of Michigan this past season. Population counts of up to 6,000 per 100 sweeps of an insect net were recorded from some fields in southern counties. Considerable control work was done by the farmers to protect their small grain crop. Surveys have been conducted each year since 1963 in states surrounding the infested area, including Minnesota, with negative results.

The adult beetle is 3/16 of an inch long. The wing covers, underside of the abdomen, and head are metallic blue in color. The legs and front segment of the thorax are reddish-orange. The beetle overwinters as an adult. It will be found in straw and corn stubble, in grasses, fence rows and woodlots, under rubbish, and other protected sites. The adults leave winter hibernation in Michigan generally early in April and begin feeding on native grasses and winter grains. They are strong fliers and are very active on warm sunny days. During cool, cloudy weather they are very inactive and will be found hiding in clumps of grass.

Mating begins soon after emergence. Egg-laying begins about one week after adult emergence, and may continue for a period of two months. The eggs are laid singly on the leaves of grain and grasses, and each female can lay 100 to 150 eggs. The eggs will hatch in seven to ten days. Both the larvae and adults feed on the leaves of grains and grasses by eating longitudinal strips from the leaf blades.

The larvae are similar in shape to the Colorado potato beetle larvae, but are smaller and lighter in color. They also cover themselves with a black sticky substance that acts as a protective camouflage. The larvae feed for twelve to twenty days, and then pupate in the soil. Adults emerge in late June and early July. These summer adults go into a resting stage soon after emergence and remain quite inactive for the remainder of the summer.

In an effort to delay the spread of the cereal leaf beetle, the infested areas have been placed under state quarantines. All articles that could possibly harbor the cereal leaf beetle are regulated. These articles include such materials as grains, hay, straw, sod, and harvesting equipment. For these articles to move out of the regulated area, they must be certified free of cereal leaf beetle by inspection, insecticide treatment, or fumigation. In addition, areas of light infestation in Illinois have been treated by aerial application with Malathion, for the past four years to delay the westward spread of this pest. This past season over 400,000 acres were treated in Illinois in an 8-county area with L.V. Malathion.

Much has been learned about this pest since it was first found in Michigan, but more needs to be learned. Research continues on the insect's biology, methods of control, and in the development of resistant small grain varieties.

A Biological Control Station was established by the USDA in Michigan for the purpose of rearing and releasing cereal leaf beetle parasites. Parasites native to Europe have been brought to this station where methods have been developed to rear and release them in infested fields. The first releases were made in the spring of 1967. In 1968 parasites of the same species were recovered at distances of 10 to 18 miles from the release sites. This indicates that these parasites will survive and become established under Michigan conditions. Further releases were made in Michigan and Indiana in 1968.

PAINTED LADY THISTLE CATERPILLAR AND GREEN CLOVERWORM

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Department of Entomology, Fisheries, and Wildlife
University of Minnesota

The thistle caterpillar is the larval stage of the butterfly commonly called the "painted lady", Vanessa cardui L. This insect is believed to be the most widely distributed butterfly in the world; often abundant in the West, sometimes in large migratory flights. The adult is about 2 1/2 inches across the wings, orange-red with black and white markings. The larval stage varies from green to brown mottled with black. Each has a light dorsal stripe and a light yellow stripe along each side with grayish spines.

The thistle caterpillar prefers Canada thistle but will feed on many other species of plants. Moderate to heavy populations were reported on soybeans in the southwest, southeast, southcentral, and westcentral districts of Minnesota in June. Few were observed on beans in the central or eastcentral area. Sevin and toxaphene at 1 to 1 1/2 lbs. /acre were recommended for control.

The green cloverworm Plathypena scabra (F) is distributed between eastern U. S. to the Plains where it feeds primarily on clover, alfalfa, garden beans, soybeans, cowpeas, strawberry and raspberry. The winter is passed in the pupal or adult stage. Adult moths are dark brown with a wingspan of 1 1/4 inches. Females lay their eggs on the underside of leaves, completing their growth in about 4 weeks. Pupal stage of 2 to 3 weeks is spent in the soil.

In early August young green cloverworms were found in relatively high populations in the southwest, southcentral, and southeast districts of Minnesota. Population estimates indicated over 6 worms per linear foot of row in these areas in mid-August. Field studies on soybeans in Lamberton produced the following results:

Treatment		Cloverworms /ft. of row			Defoliation (%)		Bu./acre
Aug.22	Rate/acre	Aug.23	Aug.28	Sept.10	Aug.28	Sept.10	Nov.1
Toxaphene	1.5	1.6	0.8	0.04	9.5	8.8	27.6
Carbaryl	1.5	0	0	0.04	7.8	6.1	27.7
Malathion	1.0	0.1	0.1	0	7.8	5.0	30.8
Diazinon	0.5	0.1	0.1	0	6.5	5.0	30.3
Check	-	5.1	4.1	1.1	14.1	18.5	28.7

SUMMARY OF INSECT CONTROL RECOMMENDATIONS

1969

Phillip K. Harein, Professor and Extension Entomologist
L. K. Cutkomp, Professor, Department of Entomology, Fisheries, and Wildlife.

University of Minnesota

Do Not Use After 1969

The U. S. Department of Agriculture recently reminded us that effective January 1, 1969, all registrations for pesticide products now registered for use in a manner involving food or feed on a "no residue" or "zero tolerance" basis are subject to cancellation unless a finite tolerance or an exemption from tolerance has been established by the FDA or a progress report shows that studies are being conducted to support a finite tolerance. Insecticides that have a questionable registration for the use intended are marked in the following recommendations. Any use of these pesticides which have an uncertain registration status, should be checked before applying them in 1969. Within one year (Dec.31, 1969) all pesticides should have a finite residue tolerance, be exempt, or be cancelled.*

It is suggested that aldrin, dieldrin, DDT, chlordane or heptachlor not be used on dairy farms. Corn treated for soil insect control with

aldrin or heptachlor shoule be grown for grain only and livestock should not be allowed to graze these treated fields.

Because of possible residues, wait at least one year before planting soybeans in soil treated for 5 consecutive years with aldrin or heptachlor. Illegal residues may result in potatoes, sugar beets or carrots if they are planted in fields previously treated with heptachlor or aldrin.

Field Crops

Insect	*Crop*	*Insecticide*	*Dosage*	*Limitations*
Aphids	*Small grain*	*malathion*	*1 lb. + 0.6 lb ULV by air*	*7 days*
				7 days
		methyl parathion	*4 oz.*	*No time limitations.*
		parathion	*4 oz.*	*15 days*
	Corn	*malathion*	*1 lb.*	*5 days*
		methyl parathion	*4 oz.*	*12 days*
		parathion	*4 oz.*	*12 days*
		phorate (Thimet)	*1 lb.*	*Granular applied to whorl immediately before tasseling. Do not apply if used as soil application.*
Armyworms	*Small grain*	*carbaryl (Sevin)**	*1 lb.*	*Do not apply after heads are visible*
		toxaphene	*2 lb.*	*Do not feed ~~stalks~~ treated forage ~~leaves, and husks.~~ No restrictions on grain*
	Corn	*carbaryl (Sevin)*	*1 lb.*	*No time limitation.*
		toxaphene	*2 lb.*	*Do not feed stalks, leaves and husks.*
Bean leaf beetle	*Soybeans*	*carbaryl (Sevin)*	*1 lb.*	*No time limitations.*
		toxaphene	*1 1/2 lb.*	*21 days before feeding treated plants.*
Beet webworm	*Sugar beets*	*carbaryl (Sevin)*	*2 lb.*	*14 days (tops)*
		*endosulfan(Thiodan)**	*1 lb.*	*Do not feed tops.*
		*toxaphene**	*3 lb.*	*60 days. Do not feed tops.*
		*trichlorfon(Dylox)**	*1 1/2 lb.*	*14 days*
				28 days (tops)
Corn earworm	*Sweet corn*	*diazinon*	*1 1/2 lb.*	*2 days for forage*
		carbaryl (Sevin)	*1 1/2 lb.*	*No time limitations.*

Recommendations on Field Crops

Insect	*Crop*	*Insecticide*	*Dosage*	*Limitations*
Corn rootworm larvae	*Corn*	*Bux-Ten**	*3/4 lb.*	*Rate given for 40 inch rows. Band application at planting or cultivation, except by Bux-Ten, should be used at planting time only.*
		diazinon	*1 lb.*	
		phorate(Thimet)	*1 lb.*	
		Dasanit	*3/4 lb.*	
		Dyfonate	*3/4 lb.*	
Corn rootworm adults	*Corn*	*carbaryl (Sevin)*	*1 lb.*	———
		malathion	*1 lb. or 0.6 lb. ULV by air.*	*5 days*
Cutworms	*Corn*	*aldrin**	*2 lb.*	*Prelant broadcast disked in.*
		*heptachlor**	*2 lb.*	
		chloradane	*4 lb.*	
		diazinon	*2 lb.*	*Band treatment at planting time.*
		toxaphene	*2 lb.*	
		trichlorfon(Dylox)	*1 1/2 lb.*	*Post-emergence with 40 days waiting period.*
	Small grain	*toxaphene*	*2 lb.*	*Do not use straw.*
	Soybeans	*carbaryl(Sevin)*	*1 lb.*	*No time limitations.*
		toxaphene	*1 1/2 lb.*	*21 days.*
	Sugar beets	*carbaryl(Sevin)*	*1 lb.*	*14 days (tops).*
		trichlorfon	*1 1/2 lb.*	
European corn borer	*Corn*	*carbaryl(Sevin)*	*1 1/2 lb.*	
		*DDT**	*1 1/2 lb.*	*Do not feed forage.*
		diazinon	*1 lb. granular*	*Do not feed to dairy animals; 90 days before slaughter.*
		toxaphene	*2 lb. granular*	*Grain only.*

Recommendations on Field Crops

Insect	*Crop*	*Insecticide*	*Dosage*	*Limitations*
European corn borer cont'd.	*Corn*	*EPN*	*1/2 lb. as spray.*	*14 days.*
			1/4 lb. granular.	*14 days.*
		Bacillus thuringiensis (as labeled)		*No limitations*
Grasshoppers	*Alfalfa, clover hay and forage*	*carbaryl(Sevin)*	*1 lb.*	*5 days.*
		diazinon	*1/2 lb.*	*7 days*
		malathion	*1 1/2 lb. or 0.6 ULV + by air*	*No time limitation. 5 days (do not apply when in bloom).*
	Corn	*carbaryl*	*1 lb.*	
		diazinon	*1/2 lb.*	
		malathion	*1 lb.*	*5 days*
		toxaphene	*1 1/2 lb.*	*grain only*
	Small grain	*carbaryl(Sevin)**	*1 lb.*	*Not after heads are visible.*
		malathion	*1 lb. + 0.6 ULV by air*	*7 days. 7 days.*
		toxaphene	*1 1/2 lb.*	*grain only*
	Soybeans	*carbaryl(Sevin)*	*1 lb.*	*No time limitations.*
		malathion	*0.6 lb. ULV + by air*	*7 days.*
		toxaphene	*1 1/2 lb.*	*21 days - beans only.*
	Grass(pasture, hay).	*carbaryl(Sevin)*	*1 lb.*	*No time limitations*
		diazinon	*1/2 lb.*	*Do not graze on treated forage, wait 21 days before cutting for hay.*
		malathion	*1 1/2 lb. or 0.6 lb. ULV + by air.*	
Green cloverworm	*Soybeans*	*naled (Dibrom)*	*1/2 - 3/4 lb.*	*4 days for hay*
		carbaryl (Sevin)	*1.5 lb.*	
		malathion	*1.0 lb.*	

Insect	Crop	Insecticide	Dosage	Limitations
Leafhoppers	Alfalfa	diazinon	1/2 lb.	7 days for hay; 4 days for grazing
		methoxychlor	1 1/2 lb.	7 days.
Pea aphid	Alfalfa, Clover	demeton(Systox)	4 oz.	21 days
		diazinon	1/2 lb.	7 days for hay; 4 days for grazing on alfalfa. 7 days for grazing on clover.
		malathion	1 lb. 0.6 lb. ULV+ by air	No time limitations
		parathion or methyl parathion	4 oz.	15 days
Plant bugs	Alfalfa Clover	DDT*	1 1/2 - 2 lb.	Do not graze or cut for feed.
		toxaphene*	2 lb.	Seed crop only.
Sunflower moth	Sunflowers	endosulfan(Thiodan)	1 lb.	Not more than 3 applications.
Sweet Clover weevil	Sweet Clover (plowdown)	toxaphene*	2 - 3 lb.	Do not graze or cut for feed.
Thrips	Barley	parathion or methyl parathion	6 oz.	15 days.
Wireworms	Corn, beans, Small grain	aldrin*, dieldrin*, heptachlor*, or lindane.	1 oz. per bushel	Seed treatment.
Wireworms and White grubs	Corn	aldrin* or heptachlor*	1 - 2 lb.	Soil treatment, row or broadcast
		chlordane	2 - 4 lb.	

* Status uncertain. See introductory paragraph on page 1.

Pest	*Host*	*Insecticide*	*Rate*	*Limitations*
Cattle grubs	*Dairy cattle*	*rotenone**	*7 1/2 lb. 5% powder per 100 gal. (2 - 4 qts. per animal using power sprayer); 12 oz. 5% powder per 1 gal. Wash (sponge 1 pt. per animal).*	
		coumaphos(Co-Ral)	*0.5% spray*	*To heifers (not before 3 months of age or 14 days before freshening).*
	Beef cattle	*coumaphos(Co-Ral)*	*0.5% spray, 4% pour-on*	*No limitations.*
		ronnel(Trolene, Rid-Ezy, Steer-Kleer)*	*0.6% in feed or mineral 0.26% in feed*	*Not after Nov. 1 60 days before slaughter 28 days before slaughter.*
		*Ruelene**	*0.5% spray, 9.4% pour-on solution 8.3% emulsion as pour-on.*	*Not after Nov. 1 28 days before slaughter.*
		trichlorfon (Neguvon)*	*1% spray*	*14 days before slaughter*
			8% pour-on	*21 days before slaughter*
Cattle lice	*Dairy cattle*	*Synergized pyrethrum**	*0.05% - 0.1%*	*No time limitation*
		*rotenone**	*2 lb.5% powder per 100 gal.*	*No time limitation*
		*Ciodrin**	*0.25% emulsion spray*	*Do not apply oftener than once every 7 days.*
	Beef cattle	*carbaryl(Sevin)**	*0.5% spray*	*7 days before slaughter not oftener than every 4 days.*
		coumaphos(Co-Ral)	*0.25% spray or dip.*	

Recommendations on Livestock

Pest	Host	Insecticide	Rate	Limitations
Cattle lice cont'd.	Beef cattle	Ciodrin*	0.25% spray 3% dust	
		dioxathion(Delnav)	0.15% dip or spray	Not oftener than 2 weeks.
		malathion	0.5% dip or spray.	7 days
		methoxychlor	0.5% dip or spray	No time limitation.
			10% dust	
		ronnel(Korlan)*	0.25% spray or 1% in oil on backrubber.	8 weeks (spray) 14 days (in oil)
		toxaphene	0.5% dip or spray.	28 days
		trichlorfon (Neguvon)*	0.25% spray	14 days
Face Flies	Dairy cattle	dichlorvos (Vapona)	0.5% baited spray (1 tsp. to forehead).	Only once per day, morning preferred.
		dichlorvos	1% oil solution)	Apply as mist spray daily at not over 2 oz. per head per day.
		Ciodrin	1% oil solution)	
		Ciodrin	3% dust)	
		Pyrethrins + synergist	0.075% oil sol.)	
		coumaphos(Co-Ral)	1% oil for back-rubber to rub face (1 gal./20 ft. cable).	
		Ciodrin	1% oil for backrubber	
	Beef cattle	Same as for Dairy or toxaphene or ronnel	5% oil solution 1% oil sol.	On backrubbers to permit face treatment.

Recommendations on Livestock

Pest	*Host*	*Insecticide*	*Rate*	*Limitations*
Flies, (horn stable, horse) and mosquitoes	*Dairy cattle*	*dichlorvos(Vapona)**	*1% oil spray*	*Not over 2 oz. per animal daily as a mist.*
		*Ciodrin** *(or combination of above)*	*1% oil spray* *3% dust*	*Not over 1 1/2 oz. per animal daily as a mist.*
		*coumaphos(Co-Ral)**	*1% on back-rubber.*	
		*malathion**	*4 to 5% dust*	*At least 5 hrs. before milking.*
		*methoxychlor**	*50% WP as dust (1 tbsp.)*	*Apply after milking; Do not use oftener than once in 3 weeks.*
		synergized pyre-thrum (may also contain repellents)*	*0.05% to 0.1%*	*Not over 2 oz. per animal daily as a mist*
	Beef cattle	*Same materials as for dairy*		
		or		
		carbaryl (Sevin)	*0.5% spray*	*7 days before slaughter not oftener than every 14 days*
		coumaphos(Co-Ral)	*0.25% spray* *1% on backrubber*	
		or		
		dioxathion(Delnav	*0.15% spray or dip*	*Not oftener than 2 weeks.*
			1.5% in oil on backrubber	
		or		
		lindane	*0.03% spray or dip*	*30 days if sprayed, 60 days if dipped.*
			0.2% in oil on backrubber	*30 days*
		or		
		malathion	*0.5% spray* *2% in oil on backrubber* *0.6% lb. ULV+ by air**	
		or		
		methoxychlor	*0.5% spray* *5 or 6% in oil on backrubber*	

Recommendations on Livestock

Pest	*Host*	*Insecticide*	*Rate*	*Limitations*
Flies, (horn, stable, Horse) and mosquitoes cont'd.		*or*		
	Beef cattle	*ronnel(Korlan)**	*0.5% spray*	*8 weeks before slaughter.*
			1% in oil on backrubber	*14 days before slaughter*
		or		
		toxaphene	*0.5% spray) 5% in oil on) backrubber) 5% dust)*	*28 days*
		or		
		trichlorfon (Neguvon)*	*1% spray*	*14 days before slaughter*
Poultry mites, lice	*Chickens,** Turkeys*	*coumaphos(Co-Ral)*	*1/2% dust 0.25% spray (1 gal.per 100 birds)*	
		malathion	*0.5% spray 4% dust (1 lb. per 100 birds) 3% roost paint 4 - 5% dust (1 lb./50 sq.ft. litter) 1% spray (1/2 gal./1000 sq. ft. surface)*	
		carbaryl(Sevin)	*5% dust (1 lb. per 100 birds) (1 lb./40 sq.ft. litter) 0.5% water mist*	*Do not treat nest litter.*
			Spray (1 gal. per 100 birds)	
			0.5% roost spray.	*Do not use oil sprays on birds*
			(1 - 2 gal./1000 sq. ft.)	

Recommendations on Livestock

Pest	*Host*	*Insecticide*	*Rate*	*Limitations*
Poultry, mites, lice cont'd.	*Chickens, Turkey*	*nicotine sulfate*	*40% (1 pint per 150 - 200 ft. roost.*	*Do not apply to birds*
Sheep Keds	*Sheep*	*coumaphos(Co-Ral)*	*0.25% spray* *1/2% dust*	*15 days* *15 days*
		dioxathion(Delnav)	*0.15% spray or dip*	*Not oftener than 2 weeks.*
		diazinon	*0.03 - 0.06% spray* *or 2% dust*	*14 days* *14 days*
		malathion	*0.5% spray*	*No time limitation.*
		methoxychlor	*0.5% spray*	
		*ronnel(Korlan)**	*0.25% spray*	*84 days*
		toxaphene	*0.5% spray* *5.0% dust*	*28 days* *" "*
Swine mange mites (Sarcoptic) and lice	*Swine*	*lindane*	*0.06% as spray or dip* *1.0% dust* *0.2% in oil on backrubber*	*Do not treat before animals are 3 months old or sows within 2 weeks of farrowing; must be 30 days before slaughter, dips 60 days.*
		malathion	*0.6% spray or dip* *0.5% on rubbing devices.* *5.0% dust*	*No time limitations*
		toxaphene	*0.6% spray or dip* *5% dust* *8.0% on rubbing devices.*	*(Do not treat before (animals are 3 months (old.* *(* *(*

Recommendations on Livestock

Pest	*Host*	*Insecticide*	*Rate*	*Limitations*
Swine lice only	*Swine*	*coumaphos(Co-Ral)*	*0.25% spray*	*No animals under 3 months of age.*
		carbaryl (Sevin)	*0.5% spray*	*No oftener than once every 4 days.*
		Ciodrin	*0.25% spray*	*No oftener than once a week.*
		dioxathion (Delnav)	*0.15% dip or spray*	*No oftener than once in every 2 weeks.*
		methoxychlor	*0.5% dip or spray*	*No time limitations*
		ronnel(Korlan)	*0.25% spray or dip*	*No oftener than once in 2 weeks.*
			5% granular to bedding at 1/2 lb. per 100 sq. ft.	*Remove from treated bedding at least 2 weeks before slaughter.*
		ronnel		*Do not apply to animals receiving organophosphates from any other source.*

* *Status uncertain. See introductory Page* ____

+*ULV = ultra low volume*

** *Note: None of these materials* have *residue tolerance, other than zero, on eggs.*

SAFE PRACTICES FOR HANDLING HAZARDOUS CHEMICALS

George J. Raschka
Chief, Section of Industrial Hygiene
Minnesota Department of Health

Hazardous chemicals can be used safely if the nature of the hazard is recognized and appropriate measures are taken to control the hazard. Economic poisons are effective because of selective adverse physiological effects in the target host. Similar physiological effects can be expected in man. Barriers must be provided to prevent entry into the body by ingestion, inhalation, and absorption through the skin. Means must be found to measure the effectiveness of the control program. The Department's experience over the last several years with aerial spraying of parathion will be related.

PANEL ON PROBLEMS OF AERIAL APPLICATORS

Terry K. Pfeil, President
Minnesota Agricultural Aircraft Association

This panel discussion will cover a number of the everday problems of aerial applicators, the discussion will include several of the following topics:

1. Pilot training
2. Ground help
3. Collections
4. Drift
5. Getting help
6. Keeping help
7. Accidents
8. Safety
9. Pricing
10. Maintenance
11. Keeping records

CONTROLLING PESTICIDE DRIFT

Gerald Miller, Extension Agronomist

I. The Drift Problem

A. Pesticide drift is the movement of a pesticide to areas other than the intended area of application

B. Two kinds of drift

1. Spray or dust particles - Particle drift occurs at the time of application when small spray droplets or dust particles are carried by air movement from the site of application.

2. Vapor drift - Movement of pesticide fumes from the site of application when the pesticide evaporates. These vapors move by diffusion or air movement.

C. Hazard - Pesticide drift may harm sensitive crops, ornamentals, gardens, livestock, wildlife, or people. Bodies of water, streams or buildings may be contaminated. Drift onto crops could result in an illegal residue if the residue on the crop exceeds the level for which tolerances have been established or if no tolerance has been set. Poor performance could result if excessive drift occurs resulting in too low rate of application.

II. Factors Affecting and Techniques for Controlling Drift

A. Chemical, formulation and spray characteristics

1. Chemical - More potent chemicals are a great drift hazard because small amounts can result in problems. A fraction of an ounce per acre of herbicides such as 2,4-D, dicamba and picloram may affect sensitive crops. Some chemicals volatilize rapidly, but others do not volatilize fast enough to build up injurious concentrations.

2. Formulation - Vapor drift can be avoided by using relatively nonvolatile formulations. Low volatile 2,4-D formulations reduce the vapor drift hazard. Dusts drift more readily than sprays. Measurements of drift from aerial applications showed from 5 to 100 times more drift from dusts than sprays at distances of 100 feet to 1/2 mile from the flight pattern.

3. Particle or drop size

Larger particles or drops have less drift potential than smaller particles or drops. But consideration must also be given to adequate coverage.

Table 1. Distance water droplets drift while falling 10 feet, 3 mph wind

Droplet diameter, microns 1/	Classification	Drift Feet
30	cloud	500
100	mist	50
200	drizzle	16
500	light rain	7

1/ 1 micron = 1/25000 inch

Spray nozzles produce a wide range of droplet sizes. Thickened sprays are coming into use to increase the percent of large droplets. However, thickened sprays do not completely eliminate the fine droplets. Application techniques and precautions are still important in applying thickened sprays to reduce drift problems.

Table 2. Droplets of emulsions by size class from fixed-wing aircraft

	Droplet size class (microns)			
	0-150	150-300	300-450	450-900
Emulsion		Percent		
Standard	37	43	14	6
Invert, 45°1/	10	45	22	21
Invert, 15°1/	15	51	21	13

1/ Orientation of nozzles back from the vertical position.

Table 3. Effect of thickening agents on spray drift

Spray	Drift as % of the water solution spray
Water	100.0
Inverted emulsion	40.9
Hydroxyethylcellulose	9.4
Particulate	.9

4. Specific gravity or density of particles

"Lighter" particles tend to stay airborne longer and therefore, drift farther. Oil droplets are lighter than water droplets.

5. Evaporation rate - After spray drops are released, evaporation reduces their size which tends to keep the drops suspended longer. Water evaporates more rapidly than oils (e.g. 35 times as fast as diesel fuel). Small droplets may completely evaporate before they reach the ground.

Table 4. Lifetime of water droplets, 40% relative humidity, 59°F

Initial diameter microns	Life seconds	Time to fall 20 feet, sec.
50	4	- a/
100	16	20 b/
200	63	10

a/ Drop will only survive about 1 foot of the free fall.
b/ Evaporation would decrease size and rate of fall so drop would not reach ground.

B. Equipment and application techniques

1. Nozzles and pressure

Nozzles are designed to convert spray liquids into droplets and distribute them in a uniform pattern. Nozzle construction plus the pressure of operation determine the size and uniformity in size of the droplets.

At low pressures the liquid escapes from the nozzle tip as a liquid film. As the film expands it forms droplets at the outer edge based on surface tension of the liquid.

As pressures increase droplet formation occurs closer to the nozzle tip with the formation of smaller droplets. At high pressures droplets are formed directly from the nozzle tip as a result of escape from hydraulic force. Under high pressures droplets may be of a fog and mist size, creating a drift hazard.

Most nozzles have a relatively low pressure which permits droplet formation as a result of surface tension. If nozzles are operated at this pressure, there will be a minimum amount of mist size droplets to cause spray drift. Large nozzles can be used at low pressure to deliver the same gallons per acre as small nozzles at high pressure.

2. Height of release - The distance and thus the time required for droplets to reach the ground are directly affected by height of release. Wind velocities are usually lower close to the ground. Sprays should be released as near the vegetation or soil surface as will permit adequate coverage. Using drop nozzles to release the spray below the crop canopy will minimize drift.

C. Weather

1. Air movement - Horizontal and vertical.

In general, air is least turbulent just before sunrise, and secondly just after sunset and on through the night. Air is usually most gusty and turbulent between 2 and 4 p.m.

Differences between temperatures at ground level and that of higher air determines the amount of air turbulence. Normal daytime heating of the soil causes the air near the soil surface to be warmer than the air aloft. The warm air at the lower levels rises setting up air currents. The temperature differential is usually least during early morning or late evening, thus the calmer conditions. As the temperature differential increases, air currents may carry particles for long distances. Avoid application when this condition exists.

If the air near the soil surface is cooler than the air above (an "inversion" condition), the warm air aloft remains on top and no vertical mixing can take place. Low wind conditions with a high inversion (ground air 2 to 5 degrees cooler than the air above) may cause the smallest spray drops or dust particles to remain suspended in the layer of cold undisturbed air and eventually move out of the area. Avoid application under this condition.

2. Temperature

   a. Effects on air movement discussed above

   b. High temperatures increase losses of volatile herbicides. The carbamates, dinitro compounds and high volatile esters of 2,4-D, 2,4,5-T and other phenoxy compounds volatilize rapidly at temperatures above 80 degrees. At temperatures above 90 degrees, even the low-volatile esters of 2,4-D and other phenoxy compounds become significantly volatile.

      Higher temperatures increase the rate of evaporation from spray droplets resulting in the droplets staying airborne longer.

3. Humidity - The relative humidity affects the rate of evaporation from spray drops, the rate being faster at low relative humidities.

Temperature, humidity and moisture conditions indirectly affect the potential for drift affects on crops by affecting the susceptibility of the crop to the herbicide. Crops are generally more susceptible to injury under favorable growing conditions. But favorable growing conditions following herbicide effects may promote recovery.

Table 5. Micro-weather effects on drift

Wind speed at 8 ft. mph	Temperature at 8 ft. °F	Temperature difference °F at 32 ft. minus °F at 8 ft.	Relative humidity %	
3 - 5	70 - 95	0	20-50	Best weather for application
2 - 3	70 - 100	+2 to +5	40-50	Calm, cool surface air, strong inversion, drift 3 to 10 times best conditions
8 - 10	70 - 110	0 to -5	20-40	Windy, turbulent drift 3 to 6 times best conditions

III. Summary

Pesticide drift control should be a consideration in every pesticide application. Severe problems can be avoided by giving proper attention to chemical formulations, equipment and weather considerations. To reduce drift:

A. Use low volatile formulations

B. Use low pressure

C. Use large nozzles

D. Use high volume

E. Release spray near crop or soil surface

F. Avoid spraying at high temperatures

G. Spray when wind is low and blowing away from sensitive crops or areas that should not be contaminated

IV. References

A. Aerial Application of Agricultural Chemicals. 1965. Agricultural Handbook No. 287. U. S. Department of Agriculture. Washington, D. C. 48 p.

B. Behrens, Richard. 1967. Pesticide Drift Problems - Factors Affecting Drift in Agricultural Pesticides Short Course. University of Minnesota. pp. 33-34.

C. Klingman, D. L. 1966. Drift Control Additives and Their Effectiveness. Paper Presented to North Central Extension Weed Control Workshop. Wichita, Kansas. 12 p.

D. Klingman, G. C. 1961. Weed Control: As a Science. John Wiley and Sons, Inc. New York. pp. 96-99.

E. Lehman, S. K. and R. H. Haas. 1965. Spray Characteristics of Invert Emulsion Sprays Applied from Aircraft with the Bifluid System. Southern Weed Conference Proceedings. p. 315-321.

F. Mann, W. J. 1963. Handbook for Agricultural Pilots, Fixed-Wing Aircraft. International Agriculture Aviation Centre, The Hague. p. 77.

G. Reimer, Byrd and Johnson. 1966. Down to Earth. 22:1(3-6).

H. Scotton, John W. 1965. Atmospheric Transport of Pesticide Aerosols. U. S. Department of Health, Education and Welfare. Public Health Services. Office of Pesticides. Washington, D. C. 30 p.

I. Seymour, K. G. and B. C. Byrd. 1964. Wind Tunnel Evaluation of Spray Drift Potential. American Society of Agricultural Engineering. Paper No. 64-609 C.

AGRICULTURAL EXTENSION SERVICE
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Weed Control Problems

1.(a) "Kill-a-Weed" is a 75% wettable powder. The suggested rate of application is 1 1/2 pounds of active ingredient per acre broadcast. How many pounds of 75% wettable powder would you apply per acre broadcast or per acre actually treated?

_____ pounds

(b) If "Kill-a-Weed" were applied in a 12 inch band over rows spaced 36 inches wide, how many pounds would you apply per crop-acre?

_____ pounds

2. "Stop-Weed" is a liquid emulsifiable concentrate containing 2 pounds acid equivalent and 25% active ingredients per gallon. The suggested rate of application is 1/4 pound of acid equivalent per acre broadcast. How many pints of concentrate would you apply per acre broadcast?

_____ pints

3.(a) Farmer Herb I. Sjeid found that his sprayer applied 2 gallons of water in traveling 660 feet at a constant speed of 5 miles per hour and 30 pounds per square inch pressure. The sprayer boom covers a swath 22 feet wide. How many gallons of spray is Herb applying per acre?

_____ gallons

(b) Herb's sprayer tank holds 75 gallons. How many acres will one tank spray if the spray is broadcast?

_____ acres

(c) If "Stop-Weed" is used at 1/4 pound of acid equivalent per acre, how many quarts of concentrate would you put in a tank of water?

_____ quarts

4. Herb has a 4 row corn planter that plants in 36 inch rows. The planter is equipped with granular applicators. Herb set the applicators at the manufacturer's suggested setting, then checked the adjustments so each box was putting out the same amount of material. The applicators cover a 12 inch band over the row.

(a) Herb is using "Grani-Weed," a granular formulation that contains 20% active ingredient. The suggested rate of application is 5 pounds of active ingredient per acre broadcast. How many pounds of granules should he apply per acre actually treated?

_____ pounds How many pounds per crop acre?

_____ pounds

(b) Herb drove the planter 660 feet and collected 1 pound of granules from all 4 boxes. Should he readjust the boxes to apply more granules or less?

_____

Added Advantages of DACAGIN

by
J. A. Ignatoski, Technical Representative
Diamond Shamrock Corporation, Cleveland, Ohio

In order to reduce the problems caused by spray drift when applying weed and brush killer herbicides (2,4-D and 2,4,5-T), Diamond Shamrock Corporation developed DACAGIN. A DACAGIN plus water carrier remains quite flowable while under agitation in a spray tank, but when subjected to a high shear stress, as when it passes through a nozzle orifice under pressure, it permanently assumes a high viscosity which consequently reduces the number of fine droplets in the atmosphere, as compared to water alone. Increase in droplet size reduces the spray drift while the high viscosity and possibly the physio-chemical nature of the material itself gives DACAGIN several additional advantages such as increased efficacy of 2,4-D amines.

Research conducted at Boyce Thompson Institute indicate that DACAGIN enhanced the effect of the diethanolamine salt of 2,4-D (Table I)

Table 1. Effect of DACAGIN on Growth Responses Induced by 2,4-D Amine Salt on Tomatoes

Treatment	Dosage	Epinasty and stem bending	Rating 1/ Modification	Stem Proliferation
2,4-D amine	12.5 ug. (0.05 ml.)	1.1	1.1	0.7
	25.0 ug. (0.1 ml.)	7.0	1.0	7.0
2,4-D + DACAGIN	12.5 ug. (0.1 ml.)	6.3	1.0	5.0
	25.0 ug. (0.2 ml.)	6.3	1.0	6.8
DACAGIN alone	0.1 ml.	0	0	0
No treatment	-	0	0	0

1/ = 0 = no effect, 10 = severe effect (each category rated separately)

ntbk. ref. 711: 112

One year's data, from Dr. Wayne T. Flincham (Texas A & M University) on the use of DACAMINE and DACAGIN, while not conclusive, does indicate the possibility of increased efficacy of DACAMINE on Mexican Weed (Caperonia castanaefolia) in rice.

Table II. Yield of rough rice and weed control data from plots sprayed with 2,4-D amine and DACAMINE 4D

Time of Application	Herbicide	Rate lbs/Aai	Yield lbs/A	Broadleaf Control		
				Sedge	Mexican Weed	Coffeeweed
Postemergence	2,4-D Amine	0.75	912.0a[1/]	4.53ab[2/]	1.75 cd[2/]	0.33 b[3/]
	"	1.75	893.9a	4.9 a	6.38a	0.00 b
(Light flood)	DACAMINE 4D	0.5	898.4a	4.28ab	6.25ab	0.00 b
	DACAMINE 4D	1.0	880.3a	7.03a	3.13bc	0.58 b
	DACAMINE 4D + DACAGIN	1.0	844.0a	4.78a	6.50a	0.00 b
	Hand Weeded		830.4a	3.18ab	7.75a	1.75b
	Weedy Check		875.7a	0.00 b	0.0 d	10.03a

1/ Duncan's sequential test of means (data followed by the same letter do not differ at the .05 probability level)

2/ 0 = No control; 10 = 100% control

3/ Number of coffeeweeds present in each 4 x 20' plot

It is interesting to note that this response was only limited to Mexican Weed and not Sedge or Coffeeweed. Possibly different rates of 2,4-D are needed to show the effect of DACAGIN since the various rates of 2,4-D used in this study were only reflected statistically in the weed control results of Mexican Weed (Table II).

Increased efficacy of insecticides has also been reported by Dr. Zane Smilowitz (Thesis at Cornell University, 1967) entitled, "A Laboratory and Field Investigation of Adjuvants to Increase the Residual Toxicity of Dichlorvos, Mevinphos and Malathion to Mexican Bean Beetle and Southern Armyworm Larvae". In these studies DACAGIN increased the residual effect of various insecticides in the laboratory and field in controlling larvae of the Mexican Bean Beetle,

Epilachna varivestis (Muls.) and larvae of Southern Armyworms, Prodenia cridania (Cram.)(Table III and Table IV).

Table III. DACAGIN/Insecticides[1/]

Laboratory Data

1. Only 24 hour residual effect was noted.

2. Treatment:

   0.5 parts DACAGIN (Label rate)
   0.13 parts Insecticide

	Phosdrin		Vapona	
	Mexican Bean Beetle	Southern Armyworm	MBB	SAW
Toxicant only	41% kill	24% kill	13% kill	3% kill
Toxicant w/DACAGIN	100% kill	100% kill	100% kill	97% kill

1/ Dr. Zane Smilowitz - Cornell University, Dept. of Entomology, Thesis.

Table IV. DACAGIN/Insecticides[1/]

Field Data:

1. Five day residual effect was studied with observations made at different intervals.

2. Treatments:
   0.5 parts DACAGIN (Label Rate)
   Insecticides as noted.

	Hours				
	24	48	72	96	120
a. Malathion at 0.125 parts on MBB[2/]					
Toxicant only	75	55	6	8	5
Toxicant w/DACAGIN	45	63	8		
on SAW[3/]					
Toxicant only	79	26	1	5	0
Toxicant w/DACAGIN	98	76	20	-	-
b. Phosdrin at 0.05 parts on MBB					
Toxicant only	76	29	7	21	0
Toxicant w/DACAGIN	100	23	-	-	-

	Hours				
	24	48	72	96	120
c. Vapona at 0.5 parts					
on MBB					
Toxicant only	73	7	2.5	-	-
Toxicant w/DACAGIN	100	33	0	-	-
on SAW					
Toxicant only	69	4	3	-	-
Toxicant w/DACAGIN	100	12	-	-	-

1/ Dr. Zane Smilowitz - Cornell University, Dept. of Entomology, Thesis

2/ MBB - Mexican Bean Beetle

3/ SAW - Southern Armyworm

Reports from the field also indicate that DACAGIN may increase the efficacy of cotton defoliants as well as increasing the rate of defoliation.

Dr. R. J. Smith, Jr. - Research Agronomist at the Crops Research Division of the U.S. Department of Agriculture at Stuttgart, Arkansas is presently studying the use of DACAGIN with Propanil on rice. Dr. Smith has reported that "Propanil-Water-DACAGIN mixtures of 5 gpa controlled barnyardgrass better than 5 gpa of Propanil-water-mixtures, and about as well as 10 gpa of Propanil-water-mixtures." The rate of Propanil, however, had to be maintained at 4 lb./A. Thus it appears that one-half the carrier (DACAGIN + water) per acre would give satisfactory weed control attained only with double the amount of carrier (water alone).

The increased efficacy of 2,4-D amines, insecticides and the reduction of carrier needed to get satisfactory results with Propanil indicate that DACAGIN has certain advantages other than that of a spray drift retardant. Further testing of the above is necessary before we can recommend DACAGIN for these uses, but these results are encouraging.

2,4-D + DSMA Possible Substitute for 2,4,5-T

J. A. Ignatoski*

With the recent shortage of 2,4,5-T (2,4,5-Trichlorophenoxyacetic acid) in 1967, a combination of 2,4-D (2,4-Dichlorophenoxyacetic acid) and DSMA (Disodium methanearsonate) was evaluated as a possible substitute for this product. This combination of 2,4-D acid plus DSMA (4 + 10 pounds per 100 gallons of water) was evaluated in Arkansas, Ohio and Wisconsin. The material was applied during the month of July with an intermediate reading taken that September. This combination product exhibited good burn at this time, and the following spring little to no regrowth was observed on the following plants:

Aspen (Populus tremuloides, Michx.)

Red oak (Quercus rubra, Michx.)

Yellow birch (Betula alleghaniensis, Britton)

Common Choke Cherry (Prunus virginiana, L.)

Wild Raspberry (Rubus spp. L.)

Eastern Hemlock (Tsuga canadensis (L.) Carr.)

Eastern White Pine (Pinus strobus, L.)

Since this combination of 2,4-D acid and DSMA exhibited good brush killing capabilities, further extensive tests on this product were carried out during the spring of 1968. The following materials were applied on June 24, 1968, on a power line right-of-way near Minocqua, Wisconsin:

Herbicide	Rate (lbs.) per 100 gallons of water
**MSMA (Monosodium methanearsonate) + surfactant	4
**MSMA (Monosodium methanearsonate) + surfactant	8
***2,4-D (N-Oleyl 1,3-Propylenediamine salt)	4

*Technical Representative, Diamond Shamrock Corporation, Cleveland, Ohio

2,4-D (Dimethylamine salt)	4
2,4-D (Dimethylamine) + MSMA + surfactant	4 + 4
DSMA + surfactant	10
2,4-D acid + surfactant	4
DSMA + 2,4-D acid + surfactant	10 + 4
2,4,5-T (Isopropyl ester)	4

**DACONATE
***DACAMINE

A preliminary evaluation of these plots was made this October. Though it is too early to tell about the degree of control achieved on the hardwoods, percent foliar burn readings could be obtained on conifers in this test. The results were as follows:

Herbicide	Rate (lbs.) per 100 Gallons of Water	Per cent Foliar Burn of Conifers
**MSMA + surfactant	4	50 - 60
**MSMA + surfactant	8	50 - 60
***2,4-D (N-Oleyl 1,3-Propylenediamine)	4	50 - 60
2,4-D (Dimethylamine)	4	40
2,4-D (Dimethylamine) + MSMA + surfactant	4 + 4	50 - 60
DSMA + surfactant	10	50
2,4-D acid + surfactant	4	40
DSMA + 2,4-D + surfactant	10 + 4	90 - 100
2,4,5-T (Isopropyl ester)	4	50 - 60

**DACONATE
***DACAMINE

These results indicate that the DSMA plus 2,4-D acid (10 + 4) combination was superior to all other treatments with regards to percent foliar burn of conifers.

11/68
1500

AGRICULTURAL EXTENSION SERVICE
UNIVERSITY OF MINNESOTA - U. S. DEPARTMENT OF AGRICULTURE
INSTITUTE OF AGRICULTURE ST. PAUL, MINNESOTA 55101

Corn and Soybean Weed Control Demonstration Results 1968

Gerald Miller and Oliver Strand, Extension Agronomists

Tables 1 to 8 summarize results of weed control demonstrations conducted by Minnesota county agricultural agents and extension specialists. These data are the average results from a large number of trials on various soil types and under different weather conditions. They may assist in evaluating herbicides, but for information on herbicides, rates, and methods of use for specific situations, refer to University of Minnesota Extension Folder 212, Cultural and Chemical Weed Control in Field Crops, 1969.

Chemicals were applied on 1/100-acre plots either preplanting and incorporated (before planting and disked in), preemergence (after crop planted but before crop or weed emergence), or postemergence (after crop and weeds emerged) as specified in the tables. Preemergence treatments were not incorporated. Early postemergence applications of atrazine (AAtrex) alone, with oil or with "Tronic" on corn and chloroxuron (Tenoran) on soybeans were made when weeds were less than 1 1/2 inches. Soybeans had the first trifoliolate leaf when chloroxuron was applied. Dicamba or 2,4-D were applied when corn was approximately 6 inches tall. Propachlor (Ramrod) was applied to control grasses before the postemergence treatments of 2,4-D, dicamba or chloroxuron. Sprays were applied with a knapsack sprayer; granules were mixed with inert granules and spread by hand.

Plots were placed across eight crop rows. One-half of each plot was cultivated once or twice as needed; the other half was left uncultivated. Several check plots with no chemical applied were left in each trial.

Weed control was visually evaluated 3 to 7 weeks after chemicals were applied (early evaluations) and again near the end of the growing season (late evaluations). Control is rated "good" if more than 75 percent of the weeds were controlled, "fair" if 50 to 75 percent of the weeds were controlled, and "poor" if less than 50 percent of the weeds were controlled. "Grasses" in the tables refers to annual grasses such as foxtail, barnyardgrass, and crabgrass. "Broadleafs" refers to annual broad-leaved weeds such as redroot pigweed, lambsquarters, pennsylvania smartweed, common ragweed, cocklebur, velvetleaf, wild mustard, etc. Perennial weeds such as Canada thistle and quackgrass were not included in the evaluation.

Table 1 summarizes early evaluations of herbicides that have been included for two or more years. These results are from uncultivated plots. Tables 2 to 7 are 1968 results. Each table specifies uncultivated or cultivated and early or late evaluations. Corn yields for the last 4 years from several locations with replicated plots are given in Table 8. Comparisons should be made within the same year or using averages of the same years since yield levels vary considerably from year to year depending on weather conditions.

Table 1. Weed Control Demonstration Results, Several Year Summary, Early Evaluations, Uncultivated.

Chemical	Pounds per acre A.I. or A.E.* broadcast	Years in trial	Number of trials		Percent of trials in each class					
			Grasses	Broad-leaved weeds	Grasses			Broad-leaved weeds		
					Poor	Fair	Good	Poor	Fair	Good
CORN										
Preemergence										
Atrazine	3	1959-68	556	532	8	16	76	5	9	86
CDAA, gran. (Randox)	5	1963-66	252	236	22	30	48	64	21	15
CDAA-T, gran. (Randox-T)	3 1/2 + 7	1960-66	417	397	19	33	48	23	31	46
Linuron (Lorox)	2	1963-65	189	179	22	26	52	18	21	61
Propachlor (Ramrod)	5	1965-68	225	221	7	14	79	32	28	40
Atrazine + linuron	1 1/2 + 1 1/2	1965-68	220	220	5	15	80	5	11	84
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	1964,65, 68	175	170	8	19	73	7	11	82
Atrazine + propachlor	1 1/2 + 3	1967-68	89	101	2	15	83	3	14	83
Preemergence followed by postemergence										
Propachlor and 2,4-D	4 + 1/2	1967-68	89	101	4	11	85	11	19	70
Propachlor and dicamba (Banvel)	4 + 1/4	1967-68	89	101	4	13	83	12	12	76
Propachlor and 2,4-D + dicamba	4 + 1/4 + 1/8	1967-68	88	99	6	11	83	9	12	79
Early postemergence										
Atrazine	3	1961-67	398	374	13	14	73	6	7	87
Atrazine + oil	2 + 10%**	1966-68	167	166	4	5	91	2	5	93
SOYBEANS										
Preplanting and disked in										
Trifluralin (Treflan)	1	1965-68	92	85	2	13	85	14	24	62
Preemergence										
Amiben	3	1959-68	344	332	10	18	72	8	18	74
CDAA (Randox)	5	1963-68	205	185	12	28	60	51	27	22
DCPA (Dacthal)	9 or 10.5***	1967-68	50	46	16	26	58	24	33	43
Linuron (Lorox)	2	1962-68	256	248	25	25	50	17	19	64
Propachlor (Ramrod)	5	1965-68	125	118	6	15	79	25	35	40
Preemergence and postemergence										
Propachlor and chloroxuron (Tenoran) + "Adjuvan-T"	4 + 1.5 + 0.5%**	1967	34	32	12	20	68	6	16	78

* A.I. = active ingredient; A.E. = acid equivalent

** Percent of spray volume

*** DCPA applied at 10.5 lb/A in 1967 and at 9.0 lb/A in 1968

Table 2. Weed Control Demonstration Results, 1968, Early Evaluations, Uncultivated.

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of trials		Percent of trials with each degree of control							
				Grasses				Broad-leaved weeds			
		Grasses	Broad-leaved weeds	Under 50%	50-75%	75-95%	Over 95%	Under 50%	50-75%	75-95%	Over 95%
CORN											
Preplanting and disked in											
Atrazine	3	35	35	11.4	8.6	48.5	31.4	5.7	2.9	40.0	51.4
Butylate (Sutan)	4	32	32	25.0	15.6	46.9	12.5	31.3	34.4	28.1	6.3
Atrazine + butylate	1 + 3	32	31	15.6	12.5	56.3	15.6	12.9	12.9	38.7	35.5
Preemergence											
Atrazine	3	43	43	7.0	20.9	25.6	46.5	0	7.0	39.5	53.5
Propachlor (Ramrod)	5	45	45	4.4	4.4	57.8	33.3	40.0	17.8	33.3	8.9
Atrazine + propachlor	1 1/2 + 3	44	44	2.3	9.1	54.6	34.1	2.3	9.1	43.2	45.5
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	45	45	6.7	17.8	44.4	31.1	0	13.3	40.0	46.7
Atrazine + linuron (Lorox)	1 1/2 + 1 1/2	46	46	2.2	34.8	30.5	32.6	0	19.6	39.1	41.3
Linuron + propachlor (Londax)	1 1/2 + 3	46	46	8.7	10.9	54.4	26.1	10.9	19.6	45.7	23.9
Preemergence followed by postemergence											
Propachlor and 2,4-D	4 + 1/2	43	44	7.0	4.7	65.1	23.3	9.1	11.4	54.5	25.0
Propachlor and dicamba (Banvel)	4 + 1/4	44	45	4.5	4.5	70.4	20.5	4.4	11.1	48.9	35.6
Propachlor and 2,4-D + dicamba	4 + 1/4 + 1/8	44	44	9.1	2.3	65.9	22.7	6.8	6.8	50.0	36.4
Postemergence											
Atrazine + oil	2 + 10%**	46	46	4.3	8.7	45.7	41.3	0	2.2	39.1	58.7
Atrazine + "Tronic"	2 + 1 pt.	45	45	6.7	22.2	44.5	26.7	0	8.9	35.5	55.6

* A.I. = active ingredient; A.E. = acid equivalent

** Ten percent of spray volume.

Table 3. Weed Control Demonstration Results, 1968, Early Evaluations, Cultivated.

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of trials		Percent of trials with each degree of control							
				Grasses				Broad-leaved weeds			
		Grasses	Broad-leaved weeds	Under 50%	50-75%	75-95%	Over 95%	Under 50%	50-75%	75-95%	Over 95%
CORN											
Preplanting and disked in											
Atrazine	3	24	23	0	4.2	50.0	45.8	0	0	17.4	82.6
Butylate (Sutan)	4	22	22	13.6	13.6	45.4	27.3	4.5	13.6	63.6	18.2
Atrazine + butylate	1 + 3	22	22	0	9.1	45.5	45.5	0	9.1	36.3	54.5
Preemergence											
Atrazine	3	30	30	3.3	3.3	33.4	60.0	0	0	26.7	73.3
Propachlor (Ramrod)	5	33	33	0	3.0	27.2	69.7	24.2	12.1	42.4	21.2
Atrazine + propachlor	1 1/2 + 3	33	33	0	3.0	27.3	69.7	0	9.1	18.2	72.7
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	33	33	0	12.1	30.4	57.6	0	6.1	27.3	66.7
Atrazine + linuron (Lorox)	1 1/2 + 1 1/2	33	33	0	15.2	36.4	48.5	0	9.1	24.3	66.7
Linuron + propachlor (Londax)	1 1/2 + 3	32	33	3.1	6.3	28.1	62.5	9.1	18.2	18.2	54.5
Preemergence followed by postemergence											
Propachlor and 2,4-D	4 + 1/2	32	32	3.1	3.1	34.4	59.4	6.3	12.5	46.9	34.4
Propachlor and dicamba (Banvel)	4 + 1/4	33	33	0	3.0	30.3	66.7	3.0	3.0	39.4	54.5
Propachlor and 2,4-D + dicamba	4 + 1/4 + 1/8	31	32	3.2	0	38.7	58.1	3.1	6.3	40.6	50.0
Postemergence											
Atrazine + oil	2 + 10%**	33	33	0	9.1	21.3	69.7	0	3.0	15.2	81.8
Atrazine + "Tronic"	2 + 1 pt.	33	32	6.1	9.1	30.3	54.5	0	9.4	15.7	75.0

* A.I. = active ingredient; A.E. = acid equivalent
** Ten percent of spray volume

Table 4. Weed Control Demonstration Results, 1968, Early Evaluations, Uncultivated and Cultivated.

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of trials		Percent of trials with each degree of control							
				Grasses				Broad-leaved weeds			
		Grasses	Broad-leaved weeds	Under 50%	50-75%	75-95%	Over 95%	Under 50%	50-75%	75-95%	Over 95%
SOYBEANS											
Uncultivated											
Preplanting and disked in											
Trifluralin (Treflan)	1	24	21	0	0	75.0	25.0	9.5	19.0	47.6	23.8
Vernolate (Vernam)	3	23	21	13.0	26.1	47.8	13.0	23.8	42.9	28.6	4.8
Preemergence											
Amiben	3	25	22	4.0	8.0	44.0	44.0	4.5	0	45.5	50.0
C6989 (Preforan)	4 1/2	25	22	8.0	12.0	56.0	24.0	18.2	4.5	40.9	36.4
CDAA (Randox)	5	20	17	5.0	15.0	75.0	5.0	41.2	41.2	17.7	0
Propachlor (Ramrod)	5	25	22	0	4.0	60.0	36.0	45.5	27.3	22.7	4.5
DCPA (Dacthal)	9	25	21	16.0	44.0	28.0	12.0	38.1	28.6	28.5	4.8
Linuron (Lorox)	2	24	21	33.3	16.7	37.5	12.5	9.5	19.0	47.6	23.8
Naptalam + chlorpropham (Alanap Plus)	4 + 2 2/3	25	22	24.0	32.0	36.0	8.0	22.7	13.6	45.5	18.2
Preplanting (disked in) followed by postemergence											
Trifluralin and chloroxuron (Tenoran) + "Adjuvan-T"	3/4 + 1 1/2 + 0.5%**	21	19	4.8	4.8	42.8	47.6	0	5.3	57.9	36.8
Cultivated											
Preplanting and disked in											
Trifluralin (Treflan)	1	22	19	0	0	36.3	63.6	0	15.8	21.0	63.2
Vernolate (Vernam)	3	21	19	0	9.5	52.4	38.1	5.3	15.8	47.4	31.6
Preemergence											
Amiben	3	22	19	0	0	18.2	81.8	0	0	26.3	73.7
C6989 (Preforan)	4 1/2	22	19	0	4.5	45.5	50.0	0	21.1	31.6	47.4
CDAA (Randox)	5	17	14	0	0	70.6	29.4	7.1	28.6	64.3	0
Propachlor (Ramrod)	5	22	19	0	0	18.2	81.8	5.3	15.8	63.2	15.8
DCPA (Dacthal)	9	22	18	4.5	13.6	45.5	36.4	11.1	27.8	44.4	16.7
Linuron (Lorox)	2	21	18	9.5	19.0	47.6	23.8	5.6	5.6	50.0	38.9
Naptalam + chlorpropham (Alanap Plus)	4 + 2 2/3	22	19	9.1	9.1	50.0	31.8	0	21.1	47.4	31.6
Preplanting (disked in) followed by postemergence											
Trifluralin and chloroxuron (Tenoran) + "Adjuvan-T"	3/4 + 1 1/2 + 0.5%**	19	17	0	0	26.4	73.7	0	0	17.7	82.4

* A.I. = active ingredient; A.E. = acid equivalent

** Percent of spray volume

Table 5. Weed Control Demonstration Results, 1968, Late Evaluations, Uncultivated.

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of trials		Percent of trials with each degree of control							
				Grasses				Broad-leaved weeds			
		Grasses	Broad-leaved weeds	Under 50%	50-75%	75-95%	Over 95%	Under 50%	50-75%	75-95%	Over 95%
CORN											
Preplanting and disked in											
Atrazine	3	18	18	0.0	5.6	66.6	27.8	0.0	0.0	55.6	44.4
Butylate (Sutan)	4	18	18	22.2	27.8	38.9	11.1	27.8	27.8	27.8	16.7
Atrazine + butylate	1 + 3	18	18	16.7	22.2	50.0	11.1	0.0	22.2	27.8	50.0
Preemergence											
Atrazine	3	21	21	4.8	23.8	33.3	38.1	0.0	9.5	38.1	52.4
Propachlor (Ramrod)	5	23	23	0.0	30.4	43.4	26.1	34.8	17.4	39.1	8.7
Atrazine + propachlor	1 1/2 + 3	23	23	4.3	26.1	52.2	17.4	0.0	13.0	30.4	56.5
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	23	23	8.7	13.0	52.1	26.1	0.0	8.7	30.4	60.9
Atrazine + linuron (Lorox)	1 1/2 + 1 1/2	23	23	8.7	21.7	47.8	21.7	0.0	13.0	30.4	56.5
Linuron + propachlor (Londax)	1 1/2 + 3	23	23	8.7	43.5	39.1	8.7	0.0	21.7	56.5	21.7
Preemergence followed by postemergence											
Propachlor and 2,4-D	4 + 1/2	23	23	26.1	26.1	43.5	4.3	0.0	13.0	65.2	21.7
Propachlor and dicamba (Banvel)	4 + 1/4	23	23	26.1	21.7	52.2	0.0	0.0	8.7	65.2	26.1
Propachlor and 2,4-D + dicamba	4 + 1/4 + 1/8	21	21	23.8	19.0	47.6	9.5	0.0	14.3	47.6	38.1
Postemergence											
Atrazine + oil	2 + 10%**	23	23	17.4	17.4	39.1	26.1	0.0	4.3	30.4	65.2
Atrazine + "Tronic"	2 + 1 pt.	23	23	17.4	17.4	56.5	8.7	0.0	4.3	39.1	56.5

* A.I. = active ingredient; A.E. = acid equivalent
** Ten percent of spray volume

Table 6. Weed Control Demonstration Results, 1968, Late Evaluations, Cultivated.

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of trials		Percent of trials with each degree of control							
				Grasses				Broad-leaved weeds			
		Grasses	Broad-leaved weeds	Under 50%	50-75%	75-95%	Over 95%	Under 50%	50-75%	75-95%	Over 95%
CORN											
Preplanting and disked in											
Atrazine	3	15	15	0.0	0.0	33.4	66.7	0.0	0.0	26.7	73.3
Butylate (Sutan)	4	15	15	6.7	20.0	46.6	26.7	0.0	13.3	53.3	33.3
Atrazine + butylate	1 + 3	15	15	6.7	6.7	53.3	33.3	0.0	0.0	46.7	53.3
Preemergence											
Atrazine	3	20	20	0.0	15.0	45.0	40.0	0.0	5.0	25.0	70.0
Propachlor (Ramrod)	5	22	22	4.5	9.1	45.5	40.9	13.6	13.6	36.3	36.4
Atrazine + propachlor	1 1/2 + 3	22	22	0.0	13.6	36.4	50.0	0.0	0.0	31.8	68.2
Atrazine + prometryne (Primaze)	1 1/2 + 1 1/2	22	22	0.0	9.1	36.4	54.5	0.0	0.0	31.8	68.2
Atrazine + linuron (Lorox)	1 1/2 + 1 1/2	22	22	0.0	13.6	50.0	36.4	0.0	0.0	40.9	59.1
Linuron + propachlor (Londax)	1 1/2 + 3	22	22	4.5	22.7	50.0	22.7	0.0	4.5	45.4	50.0
Preemergence followed by postemergence											
Propachlor and 2,4-D	4 + 1/2	22	22	22.7	0.0	40.9	36.4	0.0	4.5	45.5	50.0
Propachlor and dicamba (Banvel)	4 + 1/4	22	22	13.6	4.5	54.5	27.3	0.0	0.0	54.6	45.5
Propachlor and 2,4-D + dicamba	4 + 1/4 + 1/8	21	21	14.3	9.5	47.6	28.6	0.0	4.8	52.3	42.9
Postemergence											
Atrazine + oil	2 + 10%**	22	22	4.5	4.5	40.9	50.0	0.0	4.5	13.6	81.8
Atrazine + "Tronic"	2 + 1 pt.	22	22	9.1	13.6	50.0	27.3	0.0	4.5	22.7	72.7

* A.I. = active ingredient; A.E. = acid equivalent

** Ten percent of spray volume

Table 7. Weed Control Demonstration Results, 1968, Late Evaluations, Uncultivated and Cultivated.

Chemical	Pounds per acre A.I. or A.E.* broadcast	Number of trials		Percent of trials with each degree of control							
				Grasses				Broad-leaved weeds			
		Grasses	Broad-leaved weeds	Under 50%	50-75%	75-95%	Over 95%	Under 50%	50-75%	75-95%	Over 95%
SOYBEANS											
Uncultivated											
Preplanting and disked in											
Trifluralin (Treflan)	1	16	15	18.8	6.3	56.2	18.8	26.7	20.0	46.7	6.7
Vernolate (Vernam)	3	15	15	53.3	0.0	26.7	20.0	40.0	26.7	26.7	6.7
Preemergence											
Amiben	3	17	17	11.8	17.6	58.8	11.8	11.8	29.4	35.3	23.5
C6989 (Preforan)	4 1/2	17	17	29.4	23.5	35.3	11.8	35.3	29.4	17.7	17.6
CDAA (Randox)	5	16	16	25.0	43.8	25.0	6.3	62.5	25.0	12.5	0.0
Propachlor (Ramrod)	5	17	17	5.9	17.6	52.9	23.5	35.3	47.1	11.8	5.9
DCPA (Dacthal)	9	17	17	52.9	11.8	29.4	5.9	47.1	35.3	17.7	0.0
Linuron (Lorox)	2	17	17	52.9	5.9	23.5	17.6	11.8	17.6	47.1	23.5
Naptalam + chlorpropham (Alanap Plus)	4 + 2 2/3	17	17	47.1	29.4	17.7	5.9	35.3	5.9	47.1	11.8
Preplanting (disked in) followed by postemergence											
Trifluralin and chloroxuron (Tenoran) + "Adjuvan-T"	3/4 + 1 1/2 + 0.5%**	14	14	42.9	14.3	21.4	21.4	7.1	35.7	42.8	14.3
Cultivated											
Preplanting and disked in											
Trifluralin (Treflan)	1	13	13	0.0	0.0	61.6	38.5	7.7	15.4	53.8	23.1
Vernolate (Vernam)	3	12	12	8.3	0.0	50.0	41.7	16.7	8.3	58.4	16.7
Preemergence											
Amiben	3	14	14	0.0	0.0	57.2	42.9	0.0	14.3	42.8	42.9
C6989 (Preforan)	4 1/2	14	14	7.1	14.3	50.0	28.6	14.3	14.3	50.0	21.4
CDAA (Randox)	5	13	13	7.7	7.7	38.5	46.2	15.4	7.7	61.6	15.4
Propachlor (Ramrod)	5	14	14	0.0	0.0	35.7	64.3	14.3	7.1	57.1	21.4
DCPA (Dacthal)	9	14	14	21.4	21.4	21.4	35.7	35.7	7.1	42.9	14.3
Linuron (Lorox)	2	14	14	7.1	14.3	42.8	35.7	7.1	14.3	35.7	42.9
Naptalam + chlorpropham (Alanap Plus)	4 + 2 2/3	14	14	28.6	7.1	35.7	28.6	14.3	7.1	42.9	35.7
Preplanting (disked in) followed by postemergence											
Trifluralin and chloroxuron (Tenoran) + "Adjuvan-T"	3/4 + 1 1/2 + 0.5%**	11	11	9.1	0.0	54.6	36.4	0.0	9.1	72.7	18.2

* A.I. = active ingredient; A.E. = acid equivalent

** Percent of spray volume

Table 8. Corn yields in county weed control trials, Minnesota.

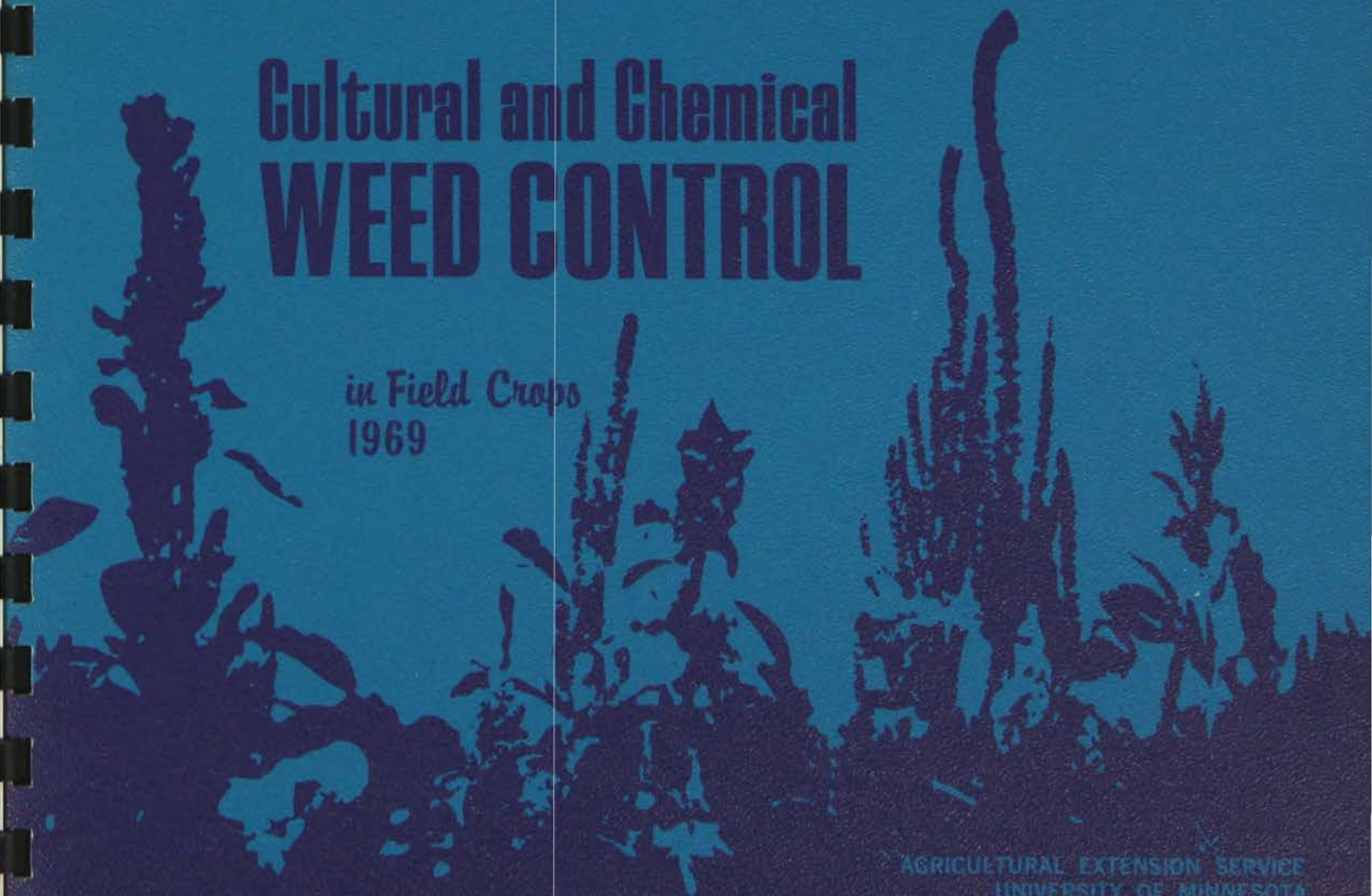
Chemical[1]	lb/A[2]	Yield, bushels per acre[3]							
		Cultivated				Uncultivated			
		1965	1966	1967	1968	1965	1966	1967	1968
Atrazine (AAtrex) prepl	3	-[4]	-	-	130	-	-	-	122
Butylate (Sutan) prepl	4	-	-	-	129	-	-	-	106
Atrazine + butylate prepl	1 + 3	-	-	-	123	-	-	-	116
Atrazine pre	3	108	129	102	130	104	114	94	126
Propachlor (Ramrod) pre	5	102	121	92	128	96	103	86	125
Propachlor granular (Ramrod) pre	5	97	119	-	-	93	100	-	-
CDAA, granular (Randox) pre	5	100	115	-	-	83	86	-	-
CDAA-T, granular (Randox-T) pre	3 1/2 + 7	103	121	-	-	90	100	-	-
Atrazine + linuron (Lorox) pre	1 1/2 + 1 1/2	104	126	97	130	102	114	95	133
Atrazine + prometryne (Primaze) pre	1 1/2 + 1 1/2	105	-	-	128	102	-	-	120
Atrazine + propachlor pre	1 1/2 + 3	-	-	96	131	-	-	97	124
Linuron + propachlor pre	1 1/2 + 3	-	-	-	122	-	-	-	123
Propachlor pre + 2,4-D post	4 + 1/2	-	-	93	115	-	-	84	111
Propachlor pre + dicamba post	4 + 1/4	-	-	103	126	-	-	91	120
Propachlor pre + 2,4-D + dicamba post	4 + 1/4 + 1/8	-	-	104	122	-	-	93	112
Atrazine + oil post	2 + 10%	-	124	106	132	-	121	112	127
Atrazine + "Tronic" post	2 + 1 pt	-	-	-	131	-	-	-	126
Atrazine post	3	102	124	102	-	99	114	100	-
2,4-D post	1/2	-	110	-	-	-	77	-	-
Dicamba (Banvel) post	1/4	-	111	-	-	-	81	-	-
Check		93	97	85	99	59	57	62	92

1/ Prepl = applied preplanting and disked in; pre = applied preemergence; post = applied postemergence.
2/ Rate is pounds per acre of active ingredient or acid equivalent broadcast.
3/ Yields are average of 13 locations in 1965, 15 in 1966, 7 in 1967, 6 in 1968; two replications at each location.
4/ Blank indicates the treatment was not included that year.

Extension Folder 212
Revised

Cultural and Chemical WEED CONTROL

in Field Crops
1969



AGRICULTURAL EXTENSION SERVICE
UNIVERSITY OF MINNESOTA

Cultural and Chemical Weed Control in Field Crops—1969

Information in this publication summarizes research at the Minnesota Agricultural Experiment Station and elsewhere on the effectiveness of using chemicals for controlling weeds. Application rates listed herein are broadcast rates and refer to acid equivalent or active ingredient rather than the amount of commercial product.

In general, the problems that might result from residues remaining on agricultural commodities from the use of these chemicals have not been investigated at this experiment station. Therefore, no claims or representations are made by the University of Minnesota or its officers or employees that the chemical pesticides discussed will or will not have residues. *Consequently, any person who uses any of the chemicals discussed in this publication does so at his own risk.*

This position is necessary because of the enactment in July 1954 of Public Law 518, an amendment (commonly known as the Miller Amendment) to the Federal Food, Drug, and Cosmetic Act. This law makes liable for seizure any raw agricultural commodity moving in interstate commerce which carries a pesticide residue (1) for which no exemption or tolerance has been established or (2) which exceeds the tolerance established by the Food and Drug Administration. Similar state regulations cover intrastate shipments.

After December 31, 1967, registrations under the Federal Insecticide, Fungicide, and Rodenticide Act for pesticides previously registered for use in a manner involving food or feed on a "no residue" or "zero tolerance" basis were canceled unless: (1) finite tolerance or exemptions from the requirement of tolerances were established by the Food and Drug Administration or (2) progress reports were submitted to the Pesticide Registration Division, U.S. Department of Agriculture, showing that studies are being conducted to obtain data to support finite tolerances. Registrations of some herbicides have been extended temporarily. *Therefore, registrations for some uses suggested in this bulletin could change by planting time.* New information will be available from county agents as changes occur.

Also observe label directions; they should be read and followed carefully. For information on specific problems contact your county agent.

Safety precautions—Always follow carefully the precautions on the label in order to help protect the operator, avoid crop injury, and prevent harmful residues in food and feed crops. Use herbicides only on crops for which they are specifically approved and recommended. Use only recommended amounts; applying too much of an herbicide may damage the crop, may be unwise if the crop is to be used for food or feed, and is costly. Apply herbicides only at times specified on the label; observe the recommended intervals between treatments and pasturing or harvesting of crops. Wear goggles, rubber gloves, and other protective clothing as recommended on the label. Guard against possible injury to nearby susceptible plants.

Revised for 1969 by G. R. Miller, associate professor and extension agronomist, and R. Behrens, professor, Department of Agronomy and Plant Genetics. Other staff members concerned with field crop weed control include R. G. Robinson, associate professor, Department of Agronomy and Plant Genetics; O. E. Strand, assistant extension agronomist; and R. N. Andersen, plant physiologist, Agricultural Research Service, United States Department of Agriculture (USDA).

Trade names are sometimes used in this publication to clearly identify the herbicide under discussion. Omission of other trade names of similar herbicides is unintentional. The inclusion of a trade name does not imply endorsement and exclusion does not imply nonapproval.

Single copies of this publication are free to Minnesota residents. Additional copies may be purchased @ 15 cents per copy. A 10 percent discount will be allowed for orders of 100 or more. Please include Minnesota sales tax when ordering.

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roland H. Abraham, Director, Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55101. 35M—12-68

Follow label instructions carefully when using agricultural chemicals.

Contents

Chemical Weed Control Practices

The terms listed below are used in this folder to describe herbicide applications:

Acid equivalent—A term used to express a rate or quantity of an acid herbicide.

Active ingredient—A term used to express a rate or quantity of a nonacid herbicide.

Band application—Herbicide applied to a narrow strip centered over the crop row.

Broadcast application—Herbicide applied over entire area.

Directed spray application—Herbicide applied to a band over the row that includes the base of crop plants and the weeds in the row. Spray is directed across the row from nozzles positioned near ground level on each side of the row. This type of application allows use of chemicals that will injure the crop plant if more than a small part of the plant is contacted by spray. Special units that guide from the ground or mount on cultivators must be used.

Drop-nozzle application—Herbicide applied by means of nozzles mounted on extensions below the spray boom to avoid spraying upper parts of the crop plant.

Postemergence application—Herbicide applied to the crop and weeds after they emerge.

Pre-emergence application—Herbicide applied after a crop is planted but before it or weeds emerge.

Preplanting application—Herbicide applied before the crop is planted.

Preplow application—Herbicide applied to soil and/or foliage of weeds before plowing.

Rate—The amount of active ingredient or acid equivalent of an herbicide applied to the area treated, i.e., on a broadcast basis.

Soil incorporation—Mechanical mixing of the herbicide with the soil. Chemicals may be incorporated 3 to 4 inches with a disk or rotary tiller, 1 to 2 inches with a harrow or rotary hoe, or slightly covered with planter attachments. The desired depth of incorporation depends on characteristics of the chemical being used.

Butylate, diallate, EPTC, triallate, trifluralin, and vernolate require some incorporation. Incorporation of linuron usually reduces its effectiveness. Incorporation of atrazine by disking has resulted in weed control equal to or, under dry conditions, slightly better than pre-emergence applications.

Pre-emergence Applications

Several excellent herbicides are now available for use as pre-emergence applications. These herbicides generally give good weed control. But results may vary depending on the kinds of weeds present, weather conditions, and soil type. Established perennials are usually not controlled with pre-emergence herbicides. Control of some deep-germinating and tolerant annual species may not be adequate with pre-emergence treatments. The surviving species vary with the herbicide used. Weed control may be poor if there is no rainfall soon after treatment. Or, if rainfall is very heavy, some herbicides will move downward in the soil, resulting in poor weed control and/or crop injury. Soil type can affect weed control. Use the rates given in instructions on the herbicide label for the soil type.

Numerous tests have been conducted in Minnesota to determine the overall effectiveness of pre-emergence applications of herbicides. Table 1 shows the performance of pre-emergence herbicides on uncultivated corn plots in several years of county demonstrations. Table 3, page 10, gives similar information for herbicides in soybeans. Figures in Tables 1 and 3 are the percentage of trials in which weed control was rated good (more than 75 percent of the weeds controlled), fair (50 to 75 percent of the weeds controlled), or poor (less than 50 percent of the weeds controlled). Evaluations were made about 5 weeks after application. Herbicides not included in these tables have not been adequately tested or have performed poorly under Minnesota conditions.

Table 1. Early evaluations of herbicides in weed control demonstrations in uncultivated corn

Chemical	Pounds per acre active ingredient or acid equivalent broadcast	Years in trial	Number of trials		Percent of trials in each class					
					Grasses			Broad-leaved weeds		
			Grasses	Broad-leaved weeds	Good	Fair	Poor	Good	Fair	Poor
Amiben	2	1965-66	124	122	49	27	24	51	25	24
Atrazine (AAtrex)	3	1959-68	556	532	76	16	8	86	9	5
Atrazine (early postemergence)	3	1961-67	398	374	73	14	13	87	7	6
Atrazine + linuron	1½ + 1½	1965-68	220	220	80	15	5	84	11	5
Atrazine + oil (early postemergence)	2	1966-68	167	166	91	5	4	93	5	2
Atrazine + prometryne (Primaze)	1½ + 1½	1964-65, 68	175	170	73	19	8	82	11	8
Atrazine + propachlor	1½ + 3	1967-68	89	101	83	15	2	83	14	3
CDAA (Randox) granular	5	1963-66	252	236	48	30	22	15	21	64
CDAA-T (Randox-T) granular	3½ + 7	1960-66	417	397	48	33	19	46	31	23
Dicamba (Banvel)	1	1966-67	119	117	19	20	61	63	17	20
EPTC + 2,4-D (Knoxweed)	2 + 0.8	1964-65	131	127	21	31	48	34	31	35
Linuron (Lorox)	2	1963-65	189	179	52	26	22	61	21	18
Propachlor (Ramrod)	5	1965-68	225	221	79	14	7	40	28	32

Granular Versus Spray Forms of Herbicides

Several herbicides are available in granular or spray forms which may or may not perform equally in either form. Granular forms require no mixing and they can be used directly from the package. The cost of granules is usually higher than the cost of an equal amount of the spray form. Distribution of chemicals with granule applicators is sometimes not as uniform as with sprayers, especially on rough ground. In some instances this has resulted in variable weed control. Chemicals that cause irritation, such as CDAA and CDAA-T, are safer in the granular form than in the spray form.

Herbicide Mixtures

Some herbicide mixtures are in use and several new herbicide mixtures show promise for overcoming limitations of single chemicals. Certain mixtures may (1) control more kinds of weeds, (2) give more consistent performance with different soils and weather conditions, (3) lessen soil residue problems, (4) increase persistence enough to give full-season weed control, (5) reduce crop injury, or (6) reduce costs.

Only those mixtures that have been field tested under local conditions and registered for use by the U.S. Department of Agriculture should be used. Use of unregistered mixtures may result in poor weed control, crop injury, or accumulation of illegal chemical residues in the crop. Growers are responsible for residues resulting from use of unregistered mixtures.

CONTROL OF WEEDS IN FIELD CROPS

Corn

Weed control in corn is based on a combination of cultural practices and herbicide applications.

Cultural Practices—Cultural practices include seedbed preparation, establishment of an adequate stand, and timely, effective cultivations.

Early germinating weeds can be destroyed with a disk, field cultivator, or harrow before planting if conventional tillage is used. Minimum tillage methods that leave the space between the rows rough discourage weed growth.

Early cultivations are most effective for killing weeds. The rotary hoe or harrow works best if used after weed seeds have germinated and before or as soon as the weeds appear above the soil surface. Row cultivators should also be used while the weeds are still very small. Set the shovels for shallow cultivation to prevent root pruning and to bring fewer weed seeds to the surface. A rotary hoe or cultivator should be used as soon as weeds appear even if pre-emergence applications have been used.

Herbicides—Table 2 indicates corn tolerance to herbicides suggested for use in corn and relative efficiency of these herbicides in controlling common annual weeds. This is a general comparative control rating based on field observations. Under unfavorable conditions any of the herbicides may give unsatisfactory results. Under favorable conditions control may be better than indicated.

Preplanting applications of butylate (Sutan) incorporated into the soil at 4 pounds per acre have given good control of annual grasses, but butylate does not control annual broadleafs or perennial weeds. Butylate should be applied before planting and incorporated immediately by disking twice. Disk twice, once in each direction, for best incorporation.

Preplanting and disked-in applications of atrazine (AAtrex) have resulted in weed control equal to or, under dry conditions, slightly better than pre-emergence applications without incorporation. Fall and early spring applications of atrazine have given adequate weed control, but if applied in the fall, higher rates are required to give control equal to spring application. Fall applications require fall disking and therefore leave the soil subject to erosion. Broadcast applications, necessary when preplanting treatments are used, may increase the potential of atrazine carryover compared to banded pre-emergence applications.

A mixture of butylate at 3 pounds per acre and atrazine at 1 pound per acre applied preplanting and disked-in has controlled both annual grasses and broadleafs. This mixture improves broadleaf control compared to butylate alone, and reduces atrazine carryover problems since lower rates of atrazine are applied.

Pre-emergence applications of atrazine (AAtrex) at 1 to 4 pounds per acre have given good control of annual weeds with no injury to corn. A 4 pound per acre rate of atrazine should be used on fine textured soils or those high in organic matter. One to 2 pounds per acre of atrazine is adequate on sandy soils. Atrazine may remain in some soils for more than one season. Toxic residues are more likely to persist if soil moisture or temperatures are low.

Atrazine sometimes affects small grains, flax, sugar beets, soybeans, and other legumes planted the following spring. The label requires that small grains, flax, sugar beets, and small-seeded legumes not be planted in the year following atrazine application. Soybeans cannot be grown the year following atrazine use if the rate of atrazine application was more than 2 pounds per acre of active ingredient in western Minnesota or 3 pounds in eastern Minnesota. Residue can be minimized by using the lowest rate of chemical consistent with good weed control, use of band applications rather than broadcast applications, and plowing or thorough tillage of the soil prior to planting soybeans.

Propachlor (Ramrod) has given good annual grass control on all soils when applied pre-emergence at 4 to 5 pounds per acre. Propachlor does not consistently control most broad-leaved or perennial weeds, but it may be used in mixtures with atrazine or linuron for annual grass and broadleaf control. Corn is very tolerant to propachlor.

CP50144 (Lasso), chemically related to propachlor, is a recently developed pre-emergence herbicide that shows promise for grass control in corn. CP50144 has given fair to good control of redroot pigweed, common ragweed, and lampsquarters, but control of other broadleafs has been erratic. Corn has good tolerance to CP50144. Suggested rates are 2 to 2½ pounds per acre.

Caution: As of December 1968, CP50144 has not been cleared for any use on corn.

Pre-emergence applications of CDAA (Randox) at 4 to 5 pounds per acre have given good early season annual grass control in corn on high organic matter soils. CDAA has not controlled broadleafs and it has not performed well on low organic or sandy soils. CDAA might be preferred on organic soils, but propachlor, a related chemical, has performed better on mineral soils. CDAA causes considerable skin and eye irritation.

Pre-emergence applications of amiben, 2,4-D, dicamba (Banvel) or EPTC (Eptam) are not recommended because they have frequently caused corn injury and/or given erratic weed control.

Pre-emergence herbicide mixtures. Mixtures of atrazine with linuron, prometryne or propachlor are registered for pre-emergence application on corn to control annual grasses and broadleafs. Soil residues of atrazine are reduced by using these mixtures since application rates are lower than if atrazine is used alone. These mixtures are less effective than atrazine alone on quackgrass. Do not apply the mixtures with linuron or prometryne after corn is up or severe corn injury will occur. These mixtures should not be incorporated into the soil.

A 1-to-1 ratio of active ingredients of an atrazine-linuron mixture has given weed control comparable to an equivalent rate of atrazine alone. Using linuron in combination with atrazine reduces the likelihood of corn injury and usually improves weed control compared with linuron alone. Rates vary from one-half to 1½ pounds per acre of each chemical according to soil type. In pre-emergence applications, corn tolerance to this mixture is not as great as to atrazine alone. Corn injury may occur on low organic, coarse textured soils.

A mixture of atrazine and prometryne (Primaze) applied pre-emergence has given weed control comparable to atrazine alone, but corn has been injured under some soil and weather conditions. Suggested rates are 0.8 to 1.5 pounds per acre of each chemical. Label instructions specify this mixture *should not be used* under the following conditions: on sand, high organic clay, peat or muck soils; on eroded hillsides; on alkaline calcareous soils of western Minnesota; where irrigation is used; nor on inbred lines of corn.

The mixture of atrazine and propachlor controls broad-leaved weeds better than propachlor alone and gives more consistent control on high organic matter soils or with limited rain than atrazine alone. Corn has good tolerance to this mixture. Suggested rates are 1 to 1½ pounds per acre of atrazine and 2 to 3¾ pounds per acre of propachlor.

Using the mixture of linuron and propachlor (Londax) reduces the potential for corn injury compared to linuron alone since lower rates of linuron are used. This mixture controls broadleafs better than propachlor alone. Suggested rates are 1 to 1½ pounds per acre of linuron with 3 pounds per acre of propachlor. Do not use the mixture on sandy soils because of possible crop injury from linuron.

CDAA-T (Randox-T) contains an additive that kills some broad-leaved species not controlled by CDAA.

Table 2. Effectiveness of herbicides on major weeds in corn

	Pre-emergence					Postemergence		
	Atrazine	Butylate	CDAA	Propachlor	Linuron	2,4-D	Dicamba	Atrazine and oil
Corn tolerance	G	G	G	G	F	G	G	G
Grasses								
Giant foxtail	F	G	F	G	F	N	N	F
Green foxtail	G	G	G	G	F	N	N	G
Yellow foxtail	G	G	G	G	F	N	N	G
Barnyardgrass	F	G	F	F	F	N	N	F
Crabgrass	P	G	G	G	G	N	N	P
Nutsedge	P	F	P	F	P	N	N	F
Quackgrass	G	N	N	N	N	N	N	G
Broadleafs								
Cocklebur	F	P	N	P	P	G	G	F
Lambsquarters	G	P	P	P	G	G	G	G
Mustard	G	P	N	P	G	G	F	G
Pigweed	G	P	F	F	G	G	G	G
Ragweed	G	P	P	P	G	G	G	G
Smartweed	G	P	N	P	F	P	G	G
Velvetleaf	F	P	N	P	F	G	G	F
Wild sunflower	P	P	N	P	P	F	G	F
Canada thistle	P	N	N	N	N	F	G	F

G—Good
F—Fair
P—Poor
N—None

Soybeans may be affected by soil residues if planted in areas treated with CDAA-T the previous crop season. Take special care to avoid getting CDAA or CDAA-T in contact with the skin and eyes. Both materials cause considerable irritation and discomfort.

Early postemergence sprays of atrazine effectively control most annual weeds in corn. Broad-leaved weed control is especially good. Grass control is less consistent. It is important to apply early postemergence treatments at the proper time or results may be poor. Apply atrazine within 3 weeks of planting while the weeds are less than 1½ inches tall. The addition of 1 to 2 gallons per acre of special oils with an emulsifier to the spray increases the effectiveness of early postemergence applications of atrazine. Use only the oils that are labeled for this purpose. Suggested atrazine rates for postemergence application with oil are 1 to 3 pounds per acre. When atrazine is used, early postemergence treatments are preferred to pre-emergence if the soil is high in clay or organic matter and in western Minnesota where rainfall is less certain. These are the areas where pre-emergence applications of atrazine have given less satisfactory weed control. Do not mix other chemicals with atrazine and oil. Severe corn injury has resulted from the addition of 2,4-D to this mixture.

Postemergence—Annual broad-leaved weeds can be controlled with broadcast postemergence applications of one-fourth to one-half pound per acre of 2,4-D amine when the corn is less than 8 inches tall. The one-fourth pound rate has been adequate for susceptible weeds and is less dangerous to corn. The one-half pound rate has been satisfactory for moderately resistant weeds, but corn has usually been injured by this rate.

If 2,4-D esters are used, reduce application rates about one-third. Since the ester forms are volatile, vapor injury to nearby susceptible crops is a possibility. The use of amines eliminates the danger of vapor injury because amines are not volatile. Spray drift from either amines or esters of 2,4-D will injure susceptible plants.

To reduce the danger of 2,4-D injury when the corn is more than 8 inches tall, avoid spraying the upper leaves and leaf whorl of corn by using drop nozzles between the rows. However, adequate spray coverage of the tops of the weeds is necessary for maximum weed control. If nozzles are directed toward the row from both sides, the herbicide concentration must be reduced to compensate for the double coverage.

Some injury may result when corn is sprayed with 2,4-D. Brittleness followed by bending or breaking of stalks is the most serious type of injury, and it may result in severe stand losses when applications of 2,4-D are followed by a storm or careless cultivation.

Several factors influence the degree of injury resulting from 2,4-D. Hybrids vary in tolerance to 2,4-D. Corn growing rapidly is more susceptible than corn developing under less favorable growth conditions. When temperatures exceed 85° F. just before or at the time of 2,4-D application, the corn is more likely to be injured. At the rates of application commonly used, the stage of growth at which treatment is made during the period from emergence to tasseling is less critical than the effects of environmental factors.

If broad-leaved weed control is necessary after layby, 2,4-D ester at one-half pound per acre or 2,4-D amine at three-fourths to 1 pound per acre may be applied using drop nozzles. Do not apply 2,4-D from tasseling to dough stage; 2,4-D can be applied after the early dough stage if necessary, but it is more beneficial to control weeds earlier.

MCPA can be used on corn, but it has not proved less injurious to corn than 2,4-D.

Dicamba (Banvel) as a postemergence spray in corn has given better control of Canada thistle and smartweed than 2,4-D with less effect on the corn. But when used, dicamba drift has usually affected soybeans in the vicinity of treated cornfields. Dicamba also controls other broad-leaved weeds except mustard, but does not control grasses.

Dicamba can be used in corn at one-eighth to one-fourth pound per acre either alone or in mixtures with 2,4-D amine at one-fourth to one-half pound per acre. Applications can be made only until corn is 3 feet tall. Later applications, especially when corn is tasseling, may result in poor kernel set. Use drops after corn is 8 inches tall.

Caution: Soybeans and other broad-leaved plants are very sensitive to dicamba. Dicamba effects have been observed on soybeans considerable distances from treated corn fields and in some cases soybean yield losses have occurred. Users of dicamba should take special precautions to avoid drift. Drift can be minimized by reducing sprayer pressure, increasing water volumes with larger nozzles and using drop nozzles to keep the spray release as low as possible and still give weed coverage. Drift potential is greater with windy or high temperature conditions. Do not graze or harvest for dairy feed prior to the milk stage of the grain if corn is treated with dicamba.

Atrazine and oil, discussed above, may be applied up to the layby stage of corn. However, results are not as good as from earlier applications when weeds are less than 1½ inches tall. Drop nozzles should be used to keep the spray out of the tops of the corn and to give better spray coverage on the weeds.

A mixture of atrazine, dalapon, and oil applied when corn is less than 6 inches tall has given promising results in limited research trials. Both grasses and broadleafs were controlled. Proper timing and rate of application appear critical to avoid corn injury. Rates that look promising are ¾ to 1½ pounds per acre of atrazine and ⅜ pound per acre of dalapon. **Caution**: As of December 1968, this mixture is not cleared for use on corn.

Flame weeding or directed sprays cannot be used on small corn. Therefore, early season weed growth must be controlled by some other means (use of rotary hoe, harrowing, pre-emergence herbicides, or cultivation) to prevent yield losses from early weed competition. Directed sprays and flame weeding are considered emergency measures to control heavy weed stands that have become established within corn rows.

Directed sprays—Specially designed equipment has been developed to make directed spray applications in corn. When applying directed sprays, the nozzles should be mounted so that wheels, skids, cultivator shanks, or similar devices control the nozzle height. To minimize spray contact with corn leaves, use attachments to lift the corn leaves and direct the spray to the base of corn plants and onto weeds in the row.

Directed sprays of dalapon-2,4-D mixtures at rates of 1½ pounds of dalapon and one-half pound of 2,4-D per acre can be used when corn height to the whorl is 8 to 16 inches. This mixture will stunt or kill most weeds in the row that are hard to control by cultivation. If excessive amounts of dalapon contact the corn leaves, plants become stunted and deformed. Twisted leaves and undeveloped ear husks are typical injury symptoms.

Caution: Do not use dalapon on corn grown for seed.

Directed sprays of linuron at 1½ pounds per acre can be applied when the corn is not less than 15 inches tall. The addition of a wetting agent is necessary for effective weed control. Care must be taken in application to minimize spray on the corn leaves while covering most of the weed foliage with the linuron spray. Linuron will kill corn leaf tissue it contacts and, if leaf kill is extensive, corn yields may be reduced.

Flame weeding of corn is a practice that can be used in the same manner as directed sprays. Special equipment using LP-gas as fuel has been developed for flame weed control after corn is 8 inches tall. Flaming must be carried out carefully by experienced operators to avoid corn injury. Several flamings are usually required within 5 to 10 days to give adequate weed control with slight effect on the corn in most instances. Serious corn leaf burn can occur when the flame weeder is improperly adjusted or the operating speed is too slow. Searing of the bottom two or three leaves of corn commonly occurs and may slightly depress the corn height but has no apparent effect on corn yield. Corn yields in flame-weeded plots have often equalled those obtained using herbicides for weed control. A disadvantage of flame weeding is the necessity of flaming several times to obtain adequate weed control.

Dry Edible Beans

Before emergence, bean fields can be spike-tooth harrowed to kill emerging weeds. After beans emerge, use such implements as the weeder, rotary hoe, spike-tooth harrow, or coil spring harrow to kill weeds. Only small emerging weeds in the "white" stage can be uprooted and killed without injury to the larger beans. It may pay to harrow the field several times before the first cultivation if weeds emerge.

Beans are generally cultivated twice before the vines cover the middles. Hand hoeing is desirable when economically feasible.

Herbicides cleared for use on beans and tested by the University of Minnesota include EPTC (Eptam) trifluralin (Treflan), amiben, DCPA (Dacthal), and DNBP amine.

EPTC at 3 pounds per acre or trifluralin at three-fourths pound per acre on sandy soil to 1 pound per acre on finer textured soils are applied preplanting and incorporated into the soil. Incorporation must be accomplished within minutes after application to avoid loss of the herbicide. If a disk is used for incorporation, the field should be disked twice, once in each direction. The second disking need not be done the same day.

Amiben, DCPA, or DNPB amine are applied preemergence at 2, 10½, or 9 pounds per acre, respectively. Weed control at these rates may be less satisfactory than that obtained from the herbicides suggested for preplanting application.

DNBP amine may be applied when beans are emerging (not later than crook stage) at a rate of 3 to 4½ pounds per acre. This is primarily a contact killer for small and germinating weeds. Weather often makes treatment at this time impractical.

Flax

Cultural practices—Weeds are generally more of a problem in flax than in small grain; therefore growers should sow flax on relatively clean land. To prepare land for flax, practice early afterharvest tillage of small grain stubble—except where such tillage results in serious wind erosion—to control perennial weeds, prevent weed seed production, and stimulate annual weed seed germination in late summer and fall.

Another desirable weed control practice is to prevent weed seed production in the preceding corn, soybean, or other cultivated crop and prepare the seedbed for flax by shallow tillage. Delayed sowing of flax to permit spring tillage for wild oat control has been successful in some areas although the delay is sometimes detrimental to the flax. For delayed sowing, use early maturing varieties such as Bolley, Summit, or Windom.

Herbicides—Time of application of herbicides is very important on flax. Flax is likely to be seriously hurt if sprayed during the period between bud stage and when 90 percent of the bolls have formed. Germination of the seed may be reduced by spraying between full bloom and the stage when seeds are colored. The preferred time to spray is when flax is 2 to 6 inches tall. MCPA is less likely to injure flax than 2,4-D. Weed control is most effective when spraying is done as soon as most of the weeds have emerged. MCPA sprays may reduce yield of flax seed and straw unless weed competition is reduced sufficiently to offset injury from the chemical.

Susceptible weeds like wild mustard are killed by 2 to 3 ounces per acre of MCPA. Lambsquarters, field pennycress, cocklebur, marshelder, and ragweed require 4 ounces. From 5 to 8 ounces per acre of MCPA amine are required for control of wild buckwheat, thistles, smartweed, and redroot pigweed. At these rates flax may be injured and a good kill of these weeds seldom results, though their growth is usually checked and seed production reduced.

TCA at 5 pounds per acre or dalapon (Dowpon) at three-fourths pound per acre will kill green, yellow, and giant foxtail in young flax. Best results have followed application when the flax was 2 to 6 inches tall and the weeds less than 2 inches. TCA or dalapon can be applied in a mixture with MCPA to kill susceptible grass weeds and susceptible broad-leaved weeds with one application—but spraying must be done before early bud. Neither TCA nor dalapon should be used unless a serious annual grass population is present. Flax varieties recommended for use in Minnesota are approximately equal in tolerance to MCPA and TCA. However, varieties differ in their tolerance to dalapon. Most tolerant to least tolerant varieties are: Nored, B-5128, Bolley, Windom, and Summit.

When flax is used as a companion crop to establish alfalfa, red clover, alsike clover, ladino clover, birdsfoot trefoil, timothy, meadow fescue, bromegrass, or crested wheatgrass, use MCPA as directed for susceptible weeds in flax except that legume seedlings should be at least

2 inches tall. Sweetclover seedlings are likely to be killed and other legumes injured by MCPA. Dalapon can be used on flax sown with alfalfa, sweetclover, or birdsfoot trefoil but will probably kill forage grasses and seriously injure red and alsike clovers.

Use 10 to 20 gallons per acre of spray solution when spraying with TCA, dalapon, or more than 4 ounces per acre of MCPA amine.

For chemical control of wild oats in flax see section on WILD OATS control on page 16.

Forages—Alfalfa, Clover, and Grasses

Seedling legumes generally are poor competitors with weeds. Management practices in preceding crops such as use of intertilled crops and afterharvest tillage to make the land as weed free as possible for the legume seedlings are desirable.

Clipping of seedling legumes (except sweetclover) when sown alone, mowing the stubble of companion crops, and patch mowing of perennial weeds aid in weed control.

Preplant incorporation treatments at 2 to 3 pounds of EPTC (Eptam) per acre have given effective control of annual broad-leaved and grass weeds in alfalfa, red clover, sweetclover, alsike clover, and birdsfoot trefoil when these legumes were sown without a grass in the mixture or a companion crop.

Benefin (Balan) has given effective control of annual grasses and fair control of lambsquarters and pigweed when applied preplanting and incorporated into the soil just before seeding legumes. Benefin is cleared for use on alfalfa, birdsfoot trefoil, red, alsike and ladino clovers at rates up to 1½ pounds per acre. On sandy soils a rate of 1⅛ pounds per acre should be used. Benefin controls weeds by affecting seed germination. It does not control established weeds.

Postemergence treatments with 2,4-DB at one-half to 1½ pounds per acre can be used to control broad-leaved weeds in seedling alfalfa, birdsfoot trefoil, red clover, alsike clover, and ladino clover when sown alone or with small grains. Spray when weeds are less than 3 inches tall, when the legumes are 2 to 3 inches tall, and small grains are 6 to 8 inches tall. Wild mustard is not effectively controlled by 2,4-DB. **Caution**: To avoid residues do not graze or harvest forage for livestock feed for 30 days after treatment.

Small grass weeds can be controlled in seedling alfalfa (2 to 3 inches tall) with dalapon at 1 pound per acre. **Caution**: Do not feed first-year crop to dairy animals or animals being finished for slaughter. First-year crop should not be sold commercially or shipped interstate.

Dalapon-2,4-DB mixtures may be used to control weeds in alfalfa sown without a forage grass or companion crop.

Seedling stands of ladino clover, alsike clover, red clover, and alfalfa sprayed with the sodium or amine salt of 2,4-D or MCPA at rates of one-fourth pound per acre or less have not been seriously injured, especially if a canopy of companion crops or weeds has been present. Reduced sprayer pressure helps minimize damage.

Seedlings of perennial grasses may be treated with 2,4-D when broad-leaved weeds are a problem. Up to three-fourths pound per acre of 2,4-D may be used after the grass seedlings have reached the two- to four-leaf stage.

Mowing is the recommended practice for controlling many kinds of weeds if done at the right time and if repeated for 2, 3, or 4 years. In general, mow herbaceous weeds in the early bud to blossom stage.

In established legumes, the amine salt of 2,4-DB can be applied at one-half to 2 pounds per acre or the ester of 2,4-DB can be applied at one-half to 1 pound per acre in 15 to 30 gallons of water per acre. Do not use more than three-fourths pound of the ester per acre on red clover. Apply when the annual broad-leaved weeds are 2 to 3 inches tall or when perennials are 6 to 8 inches tall. The same feeding restrictions apply that were mentioned above.

Use of 2,4-D or MCPA is often hazardous to legumes. Either herbicide should be applied in the dormant stage of the legume—late fall or very early spring —to control weeds that are present at this time. MCPA or 2,4-D amine at 4 to 8 ounces per acre may be used during legume dormancy to control yellow rocket, a weed that is sometimes troublesome in legumes. White cockle is not controlled by 2,4-D or MCPA. Harvest of the legume before white cockle seed matures will reduce the rate of spread by seed.

Simazine (Princep) has been recently cleared for use on pure alfalfa stands established for a year or more to control seedling plants of wild mustard, yellow rocket, hoary alyssum, white cockle, shepherdspurse and pennycress. Application should be made after the first killing frost in the fall or very early in the spring before alfalfa growth starts. Grasses in the alfalfa will be killed or injured. Some injury to alfalfa may occur. Recommended rates are 0.8 to 1.6 pounds per acre depending on soil type. Simazine should not be used on sandy or gravelly soils.

Caution: Do not graze areas treated with simazine for 30 days or cut hay for 60 days after treatment.

Legumes grown for seed present some different weed control problems than do forage legumes. Weeds cannot be controlled by grazing or clipping. Also, weed seeds are a more serious problem.

Several herbicides can be used on seed fields if the forage is not fed to livestock. Herbicide residues in milk or meat prohibit the use of some of these compounds on forages grown for feed.

EPTC or benefin can be used to establish legumes without a companion crop (see suggestions above).

Dalapon has given no injury and good grass control in seedling stands of alfalfa or birdsfoot trefoil when applied at 1 or 2 pounds per acre soon after emergence of grassy weeds. (Note feeding restrictions mentioned above.)

Established stands of alfalfa, sweetclover, and birdsfoot trefoil have been sprayed with TCA at 5 to 7 pounds per acre for control of many annual grasses (not wild oats) without permanent injury to the legumes. Do not treat ladino clover, alsike clover, and red clover with TCA.

A 2 pound per acre dalapon application will suppress quackgrass in birdsfoot trefoil seed fields during the growing season. Treat early in the spring soon after quackgrass growth starts.

One to 1½ pounds per acre of 2,4-DB will control many broad-leaved weeds in legumes with little or no injury to the legumes. **Caution:** Forage harvested within 30 days of treatment cannot be fed to livestock.

DNBP dried the foliage of crop and weeds, including Canada and perennial sow thistle, when alfalfa, red clover, and alsike clover were sprayed preharvest with 1.87 pounds per acre. Two applications may be necessary for complete drying of the vegetation.

For timothy grown for seed, early spring applications of dicamba (Banvel) at one-fourth to one-half pound per acre have controlled young nightflowering catchfly and white cockle. The chemical should be applied after weeds start to grow and when timothy is 2 to 4 inches tall. Timothy injury is more likely if dicamba is applied late or at the higher rate. When applied in the spring, silvex at 1 to 2 pounds per acre gave good control of nightflowering catchfly and white cockle with little injury to the timothy. Combinations of dicamba with MCPA or 2,4-D give better control of mustards and other weeds resistant to dicamba. If Canada thistle or sow thistle is a problem, a later application of 2,4-D or MCPA may be required.

Caution: Do not graze areas treated with dicamba or feed treated forage or threshings to livestock.

In established pastures good management and controlled grazing are most important in any attempt at weed control.

In very weedy pastures where good perennial grasses are thin, reseeding may be the most important practice. To be successful, prepare a firm seedbed for any reseeding and add lime and fertilizer by soil test. Protect new seedlings from grazing until they are established and graze moderately thereafter. Plowing (or intensive surface tillage) and seeding to adapted grasses, where practicable, will usually eliminate many of the perennial pasture weeds.

Spraying with 1 to 2 pounds per acre of 2,4-D, 2,4,5,-T or a mixture of the two gives better control of many weeds with a single application than is obtained with a single mowing treatment. The weeds should be sprayed when growing actively. Repeated treatment for 2 or more years is usually necessary. In general, these chemicals have been used at rates necessary for weed or brush control without appreciable injury to grasses, but legumes will be eliminated.

MCPA can be used at low rates of about one-fourth pound per acre where legumes are present. Some 2,4-D-resistant weeds such as buttercup are controlled better with MCPA.

Caution: Do not graze dairy cattle on pastures treated with 2,4-D for 7 days after treatment.

Small Grains—Spring Wheat, Oats, and Barley

Wheat and barley are less sensitive than oats to 2,4-D applications made during the growing season. All three crops are sensitive as seedlings. Wheat and barley are relatively tolerant from the time five full leaves appear until the early-boot stage. During this period one-sixth to one-half pound of 2,4-D ester or one-fourth to two-thirds pound of 2,4-D amine will control most broad-leaved weeds without serious injury to crops. Some injury to oats should be expected, but weed control generally will more than offset losses resulting from 2,4-D injury.

Caution: Do not forage or graze treated grain fields for 2 weeks after treatment with 2,4-D. Do not use treated straw for livestock feed.

Avoid spraying wheat and barley in the boot stage of development. Varietal differences in wheat and barley have been unimportant. Oat varieties differ in their response to 2,4-D.

Small grains are more tolerant to MCPA than to 2,4-D. Using MCPA permits spraying in the 2- to 5-leaf stage of the small grains, whereas using 2,4-D in this early stage would usually result in excessive crop injury. MCPA rates of one-fourth pound per acre of amine or one-sixth pound per acre of ester will control small mustard plants. For other broad-leaved weeds or larger mustard, up to two-thirds pound per acre of amine and one-half pound per acre of ester may be required.

Weeds more easily controlled by MCPA than 2,4-D are hemp nettle, horsetail, buttercup, tartary buckwheat, corn spurry, and perennial peppergrass. Those more easily controlled by 2,4-D than MCPA are Russian thistle, falseflax, velvetleaf, jimsonweed, smartweed, redroot pigweed, ball mustard, tansy-mustard, and hemp.

Bromoxynil controls most annual broad-leaved weeds, including some 2,4-D resistant weeds, in wheat and barley when applied at three-eighths to one-half pound per acre as an early postemergence treatment. Some injury to small grains has occurred at the higher rate. Bromoxynil has also been used in combination with MCPA ester at one-quarter pound of each material per acre applied early postemergence. The combination has injured underseeded legumes more than either material used alone. Bromoxynil does not control annual grasses or perennials.

Dicamba at one-eighth pound per acre controls hard-to-kill broad-leaved weeds such as wild buckwheat and smartweed in oats and wheat when used alone or in mixtures with one-fourth pound per acre MCPA. The combination of dicamba and MCPA gives better control of mustard than dicamba alone. Oats are most tolerant, followed by wheat, with barley being least tolerant. Applications made at the two- to five-leaf stage of small grain growth are the least injurious to the grains.

Caution: As of December 1968 dicamba has received clearance for use on wheat and oats, but not for spring barley. Do not graze or feed to livestock forage or threshings from small grains treated with dicamba.

Applications of 2,4-DB at one-half to 1½ pounds per acre made when small grains are 6 to 8 inches tall will control many broad-leaved weeds with no injury to legumes, except sweetclover. Mustard is not usually controlled by 2,4-DB, and other weeds require higher rates than used for MCPA or 2,4-D. **Caution:** Grain should not be harvested for 30 days after treatment.

For control of wild oats in small grains see section on WILD OATS control (page 16).

Small Grains—Winter Wheat and Rye

Many annual broad-leaved weeds can be controlled in winter wheat and rye by spraying with 2,4-D—using the ester at one-fourth to one-half pound per acre or the amine at one-half to three-fourths pound per acre in the spring, after the grain is fully tillered but before it is in the boot. Do not spray winter wheat or rye in fall.

Grain Sorghum

Sorghum will not germinate or grow in cold soil. Therefore, late planting in warmer soil, May 25 to June 10, is necessary if sorghum is to grow rapidly enough so that weeds can be controlled by cultivation. Later planting would be still more desirable but the short Minnesota growing season will not allow later planting if maximum grain production is desired.

Treatment with CDAA (Randox), propachlor (Ramrod), norea (Herban), propazine (Milogard), or atrazine (AAtrex) is usually necessary to prevent drastic reduction in sorghum yield due to weed competition. These herbicides control annual grasses (not wild oats) in sorghum. Propazine, atrazine, and norea also kill broad-leaved annual weeds. CDAA or propachlor at 4 pounds per acre, norea at 2.4 pounds per acre, or propazine at 2 pounds per acre are applied pre-emergence. Propachlor (Ramrod) is chemically related to CDAA and usually preferred.

Atrazine at 2 pounds per acre should be applied after the sorghum has emerged and as soon as a few annual grass weeds have started to emerge. Atrazine kills both emerged and nonemerged susceptible weeds, if grasses are less than 1½ inches tall when treated. A mixture of atrazine at 1 to 2 pounds per acre plus either special emulsifiable oil at 1 to 2 gallons per acre or special adjuvant-oil emulsion at ¼ to ½ gallon per acre gives better weed control than atrazine alone at the same rates. Slight reduction of sorghum height was observed in some trials where 2 gallons of oil plus 2 pounds of atrazine were used.

A mixture of norea at 2 pounds per acre plus either atrazine or propazine at 1 pound per acre is approved for pre-emergence application.

Caution: Do not graze or feed forage within 60 days after application of atrazine or norea-atrazine mixture. Silage from propachlor-treated sorghum should not be fed to dairy cattle.

These herbicides have not seriously injured adapted grain sorghum varieties in Minnesota. Occasionally CDAA has caused injury, but the sorghum has recovered and outyielded unsprayed sorghum. Atrazine or propazine should not be used on sandy soils, as injury to sorghum may occur.

For the control of broad-leaved weeds, 2,4-D may be used at one-fourth to one-half pound per acre. However, injuries similar to those of corn may occur. Sorghum is most susceptible to 2,4-D in seedling, early boot, and pollination stages of growth. It is most tolerant when 4 to 12 inches tall but injury may occur at this stage of growth also.

Dicamba (Banvel) at one-eighth to one-fourth pound per acre is also approved for control of broad-leaved weeds in sorghum 4 to 12 inches tall. The one-fourth pound rate reduced seed set and yield of sorghum in a 1968 trial when broad-leaved weeds were not present.

Caution: Do not graze or feed forage or silage from dicamba treated sorghum prior to the mature grain stage.

Soybeans

Cool soil temperatures slow the germination and growth of soybeans considerably so that weeds may gain a competitive advantage. However, in warm soils, soybeans are good competitors of weeds because germination and growth are rapid.

Several cultural practices control annual weeds in soybeans. Fall and early spring plowing plus tillage prior to sowing of the crop can kill many weeds. Post-emergence cultivation with the rotary hoe or harrow is effective if done when the weeds are small and soil conditions are favorable.

Table 3 shows the performance of some pre-emergence herbicides in uncultivated soybeans during several years of county demonstrations. Figures show the percent of trials in which weed control was rated good (more than 75 percent of the weeds controlled), fair (50 to 75 percent of the weeds controlled), or poor (less than 50 percent of the weeds controlled). Evaluations were made about 5 weeks after application.

Table 3. Early evaluations of herbicides in weed control demonstrations in uncultivated soybeans

Chemical	Pounds per acre active ingredient or acid equivalent broadcast	Years in trial	Number of trials		Percent of trials in each class					
					Grasses			Broad-leaved weeds		
			Grasses	Broad-leaved weeds	Good	Fair	Poor	Good	Fair	Poor
Amiben	2	1963-66	149	137	54	27	19	56	25	19
Amiben	3	1959-68	344	332	72	18	10	74	18	8
CDAA (Randox)	5	1963-68	205	185	60	28	12	22	27	51
DCPA (Dacthal)	10.5, 9	1967-68	50	46	58	26	16	43	33	24
Linuron (Lorox)	2	1962-68	256	248	50	25	25	64	19	17
Propachlor (Ramrod) granular	5	1965-66	65	61	80	14	6	41	33	26
Propachlor (Ramrod)	5	1965-68	125	118	79	15	6	40	35	25
Trifluralin (Treflan)	1	1965-68	92	85	85	13	2	62	24	14

Table 4. Effectiveness of herbicides on major annual weeds in soybeans

	Pre-emergence				Pre-planting	Post-emergence	
	Amiben	CDAA	Propachlor	Linuron	Trifluralin	Chloro-xuron	2,4-DB
Soybean tolerance	G	F	G	F	F	F	P
Grasses							
Giant foxtail	G	F	G	F	G	P	N
Green foxtail	G	G	G	F	G	P	N
Yellow foxtail	G	G	G	F	G	P	N
Barnyardgrass	G	F	F	F	G	P	N
Crabgrass	G	G	G	G	G	P	N
Broadleafs							
Cocklebur	P	N	P	P	P	—	F
Lambsquarters	G	P	P	G	G	G	P
Mustard	F	N	P	G	P	G	P
Pigweed	G	F	F	G	G	F	P
Ragweed	G	P	P	G	N	P	P
Smartweed	F	N	P	F	P	P	P
Velvetleaf	F	N	P	F	P	P	P
Wild sunflower	P	N	P	P	N	—	P

G—Good
F—Fair
P—Poor
N—No control
—Inadequate information

Table 4 indicates soybean tolerance of herbicides suggested for use in soybeans and efficiency of these herbicides in controlling common annual weeds. This is a general comparative control rating based on field observations. Under unfavorable conditions any of the herbicides may give unsatisfactory results. With favorable conditions control may be better than indicated.

Pre-emergence applications of amiben at 3 pounds per acre control most annual broad-leaved and grass weeds. Performance has been consistent on all soil types where rain occurred before weeds emerged. In a few instances stand reductions and slight stunting of soybeans treated with amiben have been noted. However, yields did not appear to be reduced.

Pre-emergence applications of CDAA at 4 to 5 pounds per acre have usually given satisfactory control of grasses with little or no injury to soybeans. CDAA has performed better on soils high in organic matter than on light-colored soils. It should not be used on sandy soils because of injury potential and lack of weed control. Take special care to avoid getting CDAA in contact with the skin and eyes. The chemical causes considerable irritation and discomfort especially in liquid form.

Propachlor (Ramrod), chemically related to CDAA, gives slightly longer weed control. It has given better grass control than CDAA but is not effective against most broad-leaved weeds. Suggested rates are 4 to 5 pounds per acre. Although the chemical is less irritating than CDAA, it should be handled cautiously.

Caution: As of December 1968 propachlor has received clearance for use on soybeans grown for seed for planting only. Do not use seed for food, feed, or oil.

CP50144 (Lasso), chemically related to propachlor, is a recently developed pre-emergence herbicide that has given good grass control in soybeans. CP50144 has given fair to good control of redroot pigweed, common ragweed, and lambsquarters, but control of other broadleafs has been erratic. Soybeans have good tolerance to CP50144. Suggested rates are 2 to 2½ pounds per acre.

Caution: As of December 1968, CP50144 has not been cleared for any use on soybeans.

C6989 (Preforan) is a recently developed pre-emergence herbicide that has shown promise in limited trials for control of annual grasses and broadleafs. Soybeans have good tolerance to the chemical. Rates are 3¾ to 4½ pounds per acre.

Caution: As of December 1968, C6989 is cleared only for soybeans grown for seed for planting.

Pre-emergence applications of linuron at one-half to 2½ pounds per acre control most annual broad-leaved weeds and grass in soybeans. In a few instances severe stunting and stand reduction of soybeans have occurred. It is extremely important to use the rates recommended on the label for your soil type.

Vernolate (Vernam) has given erratic performance as a pre-emergence or preplanting herbicide on soybeans in Minnesota. Grass control is usually better than broadleaf control. Crop tolerance is not as good as

desired and occasionally soybean injury has occurred. Vernolate must be incorporated with a disk before planting.

In soybeans, trifluralin (Treflan) applied at one-half to 1 pound per acre preplanting and incorporated has given good control of annual grasses, pigweed, and lambsquarters, but has given little control of most other broad-leaved weeds. Proper incorporation can be accomplished by double disking twice in opposite directions or by other methods which thoroughly mix the chemical with the top 3 inches of soil. Incorporation with a spike-tooth harrow after planting has caused trifluralin injury to soybeans in some trials.

Applications 2 to 3 weeks before planting have given equal weed control and less soybean injury compared with applications at planting time. With early application one disking can be done at application time, followed by an additional disking at planting.

DCPA (Dacthal) is cleared for pre-emergence use on soybeans at rates up to 10.5 pounds per acre. In Minnesota trials, the maximum rate of 10.5 pounds per acre has given fair control of annual grasses, but poor broadleaf control. Soybean tolerance is good except there is an occasional plant broken over near the soil surface. **Caution**: Do not graze treated areas or feed forage to livestock.

A mixture of amiben and norea has shown promise for pre-emergence use on soybeans for broadleaf and grass control. Rates for the amiben-norea mixture are 1 to 1.5 pounds per acre of amiben and 0.8 to 1.2 pounds per acre of norea. There is some soybean injury potential with the norea-amiben mixture. Do not use on sands or sandy loams with low organic matter. **Caution**: As of December, 1968, the norea-amiben mixture is not cleared for use on soybeans.

The chemicals dinoseb (DNBP), chlorpropham (CIPC), Naptalam (NPA, Alanap), nitralin (Planavin), and PCP have occasionally caused injury to soybeans and/or have given erratic weed control.

Cocklebur can be controlled by applying 2,4-DB to soybeans from 10 days before bloom up to mid-bloom growth stages at 0.2 pound per acre. Cockleburs may develop regrowth and produce burs after a good initial dieback. The burs produced will germinate. Stunting of the soybeans may occur and appears to be more severe under hot, dry conditions.

Chloroxuron (Tenoran) can be used as an early postemergence spray on soybeans for control of certain broad-leaved weeds. The chemical is most effective against lambsquarters, mustard, and redroot pigweed. Other broadleafs are only partially controlled and grasses are usually not controlled. One of the preplanting or pre-emergence chemicals discussed above should be used for grass control. Chloroxuron can be applied over the top of soybeans or as a directed spray from time of the first trifoliolate leaf to layby. Soybeans are susceptible to injury in the unifoliolate leaf stage. Broad-leaved weeds should be no more than 2 inches tall when sprayed. Chloroxuron will not effectively control larger weeds. The spray must contact the weeds to be effective. Some soybean leaf burn and delayed growth usually occurs following chloroxuron treatment. A few days delay in maturity has sometimes resulted. Suggested rates are 1 to 1½ pounds per acre applied with a special wetting agent. Do not apply more than these rates.

Caution: Do not graze treated fields. Do not apply within 120 days of harvest.

Sugar Beets

Herbicides may be used in sugar beets to supplement conventional cultivation practices. Hand labor, mostly hoeing, is still needed but can be reduced by timely cultivations and herbicide applications.

Annual grasses, except wild oats, may be controlled by TCA at 6 pounds per acre applied pre-emergence.

Caution: TCA is not cleared for use on sugar beets if the tops are to be fed.

Propachlor (Ramrod) is cleared for pre-emergence application on sugar beets at 3.9 pounds per acre. Propachlor controls primarily annual grasses, but under certain conditions has controlled some broad-leaved weeds. Compared with TCA, propachlor has worked more consistently under a wider range of rainfall conditions and sometimes controlled more kinds of weeds. Some sugar beet injury, primarily stand reduction, has occurred. No sugar beet yields have been determined in these trials.

Caution: Do not graze or feed forage from treated areas.

Dalapon at 3 pounds per acre will control most emerged annual grasses. For best control, grasses should be sprayed before they are 3 inches tall. Late-emerging grasses can be controlled with directed sprays of dalapon at 2 to 3½ pounds per acre until sugar beets are 14 inches tall. If repeated applications are used, no more than 6 pounds per acre can be applied in any single growing season.

A combination of EPTC (Eptam) at 2 pounds per acre incorporated into the soil before planting plus TCA at 6 pounds per acre pre-emergence has given excellent control of annual grasses particularly foxtail and some broadleaf control in several years of testing. The combination has given satisfactory control under climatic conditions in which the single chemicals gave poor results. The treatment has at times given stand reduction and temporary stunting of beets. This combination treatment has given more severe injury in some years than in others.

Diallate (Avadex) at 1½ to 2 pounds per acre as a preplanting soil-incorporated treatment may be used to control wild oats in sugar beets. Barban (Carbyne) at five-eighths to three-fourths pound per acre may be used to control emerged wild oats. Wild oats should be sprayed in the two-leaf stage.

Certain broad-leaved weeds—annual smartweed, wild buckwheat, and marshelder—may be controlled by a postemergence application of endothall at three-fourths to 1½ pounds per acre. When beets and weeds have recently emerged the lower rate should be used. Application of endothall at temperatures below 60° F. may give poor results. Temperatures in excess of 80° F. at time of treatment may cause excessive injury, particularly in very small beets. Endothall may cause

leaf burn on the beets but recovery is usually rapid. Endothall will generally give disappointing results on most broad-leaved weeds not mentioned above.

Trifluralin (Treflan) is cleared for use at three-fourths pound per acre applied postemergence when sugarbeets are 2 to 6 inches tall for annual grass control. The chemical must be incorporated immediately with cultivators or tillers adjusted to mix the chemical with soil in the row without damaging the sugarbeets. Application is usually made immediately after blocking or thinning. The crop should be clean cultivated before application since trifluralin does not control established weeds. Only limited observations have been made on this treatment.

Sunflowers

Sunflowers are often a weedy crop. They compete well with weeds, but do not develop ground cover quickly enough to prevent weeds from establishing.

Weeds frequently emerge before sunflowers. Thus many weeds can be killed by spike-tooth or coil spring harrowing about 1 week after planting but before sunflowers germinate.

After sunflowers emerge such implements as the weeder, rotary hoe, spike-tooth harrow, or coil spring harrow may be used to kill weeds. Sunflower seedlings are strongly rooted so small emerging weeds in the "white" stage can be uprooted and killed without injury to the larger sunflowers. Setting of the harrow or weighting of the rotary hoe to do most damage to the weeds and least to the sunflowers can be accomplished on a "try-and-adjust" basis. It might pay to harrow the field several times if weed emergence warrants it.

Cultivation to kill weeds between the rows is the major method of weed control. Sunflowers are more easily damaged or broken by the cultivator than is corn.

EPTC (Eptam) at 3 pounds per acre or trifluralin (Treflan) at one-half to three-fourths pound per acre on sandy soil to 1 pound per acre on finer textured soils are applied preplanting and incorporated into the soil as soon as possible. If a disk is used for incorporation, the field should be disked twice, once in each direction. The second disking need not be done the same day. Both herbicides kill many grasses and some broad-leaved annual weeds but are not usually effective on wild mustard, smartweed, or wild oats although EPTC occasionally gives good control of wild oats. Trifluralin temporarily stunted sunflower roots in some trials when the crop was planted the day of application but no permanent injury resulted.

Sunflowers are tolerant of several pre-emergence herbicides, but none are approved for sunflowers at this time.

SPECIAL WEED PROBLEMS

Cultural Practices for Controlling Perennial Weeds

Perennial weeds such as Canada thistle, perennial sowthistle, field bindweed, leafy spurge, and quackgrass are difficult and expensive to control. Control is usually accomplished best with a combination of cultural practices, cropping systems, and chemicals.

These persistent perennial weeds spread vegetatively as well as by seed. Underground parts of the plants store food and produce new growth. Control programs should be planned to (1) prevent seed production; (2) destroy top growth repeatedly, thereby depleting food reserves; (3) kill underground parts by exposure to drying and freezing at the soil surface; and (4) eliminate small seedlings before they form rhizomes or other reproductive organs.

The following practices have been used successfully in Minnesota. Each farmer may need to adapt these ideas to fit his particular cropping system and soils.

Tillage—Properly timed repeated destruction of top growth by plowing followed by cultivation at regular intervals or fallowing will eventually exhaust underground food storage organs. Underground parts exposed to the surface will dry and die. Quackgrass is especially susceptible to surface exposure because roots do not extend below the plow layer and can be pulled to the surface by spring-tooth tillage implements. Cultivation must be frequent and continued over a long enough period, usually two or more seasons, to free the soil of

CANADA THISTLE

all underground rootstocks or rhizomes. Fallowing is effective in dry years but is not very successful in wet years or on poorly drained soils. When the soil is wet, underground parts do not dry when exposed to the surface. Also, under wet conditions, it may be impossible to repeat tillage operations at the proper time to destroy regrowth. The possibility of erosion may prevent the use of this control method on certain fields. If the weed is limited to scattered patches, till these patches separately or use a disk to avoid dragging rootstocks to clean parts of the field.

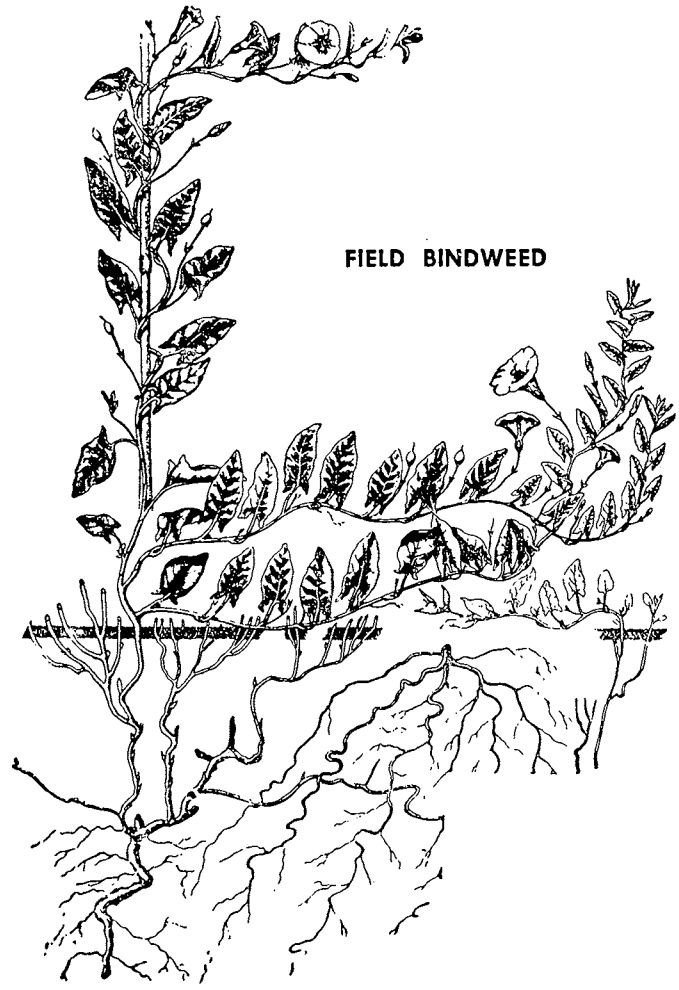
Tillage practices may be effectively combined with growing winter small grains or short-season, late-planted summer annuals such as forage sorghums, sudangrass, sorghum-sudangrass hybrids, or millet. Various combinations of the following suggested cultural practices should effectively control perennial weeds when used with chemicals.

Fall plow and cultivate at 2- to 3-week intervals until freezeup. A field cultivator equipped with overlapping sweeps operated at a 4-inch depth works well for this job.

In the spring, begin cultivation again as soon as 2 to 3 inches of top growth appears and repeat the cultivations whenever there is 2 to 3 inches of regrowth. Continue cultivations until:

a. Freezeup in the fall.
b. About July 1, when forage sorghums, sudangrass, sorghum-sudangrass hybrids, or millet can be planted. After harvest, cultivate until freezeup.
c. September, when winter rye or winter wheat can be sown. After harvest cultivate until freezeup. These practices may be repeated, used in sequence, or the land fallowed as needed to eliminate the problem weeds. Chemicals should be used in the crops to control the weeds while a crop is growing.

PERENNIAL SOWTHISTLE



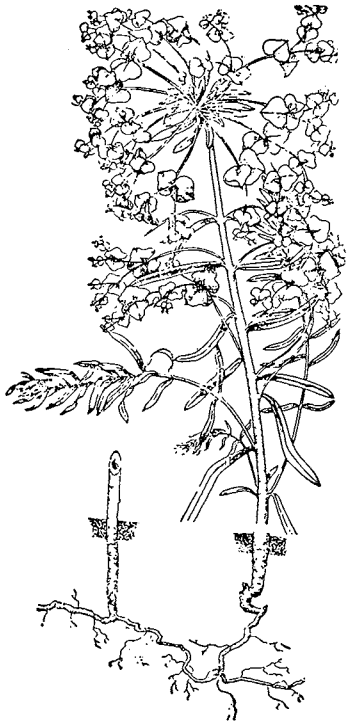
FIELD BINDWEED

Cultivation—Infestations of perennial weeds can be reduced in row crops by frequent cultivations. Timing cultivations to kill top growth when it is not more than 2 inches tall and to eliminate small seedlings before they develop rhizomes or other storage organs will increase the effectiveness of cultivations. Best results are obtained in corn by check planting and cross cultivating. However, if check planting is used it may be impossible to plant corn populations high enough for optimum yields without overcrowding the corn hill.

Mowing—Frequent mowing will weaken and suppress perennial weeds. Weeds should be mowed by the time the first flowers appear so that seeds will not form and then clipped whenever top growth warrants it.

Areas infested with perennial weeds may be planted to hay crops and cut for hay over several years to weaken the weeds and keep them from spreading.

Management—Good management in growing all crops will help control perennial weeds. Using quality seed of adapted varieties and proper seeding rates helps establish good stands to compete with weeds. Adequate preparation of the seedbed prior to planting eliminates existing vegetation and gives crops at least an even start. Narrower rows may help control weeds by shading the row middles sooner. But the row width should be wide enough to cultivate so problem weeds can be controlled by cultivation.



LEAFY SPURGE

Chemicals for Controlling Perennial Broad-leaved Weeds in Crops

Perennial broad-leaved weeds such as Canada thistle, perennial sowthistle, field bindweed, and leafy spurge can be suppressed with 2,4-D or MCPA in tolerant crops. Use 2,4-D on wheat, barley, or corn; MCPA is less injurious to oats. These chemicals may also be used in conjunction with the tillage and cropping practices mentioned above or in grass pastures.

Proper timing of the spray applications is very important for getting good results. Usually two or more applications during the growing season and retreatment for several years are necessary. The chemicals are most effective if applied when the weeds are just starting to grow in the spring and again near the bud stage of the weeds. Timing will also be influenced by the tolerance of the crop being sprayed. Avoid spraying small grains before the five-leaf stage and in the boot stage. Do not spray corn with 2,4-D from tasseling to the dough stage.

The amount of chemical used should be that recommended for the crop being sprayed. Higher rates may cause crop injury. These rates will not eradicate perennial weeds, but the treatments will usually reduce or kill top growth and prevent seed production.

Perennial broad-leaved weed infestations can be effectively reduced by applying 1 to 2 pounds of 2,4-D per acre after harvest of small grains, flax, or other early maturing crops. This treatment will kill legumes. Mow the area after harvest, allow regrowth to reach 6 to 8 inches, and spray while the weeds are still growing vigorously.

In grass pastures, perennial broad-leaved weeds have been controlled with one to two applications per year of 2,4-D at 1 to 2 pounds per acre. Spray when the weeds are growing rapidly and before the bud stage. Repeated treatment for 2 or more years is usually necessary.

Caution: Do not graze dairy cattle for 7 days after treatment.

Dicamba will suppress Canada thistle in small grains and corn. Use the maximum rate of dicamba listed for the specific crop. Drift may damage soybeans or other broad-leaved plants.

It is not desirable to grow soybeans in Canada thistle infested fields because chemicals cannot be used in soybeans for thistle suppression. If soybeans must be grown, spray with 1 pound per acre of 2,4-D when thistles are a few inches tall and at least 2 weeks before planting soybeans. Delay seedbed preparation and planting of soybeans at least 2 weeks after spraying to allow time for 2,4-D to act and to avoid 2,4-D residue effects on the soybeans.

Amitrole or amitrole-T will control Canada thistle when applied either in the fall after harvesting crops or in the spring prior to planting corn. The suggested rate is 4 pounds per acre in 30 or more gallons of water. It is important that a full stand of thistles emerges before spraying. Best results follow treatment just before bud stage or when regrowth is 6 to 8 inches tall. If thistles have been spring-plowed, delayed in emergence, are blooming or mature, or if treatment follows harvesting in late summer or fall, it is best to mow and spray the regrowth when it is 6 to 8 inches tall. Plowing or cultivating after spraying is not necessary, but, if done, should be delayed at least 2 weeks after treatment.

Corn may be planted 2 weeks after amitrole or amitrole-T treatments without danger of injury to the corn from residue.

Caution: Treated areas should not be planted to other crops, grazed, or cut for hay for 8 months after treatment.

Chemicals for Controlling Quackgrass

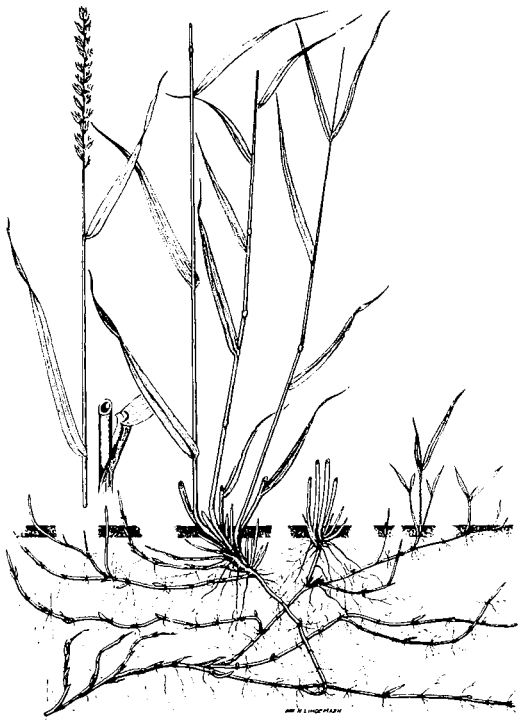
It is possible to greatly reduce or eliminate quackgrass infestations with chemicals. Weather conditions, soil type, timing of treatments, and accompanying tillage will influence the results.

Atrazine is the most effective herbicide for quackgrass control. Preplow applications of 2 to 4 pounds per acre to quackgrass sod in the fall, September to freezeup, or spring, after the frost is out until mid-May, have resulted in nearly complete elimination of quackgrass stands. The low rate is adequate on sandy soils but higher rates are necessary on heavier soils. Treated areas should be plowed and planted to corn only. Other crops are likely to be injured. If 3 to 4 pounds per acre are used, plant corn 2 years to avoid possible carryover injury.

Split applications, 2 pounds per acre of atrazine on quackgrass sod in the fall or early spring and 1 to 2 pounds per acre on the corn as a pre-emergence treatment, have the advantage of controlling annual weeds in the corn as well as eliminating the quackgrass.

TCA applied at the rate of 22 pounds per acre in September or early October on land that has recently

QUACKGRASS



been plowed or thoroughly cultivated has given fair quackgrass control. The next year, if the land is cropped make a second application of 18 pounds per acre after harvest to eradicate the quackgrass.

Normal growth of crops sown or planted in the spring following a fall application of 22 pounds of TCA can be expected from flax, potatoes, sugar beets, oats, corn, and strawberries if normal rainfall has occurred. If it has been dry following the application of TCA, all crops may be injured.

Dalapon (Dowpon) will give results similar to those obtained with TCA when applied to the soil or areas of scanty foliage. It is more effective than TCA when applied to a good growth of foliage. Fall treatment of 12 to 15 pounds per acre followed in a week or two by plowing or other similar soil preparation gives good control of quackgrass the following year. Repeated treatments are necessary for eradication. Control is best when rain occurs between treatment and plowing. Response of spring-sown crops to residues of dalapon in the soil is similar to that for TCA.

Dalapon may also be applied to quackgrass in the spring. An application of 5 pounds per acre, when quackgrass leaves are about 6 inches tall, followed in 2 or 3 weeks by plowing or other soil tillage has proved most satisfactory. Crops should not be planted until 4 weeks after the application. Corn, wheat, and soybeans are especially sensitive to small amounts of dalapon in the soil.

Wild Oats

There are two major reasons for the difficulty in controlling wild oats: (1) its habit of shattering its seed before most small grain crops are harvested, and (2) its delayed germination characteristic. Unless the crop in which the wild oats occurs is cut for hay, enough seed is shattered to infest the soil for years. The germination of the seed and the length of time it can remain viable depend on several factors.

Favorable temperature and moisture for germination are most common in fall and spring; very little seed germinates between June and September. Some seeds require afterripening or a rest period in which the seed coat becomes more permeable to oxygen, which is necessary for germination. Seeds requiring this afterripening germinate the next spring after they have been produced or the following fall.

Seeds kept under favorable conditions usually germinate in 2 or 3 years. However, when seeds are plowed under they may remain dormant and viable for a long time.

The following cultural methods of control are suggested:

1. Do not plow under seeds that have shattered from the current crop of wild oats. They may remain alive for many years when buried. Weathering helps break dormancy if seeds stay near the soil surface.

2. Cultivate shallow in the spring to break the soil crust and cover seed. Cultivate later to kill the wild oats that have germinated, and to bring up other seed that is no longer dormant. Late spring and summer cultivation should be shallow. About the middle of June sow a crop adapted to late sowing—such as early varieties of flax, potatoes, corn, sugar beets, proso millet, buckwheat, sudangrass, and soybeans.

3. Cultivate as in (2) and sow barley late. Use fertilizer and heavy sowing rate.

4. Sow tame oats early and cut for hay before wild oats form seed. Plow immediately after hay crop.

5. More than 1 year of early tillage and delayed sowing or cutting of tame oats for hay is necessary on badly-infested fields.

6. Wild oats can regrow after cultivation. Avoid this by cultivating not earlier than the three-leaf stage, completely uprooting the plants.

Several herbicides are now available which may be used to control wild oats in a number of crops.

Preplant or pre-emergence incorporated applications of diallate (Avadex) at 1½ to 2 pounds per acre will control wild oats in flax with no injury to the crop. This compound may be used for the control of wild oats in barley if applied after planting at 1¼ pounds per acre. Triallate (Fargo), a related compound, appears somewhat safer to barley and may be applied at the same rate either before or after seeding the barley. Triallate, but not diallate, may be used for the control of wild oats in hard red spring or durum wheat if applied at a lower application rate, 1 pound per acre, after seeding. Lower application rates, afterseeding applications, and greater depth of planting of the grain tend to reduce the possibility of crop injury from

diallate or triallate. However, the degree of wild oat control usually decreases as the application rate is reduced. Diallate and triallate require incorporation immediately to prevent losses by evaporation.

Fall applications after October 15 of diallate before sugar beets or flax and triallate before barley have been used successfully in northern areas. Excessive injury has occurred from fall applications prior to spring wheat. A good seedbed free of trash should be prepared before application and the chemical incorporated as above. Soil should be worked no more than 2 to 2½ inches in spring. Fall applications are not advised on soils subject to wind or water erosion.

Alfalfa and clovers may be underseeded in crops treated with diallate. Trials indicate that diallate will control wild oats in corn without injury to the corn.

Barban (Carbyne) should be applied to wild oats in the two-leaf stage from 4 to 10 days after emergence to obtain the greatest degree of control. Application rates of 4 to 6 ounces per acre will usually control wild oats in flax, wheat, and barley. Flax is more sensitive to barban than wheat, and barley is least sensitive. Spraying thin crop stands may result in unsatisfactory wild oat control. Thick stands of crop plants aid in suppression of wild oats and enhance the degree of control obtained with barban. To reduce crop injury, do not spray barban after wheat or barley is in the 4-leaf stage or more than 14 days after emergence, or after flax is in the 12-leaf stage, nor later than 1 month after sugar beets emerge.

Caution: Do not allow livestock to graze treated barley, wheat or sugar beet fields until after the crop is harvested. Do not feed treated flax straw to livestock.

Barban is cleared for early postemergence application in soybeans at rates up to 6 ounces per acre. Apply when most of the wild oats are in the 2-leaf stage. Do not apply after the first trifoliolate leaf stage of the soybeans nor later than 14 days after soybean emergence. **Caution:** Do not allow livestock to graze treated fields until after crop harvest and do not feed treated forage to livestock.

For information on the control of wild oats in sugar beets, see page 12.

Complete Vegetation Control In Noncropland Areas

Several herbicides are available for controlling small areas of perennial weeds or for complete vegetation control in noncropland areas. These herbicides may prevent the growth of plants for a few weeks to more than 2 years, depending on the chemical and rate of application. Most chemicals do not control all weed species, so read the label for weeds controlled by a specific product. The cost on an acre basis may be rather high for these chemical treatments. Use of chemicals for this type of weed control must also comply with the provisions of the Miller Amendment to the Federal Food, Drug, and Cosmetic Act (see page 2).

Be sure the treatment you select agrees with your planned future use of the area. Larger dosages than those suggested below will give better and more lasting control. Higher rates are usually more necessary on low than on high, dry locations. Lower rates and less water or other carrier are needed if applications are made before plant growth is large and dense.

Short-term control—For a temporary kill, use 5 to 10 pounds per acre of dalapon plus 1 to 2 pounds per acre of 2,4-D ester. This treatment works best if applied when the weeds are small and controls both grasses and broad-leaved weeds.

Paraquat is a contact herbicide that kills topgrowth of weeds when applied at ½ to 1 pound per acre in 50 to 100 gallons of water. Paraquat is more effective against young, succulent weeds. There is no soil residual. Perennial weeds will regrow.

Long-term control—To control vegetation on noncropland for at least 1 year, the compounds and rates described below may be used. Numerous mixtures of these materials are available.

Picloram alone at 1 to 2 pounds per acre or mixed with 2,4-D gives excellent control of perennial broad-leaved weeds such as Canada thistle, sowthistle, field bindweed, Russian knapweed, and leafy spurge in nonagricultural lands.

Dicamba may be used at 5 to 10 pounds per acre for control of broad-leaved perennials. It should be applied to the foliage or soil when the weed is actively growing.

Trichlorobenzoic acids are effective in controlling perennial broad-leaved weeds when applied at 15 to 20 pounds acid equivalent per acre. Mixtures of dichloro, trichloro, and tetrachloro benzoic acids (PBA) at rates of 30 to 50 pounds per acre have been as effective as TBA.

Mixtures of TBA and borates effectively control perennial broad-leaved weeds and annual weeds. These are not recommended for controlling perennial grasses.

Sodium chlorate at 4 to 6 pounds per square rod will control annuals, biennials, and most perennials. This compound has been used extensively in spot treatments to control bindweed, leafy spurge, Russian knapweed, Canada thistle, and other deep-rooted perennials.

Table 5. Chemicals for Noncropland Weed Control (fencerows, building sites, rights-of-way, parking lots, etc.)

Weeds Controlled		
Grasses	Broadleafs	Broadleafs and Grasses
dalapon	dicamba	amitrole, amitrole-T
TCA	2,4-D	AMS
mixtures	fenac	atrazine
	PBA	borates
	picloram	bromacil
	silvex	diuron
	2,3,6-TBA	erbon
	TBP	monuron
	2,4,5-T	paraquat
	mixtures	prometone
		simazine
		sodium chlorate
		mixtures

Follow manufacturer's recommendations on rates and times of application. Consider possible damage to nearby trees, shrubs, grass, crops, and possible movement of chemicals with water or wind.

Sodium chlorate is highly flammable when mixed with organic matter, so use it with care.

Borate and sodium chlorate mixtures cause no fire hazard and may be used as sodium chlorate is used.

Substituted urea compounds effectively control vegetation for an extended time. Monuron and diuron are related compounds that control vegetation; apply 20 to 40 pounds per acre (one-eighth to one-fourth pound per square rod). Diuron is the slower acting, but has the longer residual. Monuron and diuron are wettable powders applied as sprays.

Borate compounds at 10 pounds of B_2O_3 per square rod or borate-chlorate mixtures at 8 pounds of active ingredient per square rod have given satisfactory vegetation control. Another treatment may be required for surviving plants, beginning the second spring after the original treatment.

Mixtures of monuron and borates are designed for use as nonselective residual herbicides on industrial sites.

Bromacil controls annual and perennial weeds in noncropland where bare ground is desired. Bromacil should be applied just before or during active growth of weeds. Rates vary from 3 to 15 pounds per acre according to the weed species; refer to the label for specific rates.

Atrazine and simazine are effective for complete vegetation control when applied at 10 to 20 pounds per acre, either as granules or sprays. They are not very effective on some woody plants.

Prometone (Pramitol) is a related triazine material that gives a more rapid kill of existing top growth.

A mixture of amitrole and simazine (Amizine) at 20 pounds per acre is equal to 10 pounds per acre of simazine in length of complete vegetation control; the amitrole portion of the mixture quickly kills young vegetation that persists for long periods when simazine is used alone.

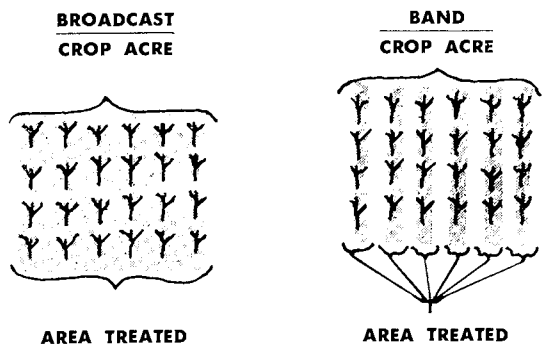
Erbon is a nonselective herbicide effective on most broad-leaved and grass weeds. Docks, nutsedge, milkweed, and Canada thistle are resistant to erbon. Apply as a spray at 1 pound per square rod.

The weeds reinfesting sterilized areas are usually broad-leaved species. Relatively inexpensive treatments with 2,4-D ester at 1 pound per acre may maintain areas free of vegetation for several additional years.

FARM SPRAYER CALIBRATION AND ADJUSTMENT

Uniform application of spray chemicals is essential for effective weed control. A small variation in the rate of application may result in poor kill of the weeds or injury to the crop, thereby causing a loss of time, effort, and money.

Rates in this bulletin are in terms of active ingredient or acid equivalent per acre treated. Rate per acre in the treated area should be the same for broadcast as for band applications. But proportionately less material is used per crop acre with band than broadcast applications. For example, a 3 pound per acre rate requires 3 pounds of material per crop acre with broadcasting but only half as much per crop acre (1½ pounds) if a 15-inch band is treated on rows spaced 30 inches apart.



To determine how much liquid a sprayer applies per acre:

1. Check the output of all nozzles for a set time to make sure that all nozzles discharge at the same rate.

2. Start with a full tank of clean water and have the pressure adjusted as you will use it in the field (usually 20 to 40 pounds).

3. Drive exactly one-eighth mile (40 rods) (660 feet) in a field at the speed you will use when spraying—usually 4 to 5 miles per hour. Mark throttle setting or speed indicator reading and maintain same speed when spraying.

4. Refill the tank, carefully measuring the amount of liquid required. (If water spillage from a full tank is a problem, you can use a calibrated stick to measure amount of liquid used.)

To calculate broadcast application rate:

$$\frac{\text{Number of gallons used} \times 66}{\text{Boom width in feet}} = \text{gallons per acre.}$$

Example: If 2½ gallons were used in one-eighth mile and the width covered by the boom is 24 feet, multiply 2½ by 66 and divide by 24. The result is 6.9 gallons per acre.

To calculate band application rate (volume per acre applied to the area within the band that is sprayed);

$$\frac{\text{Number of gallons used} \times 66}{\text{Band width in feet} \times \text{Number of bands}} = \text{gallons per acre}$$

Example: If 1½ gallons were used in one-eighth mile and the sprayer applied 4 bands 15 inches (1¼ feet) in width, multiply 1½ × 66 and divide by 1¼ × 4. The result is 19.8 gallons per acre.

This is the volume per acre applied to the area within the band that is sprayed.

To determine the amount of herbicide formulation to use per acre sprayed:

1. Determine the number of pounds of acid equivalent or active ingredient suggested per acre for your situation. Use acid equivalent if it appears on the label. Otherwise, use active ingredient.

2. For dry materials, divide the number of pounds of active ingredient or acid equivalent desired by the percent of active ingredient or acid equivalent in the commercial product to determine the number of pounds of the material to apply per acre. Example: If 3 pounds of active ingredient are required and the commercial product is an 80 percent active ingredient powder, divide 3 by .8 = 3.75 pounds of commercial powder per acre.

For liquids, determine the volume of commerial product to apply per acre to get the proper amount of acid equivalent or active ingredient per acre. Example: If one-half pound of acid equivalent is required per acre and the commercial product contains 4 pounds acid equivalent per gallon, then 1 quart contains 1 pound acid equivalent; 1 pint contains one-half pound acid equivalent.

Similar calculations were used to make table 6.

To determine the amount of herbicide to put in the tank:

1. Divide the number of gallons the tank will hold by the number of gallons your sprayer applies per acre. This will give you the number of acres one filling will spray.

2. Multiply the number of acres the tank will spray by the amount of herbicide to be used per acre. This will give the amount of herbicide to be used per tank.

CALIBRATION OF A GRANULAR APPLICATOR

1. Determine the number of pounds of active ingredient or acid equivalent suggested per acre for your situation from this bulletin.

2. Divide the number of pounds of active ingredient or acid equivalent desired by the percentage of active ingredient or acid equivalent in the commercial material to determine the number of pounds of the material to apply per acre or determine from table 6.

3. Consult the manufacturer's recommendation to make approximate setting. Adjust setting on each hopper.

4. Select an area for a test run, preferably in the field to be treated, so that speed and traction conditions are constant. Measure off a distance of 660 feet (40 rods).

Table 6. Amounts of herbicide products of different concentrations to use per acre for various application rates

Concentration of herbicide formulation	Amount of formulation to use per acre broadcast to obtain an active ingredient or acid equivalent rate of				
	⅛ lb.	¼ lb.	½ lb.	¾ lb.	1 lb.**
Pounds of active ingredient or acid equivalent per gallon	pints	pints	pints	pints	pints
1	1.0	2.0	4.0	6.0	8.0
1½	.67	1.33	2.67	4.0	5.33
2	.50	1.0	2.0	3.0	4.0
3	.33	.67	1.33	2.0	2.67
4	.25	.50	1.0	1.50	2.0
5	.20	.40	.80	1.20	1.60
6	.16	.33	.67	1.0	1.33
7	.14	.29	.57	.86	1.14
8	.125	.25	.50	.75	1.0
9	.11	.22	.44	.67	.89
10	.10	.20	.40	.60	.80
Percentage of active ingredient or acid equivalent in dry formulation	lb.*	lb.	lb.	lb.	lb.
2	6.25	12.5	25.0	37.50	50.0
5	2.50	5.0	10.0	15.0	20.0
8	1.56	3.12	6.25	9.38	12.50
10	1.25	2.50	5.0	7.50	10.0
20	.62	1.25	2.5	3.75	5.0
25	.50	1.0	2.0	3.0	4.0
30	.42	.83	1.67	2.50	3.33
40	.31	.62	1.25	1.88	2.50
50	.25	.50	1.0	1.50	2.0
60	.208	.42	.83	1.25	1.67
65	.192	.38	.77	1.15	1.54
70	.178	.36	.72	1.07	1.43
75	.167	.33	.67	1.0	1.33
80	.156	.31	.62	.94	1.25
85	.147	.29	.59	.88	1.18
90	.139	.28	.56	.83	1.11

* To convert to ounces multiply by 16.
** For rates over 1 lb/A, multiply amount for 1 lb/A by the desired rate.

5. Fill hoppers and attach a suitable container (sack, pail, etc.), to each hopper spout to catch granules from each hopper.

6. Put machine in gear and drive the measured distance at the same speed that will be used when applying the chemical.

7. Weigh the material collected from each hopper. Multiply this weight in pounds by 66 and divide by the band width (in feet). This will give the pounds of granular material applied per acre on the area treated. In equation form:

$$\frac{\text{Weight of granules in pounds} \times 66}{\text{Band width in feet}} = \text{Pounds of granules applied per acre}$$

8. Readjust machine output and repeat the calibration process until the desired amount is obtained from each hopper.

Weights and Measures

1 **pound** = 16 ounces; 454 grams.

1 **gallon** = 4 quarts; 8 pints; 128 fluid ounces; 256 level tablespoonfuls; 3,785 cubic centimeters; (milliliters).

1 **tablespoonful** = 3 teaspoonfuls; one-half fluid ounce; 14.8 milliliters.

1 **acre** = 43,560 square feet; 160 square rods; an area 208.7 feet square; an area 16½ feet wide and one-half mile long.

1 **mile** = 5,280 feet; 1,760 yards; 320 rods.

1 **rod** = 5½ yards; 16½ feet.

Table 7. Herbicide names and formulations

Common name	Trade name[1]	Chemical name	Concentration and commercial formulation[2]
Amiben	Amiben, Vegiben	3-amino-2, 5-dichlorobenzoic acid	10% G, 2 lb/gal L
Amitrole	Amino-triazole, Amizol, Weedazol, Mixtures	3-amino-1,2,4-triazole	50, 90% WSP
Amitrole and Simazine	Amizine		15% amitrole WSP 45% simazine WP
Amitrole-T	Amitrol-T, Cytrol	3-amino-1,2,4-triazole plus ammonium thiocyanate	2 lb/gal L
AMS	Ammate	ammonium sulfamate	95% WSP
Atrazine	AAtrex, Atratol, Mixtures	2-chloro-4-ethylamino-6-isopropylamino-s-triazine	80% WP 8% P
Atrazine and prometryne	Primaze		40% atrazine, 40% prometryne WP
Atrazine and linuron	Several		30.8% linuron, 30.8% atrazine WP
Barban	Carbyne	4-chloro-2-butynyl m-chlorocarbanilate	1 lb/gal L
Benefin	Balan	N-butyl-N-ethyl-a,a,a-trifluro-2,6-dinitro-p-toluidine	1½ lb/gal L
Boron compounds (borax, sodium pentaborate, boron trioxide, anhydrous sodium, biborate, and mixtures.)	Several, Mixtures		Various
Bromacil	Hyvar-X, Hyvar-XWS. Mixtures	5-bromo-3-sec-butyl-6-methyluracil	80% WP 50% WSP Various
Bromoxynil	Buctril, Brominil	3,5-dibromo-4-hydroxybenzonitrile	2 lb/gal L
Bromoxynil and MCPA	Bronate, Brominal Plus		2 lb/gal bromoxynil, 2 lb/gal MCPA L

[1] "Several" means there are numerous trade names for this chemical. "Mixtures" means the chemical is mixed with other chemicals in commercial formulations.

[2] G—granular, L—liquid, WP—wettable powder, WSP—water-soluble powder, P—Pellets

Herbicide names and formulations

Common name	Trade name[1]	Chemical name	Concentration and commercial formulation[2]
Butylate	Sutan	ethyl di-isobutylthiolcarbamate	6 lb/gal L, 10% G
C-6989	Preforan	p-nitrophenyl 2-nitro-4-(trifluoromethyl) phenyl ether	3 lb/gal L
CDAA	Randox	2-chloro-N,N-diallylacetamide	4 lb/gal L 20% G
CDAA and TCBC	Randox-T	CDAA plus trichlorobenzylchloride	3.1 lb/gal CDAA, 6.3 lb/gal TCBC L 11.7% CDAA, 23.3% TCBC G
Chloroxuron	Tenoran	N-(4-chlorophenoxy)=phenyl-N,N-di=methylurea	50% WP
Chlorpropham (CIPC)	Chloro IPC, Mixtures	isopropyl N-(3-chlorophenyl)=carbamate	5, 20% G 4 lb/gal L
CP50144	Lasso	2-chloro-2′,6′-diethyl-N-(methoxymethyl) acetanilide	4 lb/gal L, 10% G
Dalapon	Dowpon, Radapon, Mixtures	2,2-dichloropropionic acid	74% WSP
Dalapon and TCA	Dowpon C		46.5% dalapon, 26.2% TCA WSP
DCPA	Dacthal	dimethyl 2,3,5,6-tetrachloroterephthalate	50, 75% WP
Diallate	Avadex	S-2,3-dichloroallyl N,N-diisopropyl=thiolcarbamate	4 lb/gal L, 10% G
Dicamba	Banvel, Mixtures	2-methoxy-3,6-dichlorobenzoic acid	4 lb/gal L
Dicamba and MCPA	Banvel-M		1.25 lb/gal dicamba, 2.50 lb/gal MCPA L
Dinoseb (DNBP)	Several, Mixtures	4,6-dinitro-o-sec-butylphenol	1, 3, 5 lb/gal L 10% G
Diuron	Karmex, Mixtures	3-(3,4-dichloro=phenyl)-1,1-dimethylurea	L, WP, G Varies
Endothall	Endothal, Herbicide 273	7-oxabicyclo-(2.2.1) heptane-2,3-dicarboxylic acid	1.46 lb/gal L 3 lb/gal L 5% G
EPTC	Eptam	ethyl N,N-dipropyl=thiocarbamate	6 lb/gal L, 10% G
EPTC and 2,4-D	Knoxweed		4 lb/gal EPTC, 1.6 lb/gal 2,4-D L 10% EPTC, 4% 2-4-D G
Erbon	Baron, Novege	2-(2,4,5-trichloro=phenoxy) ethyl-2,2-dichloro=propionate	1, 4 lb/gal L
Fenac	Fenac, Mixtures	2,3,6-trichloro=phenylacetic acid	1½ lb/gal L 10% G
Fenac and amitrole and atrazine	Fenatrol		.55 lb/gal fenac, .33 lb/gal amitrole, 1.0 lb/gal atrazine L

[1] "Several" means there are numerous trade names for this chemical. "Mixtures" means the chemical is mixed with other chemicals in commercial formulations.

[2] G—granular, L—liquid, WP—wettable powder, WSP—water-soluble powder, P—Pellets

Herbicide names and formulations

Common name	Trade name[1]	Chemical name	Concentration and commercial formulation[2]
Fenac and amiben	Fenaben		½ lb/gal fenac 1 lb/gal amiben L
Linuron	Lorox, Mixtures	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea	50% WP
Linuron and propachlor	Londax		15% linuron, 30% propachlor WP 5% linuron, 10% propachlor G
MCPA	Several, Mixtures	2-methyl-4-chlorophenoxy= acetic acid	Various L
Monuron	Telvar, Mixtures	3-(p-chloro= phenyl)-1,1-di= methylurea	G, L, WP Various
Neburon	Several, Mixtures	1-butyl-3-(3,4-dichlorophenyl) -1-methylurea	Various WP
Nitralin	Planavin	4-(methylsulfonyl) 2,6-dinitro-N,N-dipropylanaline	75% WP
Norea	Herban, Mixtures	3-(hexahydro-4, 7-methanoindan-5-yl)-1,1-dimethylurea	80% WP
Norea and atrazine	Herban 21A		53.33% norea and related, 26.67% atrazine WP
Naptalam (NPA)	Alanap	N-1-naphthyl= phthalamic acid	2 lb/gal L, 10% G
Naptalam and Chlorpropham, (NPA and CIPC)	Alanap Plus		2 lb/gal NPA 1⅓ lb/gal CIPC L 7.5% NPA 5% CIPC G
Paraquat	Paraquat	1,1'-dimethyl-4,4'-bipyridinium salts	2 lb/gal L
PBA	Several, Mixtures	polychlorobenzoic acid	Various L
PCP	Several, Mixtures	pentachloro= phenol	L, WP, WSP, G Various
Picloram	Borolin, Tordon Beads, Mixtures	4-amino-3,5,6-trichloropicolinic acid	2% G
Picloram and 2,4-D	Tordon 212		1 lb/gal picloram, 2 lb/gal 2,4-D L
Prometone	Pramitol	2-methoxy-4,6-bis(isopropylamino) -s-triazine	2 lb per gallon L 5% P
Prometryne	Caparol, Mixtures	2,4-bis (isopropylamino)-6-methylmercapto-s-triazine	80% WP
Propachlor	Ramrod	2-chloro-N-iso= propylacetanilide	65% WP 20% G
Propazine	Propazine, Milogard	2-chloro-4,6-bis(isopropylamino) -s-triazine	80% WP
Pyrazon	Pyramin	5-amino-4-chloro-2-phenyl-3(2H)-pyridazinone	80% WP

[1] "Several" means there are numerous trade names for this chemical. "Mixtures" means the chemical is mixed with other chemicals in commercial formulations.

[2] G—granular, L—liquid, WP—wettable powder, WSP—water-soluble powder, P—Pellets

Herbicide names and formulations

Common name	Trade name[1]	Chemical name	Concentration and commercial formulation[2]
Silvex	Several, Mixtures	2-(2,4,5-trichloro= phenoxy)propionic acid	L, G Various
Simazine	Princep, Mixtures	2-chloro-4,6-bis(ethylamino) -s-triazine	80% WP, 4% G
Sodium arsenite	Several, Mixtures		L, WP Various
Sodium chlorate	Several, Mixtures		WSP Various
TBA	Several, Mixtures	2,3,6-trichloro= benzoic acid	Various
TBP	Several, Mixtures	2,3,6-trichloro= benzyloxypropanol	Various
TCA	TCA, Mixtures	trichloroacetic acid	4.76 lb/gal L 84%, 80.2% WSP
Triallate	Far-go	S-2,3,3-trichloro= allyl N,N-diiso= proplythiocar= bamate	4 lb/gal L
Trifluralin	Treflan	a, a, a, -tri= fluoro-2,6- dinitro-N,N-di= propyl-p-toluidine	4 lb/gal L, 5% G
2,4-D	Several, Mixtures	2,4-dichlorophenoxy= acetic acid	L, G Various
2,4-DB	Butyrac, Butoxone	4-(2,4-dichlorophenoxy)= butyric acid	L Various
2,4,5-T	Several, Mixtures	2,4,5-trichloro= phenoxyacetic acid	L Various
Vernolate	Vernam	S-propyl dipropyl= thiocarbamate	6 lb/gal L 10% G

[1] "Several" means there are numerous trade names for this chemical. "Mixtures" means the chemical is mixed with other chemicals in commercial formulations.

[2] G—granular, L—liquid, WP—wettable powder, WSP—water-soluble powder, P—Pellets

[3] Trade names are listed only to aid the reader in identifying herbicides. No endorsement of named products is intended nor is criticism implied of similar products which are not mentioned.
A chemical name occupying two lines separated by an equal (=) sign is joined together without any separation if written on one line.

Table 8. Suggestions for chemical control of weeds in field crops. Application rates are on a broadcast basis and refer to acid equivalent or active ingredient rather than amount of commercial product. Avoid repeated and prolonged contact with all herbicides, especially direct contact with the skin and eyes. Check label restrictions for use of crops for food or forage.

Crop	Chemicals	Pounds per acre of active ingredient or acid equivalent broadcast	Time	Remarks	USDA registration limitations on crop use
Wheat or barley	2,4-D	¼ to ⅔	Fifth leaf to early boot	Amine less injurious to crop. Reduce rates one-third for ester.	Do not forage or graze for 2 weeks after treatment. Do not use treated straw for feed.
	MCPA	¼ to ⅔	Two leaf to early boot		None
	bromoxynil	⅜	Two leaf to early boot	Injures legumes	None
	bromoxynil and MCPA esters	¼ + ¼	Two leaf to early boot	Injures legumes	None

Crop	Chemicals	Pounds per acre of active ingredient or acid equivalent broadcast	Time	Remarks	USDA registration limitations on crop use
Wheat	dicamba and MCPA	⅛ + ¼	Two- to five-leaf stage	Kills legumes.	Do not graze or feed forage or threshings to livestock.
Oats	2,4-D amine	¼ to ½	Sixth leaf to early boot	MCPA less injurious to crop.	Do not forage or graze for 2 weeks after treatment. Do not use treated straw for feed.
	MCPA amine	¼ to ½	Two leaf to early boot		None
	dicamba and MCPA	⅛ + ¼	Two- to five-leaf stage	Kills legumes.	Do not graze or feed forage or threshings to livestock.
Flax	MCPA amine	¼	Flax 2 to 6 inches	Mixture of MCPA with TCA or dalapon for broad-leaved and grass weeds.	None
	TCA	5	Flax 2 to 6 inches	Grass weeds except wild oats.	None
	dalapon (Dowpon)	¾	Flax 2 to 6 inches	See section on wild oats.	None
Corn	atrazine (AAtrex)	1 to 4	Preplanting, Pre-emergance or early post-emergence	Atrazine may injure crops the following year.	None
	butylate (Sutan)	4	Preplanting incorporation	Grass weeds only	None
	propachlor (Ramrod)	4 to 5	Pre-emergence	Grass weeds only.	None
	atrazine and butylate	1 + 3	Preplanting incorporation		None
	atrazine and linuron	½ to 1½ of each	Pre-emergence	Do not use linuron on sandy soil.	None
	atrazine and propachlor	1 to 1½ + 2 to 3¾	Pre-emergence		None
	linuron and propachlor	1 to 1½ + 3	Pre-emergence	Do not use on sandy soils.	None
	2,4-D amine	¼ to ½	After two-leaf stage to layby	Broadleafs only Corn most susceptible during rapid growth.	None
	2,4-D ester	1/6 to ⅓		Use drop nozzles after corn is 8 inches tall.	None
	2,4-D amine	½ to 1	After layby	Spray base of stalks only.	None
	2,4-D ester	⅓ to ⅔	After layby		None
Alfalfa and clover in small grains	2,4-D or MCPA amine	¼	Not before clover is 2 inches tall	Sweetclover injured. Canopy of crop or weeds reduces injury.	Do not graze dairy animals on treated areas within 7 days after application of 2,4-D.
	2,4-DB	½ to 1½			Do not graze or cut hay from treated fields within 30 days after treatment.

Crop	Chemicals	Pounds per acre of active ingredient or acid equivalent broadcast	Time	Remarks	USDA registration limitations on crop use
Alfalfa, sweetclover, and birdsfoot trefoil in flax	dalapon (Dowpon)	¾		Will injure red and alsike clover.	None
	MCPA amine	¼	Not before clover is 2 inches tall	Sweetclover injured. Canopy of crop or weeds reduces injury.	None
Legume establishment without a companion crop	benefin (Balan)	1⅛ to 1½	Preplanting incorporation		None
	EPTC (Eptam)	3	Preplanting incorporation		None
	2,4-DB	½ to 1	Legumes 2 to 3 inches	Sweetclover injured.	Do not graze livestock or cut hay from treated fields within 30 days after treatment.
	dalapon (Dowpon)	1	Legumes 2 to 3 inches	Will injure red and alsike clover.	Do not feed first year's growth to dairy animals or animals being finished for slaughter.
Established legumes	2,4-DB amine 2,4-DB ester	½ to 2 ½ to 1	When annual weeds are 2 to 3 inches tall or perennials 6 to 8 inches tall	Do not use more than ¾ pound per acre of ester form on red clover.	Do not graze treated areas nor feed straw or hay from treated crops to livestock within 30 days after application.
Grain sorghum	Propachlor (Ramrod)	4	Pre-emergence	Grass weeds only.	Do not graze or feed forage to dairy cattle.
	norea (Herban)	2.4	Pre-emergence		None
	propazine	2	Pre-emergence		None
	atrazine	2	Early postemergence		Do not graze or feed forage from treated area within 60 days after application.
	2,4-D amine	½	4 to 12 inches	For broad-leaved weeds.	None
Soybeans	CDAA (Randox)	4 to 5	Pre-emergence	Grass weeds only.	None
	propachlor (Ramrod)	4 to 5	Pre-emergence	Grass weeds only.	Only for soybeans grown for seed. Do not graze treated area or feed forage to livestock. Do not use seed for food, feed or oil purposes.

Crop	Chemicals	Pounds per acre of active ingredient or acid equivalent broadcast	Time	Remarks	USDA registration limitations on crop use
Soybeans continued	amiben	3	Pre-emergence		Do not graze or feed forage from treated fields to livestock.
	linuron (Lorox)	½ to 2½	Pre-emergence		None
	trifluralin (Treflan)	½ to 1	Preplanting incorporation	Must be well incorporated.	None
	chloroxuron (Tenoran)	1 to 1½	Soybeans in first trifoliolate, weeds less than 2 inches	Controls certain broadleafs. See page 11.	Do not apply within 120 days of harvest. Do not graze treated fields.
	2,4-DB	1/5	Postemergence	For cocklebur control.	None
Sugar beets	TCA	6	Pre-emergence	For grass weeds except wild oats.	Do not use treated tops for food or feed.
	dalapon (Dowpon)	2 to 3	Beets up to 6-leaf stage	For grass weeds except wild oats.	None
		2½ to 3½	Directed, beets 7-leaf stage to 14 inches		
	diallate (Avadex)	1½ to 2	Preplanting incorporation	For wild oats.	Do not graze unharvested crop.
	barban (Carbyne)	⅝ to ¾	Wild oats in two-leaf stage	For wild oats.	Do not allow livestock to graze treated fields until after crop is harvested.
	endothall	¾ to 1½	Early postemergence	For wild buckwheat and annual smartweed.	None
	EPTC (Eptam)	2	Preplanting incorporation	For grass and some broad-leaved weeds.	None
Dry edible beans	EPTC (Eptam)	3	Preplanting incorporation		Do not graze or feed treated vines to livestock.
	trifluralin (Treflan)	¾ to 1	Preplanting incorporation		Do not graze or feed forage from treated fields.
Sunflowers	EPTC (Eptam)	3	Preplanting incorporation		None
	Trifluralin (Treflan)	½ to 1	Preplanting incorporation		None
Established grass pastures	2,4-D	½ to 2	Before bud stage, preferably when weeds are 2 to 6 inches tall and growing vigorously	Rate depends on kinds of weeds. Use low rates of MCPA if legumes are present.	Do not graze dairy animals on treated areas within 7 days after application.
	2,4,5-T	1 to 2			None
	MCPA	¼ to 2			None

Suggestions for chemical control of specific weeds on cropland. Follow label precautions carefully.

Weed	Chemicals	Pounds per acre of active ingredient or acid equivalent broadcast	Time	Remarks	USDA registration limitations on crop use
Canada and sow thistle	2,4-D amine	½	Just before bud	Can spray in tolerant crop.	See crop
	2,4-D ester	1	Fall rosette	Plow or clip in fall and spray when 6 inches.	See crop
	amitrole	4			
	amitrole-T	4	Just before bud or regrowth when 6 to 8 inches after clipping or plowing	A full stand before spraying is important.	Do not plant to crops other than corn or graze for 8 months after treatment.
	dicamba (Banvel)	⅛ to ¼		See crop recommendations.	Do not graze or feed forage or threshings of wheat or oats to livestock.
				Drift may affect sensitive crops.	Corn—Do not graze treated areas. Do not harvest for dairy animal feed prior to milk stage.
Field bindweed	2,4-D ester	1	Late fall	Re-treat second year.	See crop
	2,4-D amine	½	Bud to bloom		See crop
Leafy spurge	2,4-D ester	2 to 3	Bud	After grain harvest or on grass pastures. Retreat growth when 4 to 6 inches.	See crop
	2,4-D ester	½	Bud	Safest in wheat or barley. Cultivate after harvest until freezeup.	See crop
Quackgrass	TCA	22	Sept. or early Oct.	Best on plowed ground.	See crop
		18	Next fall after harvest	To kill escaped plants.	See crop
	dalapon (Dowpon)	12 to 15	Fall	Foliage application, plowed 1 or 2 weeks later.	See crop
	dalapon (Dowpon)	5	Spring	Foliage application, plowed 1 or 2 weeks later.	See crop
	atrazine	2 to 4	Spring or fall	Use low rate on sandy soils. Only corn can be grown the year after treatment.	See crop
Wild oats	barban (Carbyne)	¼ to ⅜	When wild oats is in two-leaf stage	Rate for wheat, barley, flax, soybeans.	Do not allow livestock to graze treated wheat, barley, sugar beet or soybean fields until after crop is harvested.
	barban (Carbyne)	⅝ to ¾		Rate for sugar beets.	Do not feed soybean forage or flax straw from treated fields.
	diallate (Avadex)	1½ to 2	Preplanting or pre-emergence	Rate for flax and sugar beets; must be incorporated into soil.	Do not graze unharvested crop.
	diallate (Avadex)	1¼	Pre-emergence	Rate for barley.	Do not graze livestock on treated areas.
	triallate (Far-go)	1 (wheat) 1¼ (barley)	Preplanting or pre-emergence	Must be incorporated into soil.	Do not graze livestock on treated areas.

Do not use this publication after December 31, 1969.