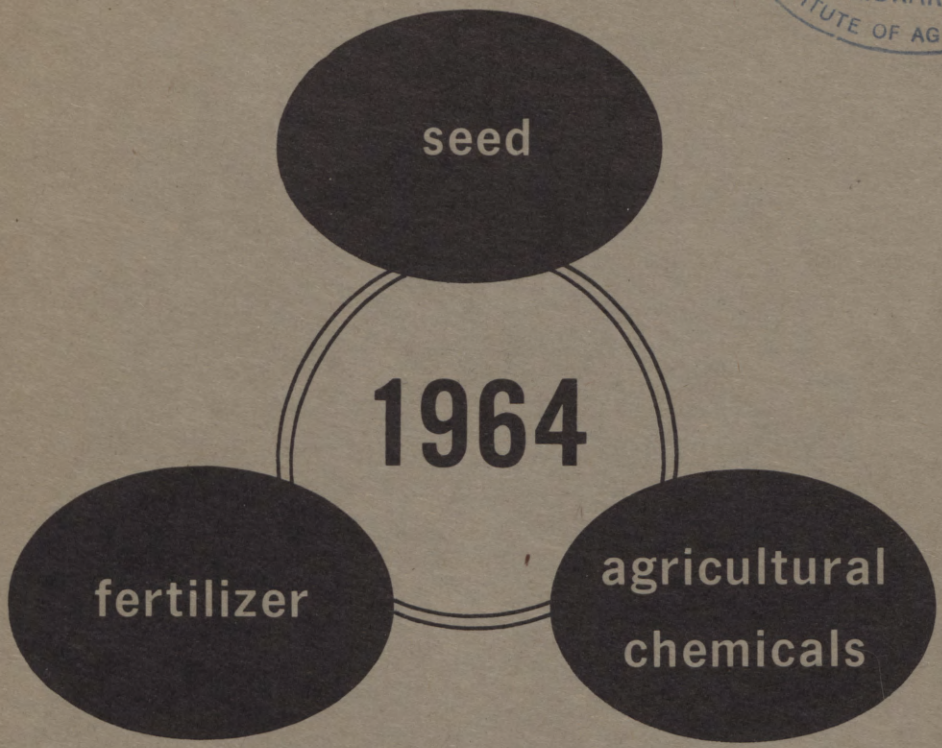
SPECIAL REPORT 12

MINNESOTA
Retail Dealers Conference



conducted by

Minnesota Extension Specialists

in

Soils, Agronomy, Plant Pathology,

Entomology, and Civil Defense

INDEX

CHEMICALS FOR WEED CONTROL IN 1964

Harley J. Otto, extension agronomist

More information on weed control in field crops can be found in University of Minnesota Extension Folder 212, Cultural and Chemical Weed Control in Field Crops.

The University of Minnesota Agricultural Experiment Station continues to evaluate promising new chemicals developed by chemical manufacturing companies. Each year new chemicals which are available and promising are compared with older ones to determine their relative effectiveness for controlling weeds in specific crops.

Time of Application

The time of application of chemicals can be grouped into these classes:

1. Preplowing -- chemical applied to soil and/or plant foliage before plowing.

2. Preplanting -- chemical applied to soil before crop is planted. Usually the chemical is incorporated into the soil by one or more tillage operations.

3. Preemergence or post planting -- chemical applied to the soil after crop is planted but before it comes up, usually at planting time.

4. Postemergence -- chemical applied to crop and weeds after they are up.

5. Postemergence directed spray -- chemical applied to base of crop plant and to weeds. Special devices are used to raise crop plant leaves to avoid contact with the chemical. This method is used only on corn at the present time. However, the corn plant is not highly resistant to chemicals used so care must be taken to avoid crop injury.

Research results indicate that early season weed competition can seriously reduce corn yields. Chemicals applied as postemergence directed sprays do not eliminate the early competition and thus may not increase crop yields as much as preemergence chemical application.

Many chemicals, developed in recent years, are used in preemergence applications. When chemicals are applied at this time, their effectiveness is quite dependent on soil type, rainfall after application, and other environmental factors. So they are often less reliable than chemicals applied after the crop and weeds have emerged. But preemergence applications do have certain advantages:

1. The chemical can be applied at planting, thus saving a trip over the field.

2. Early season competition can be reduced. Research indicates that early competition between crop and weeds may be more injurious to crop yields than later competition.

3. The first cultivation can often be delayed. This may allow more time for putting up high quality hay on farms with both row crops and hay.

4. The number of cultivations may be reduced.

5. Weeds in the row can be more nearly controlled than where cultivation is the only means of weed control.

Preemergence herbicides have often given better results on well prepared seedbeds than on poorly prepared seedbeds.

Granular versus Spray Form for Herbicides

Farmers have shown great interest in granular herbicides. The advantages and disadvantages of granular herbicides compared to the spray form are:

Advantages:

1. Granular herbicides are ready to use as they come from the package. They do not need to be mixed with water.

2. Operator does not have to haul water during application.

3. Application equipment is simpler to operate and maintain than spray equipment.

Disadvantages:

1. Cost per pound of active ingredient is somewhat more for granular than spray materials.

2. Use of granular materials is limited to soil applications since foliar applications of granules are not effective. Farmers using granular materials usually need both the granular applicator and sprayer.

3. Granular materials require more storage space per pound of active ingredient than spray materials because they usually contain a lower percentage of active ingredient.

4. Some granular applicators give poorer distribution of the herbicide than do sprayers.

Comparisons of granular and spray materials have been made in research and county demonstration trials during the past 4 years. CDAA (Randox) and CDAA-T (Randox-T) have given consistently better results in the granular than in the liquid form.

Granular applicators are more likely to apply materials uniformly on smooth seedbeds than on rough seedbeds. The applicator must be calibrated to be certain of the amount of chemical being applied. Devices are now on the market which aid accurate calibration.

Chemicals

Some of the herbicides being sold in Minnesota are listed below with comments about them. Rate of application refers to pounds of active ingredient per acre on a broadcast basis. The information given is not intended to replace label instructions; label instructions should be followed closely.

CDAA (Randox):

Use - annual grass control in corn, soybeans, and sorghum.

Rate of application - 4 to 5 pounds per acre.

Time of application - preemergence.

Remarks - very irritating to skin and eyes. Handle with extreme caution.

CDAA-T (Randox-T):

Use - control of annual grasses and broadleaved weeds in corn.

Rate of application - approximately 3.5 pounds CDAA + 7 pounds TCBC per acre ($4\frac{1}{2}$ quarts liquid or 30 pounds granular product per acre).

Time of application - preemergence.

Remarks - irritating to skin and eyes. Avoid use on soybeans. A few cases of soil residue carryover and damage to soybeans following corn have been reported.

Simazine:

Use - control of grasses and broadleaved weeds in corn.

Rate of application - 2 to 4 pounds per acre. Use heavier rate on finer textured soils or soils with high organic matter content.

Time of application - preemergence.

Remarks - residue in soil has damaged susceptible crops in rotation following corn. It has not given as good weed control results as atrazine in Minnesota.

Atrazine:

Use - weed control in corn and sorghum and quackgrass control. Experiments in Minnesota and Wisconsin have shown atrazine to be very effective in controlling quackgrass with a fall or early spring application followed by spring plowing. Corn can be planted following treatment.

Rate of application - (1) weed control in corn: 2 to 4 pounds per acre. Use higher rate on fine textured soils or soils with high organic matter content. (2) weed control in sorghum: 2 to 3 pounds per acre. (3) quackgrass control: 3 to 4 pounds per acre.

Time of application for weed control in corn and sorghum - (1) preemergence. (2) postemergence - chemical can be applied up to 3 weeks after planting. It should be applied before weeds are $1\frac{1}{2}$ inches tall.

Remarks - (1) susceptible crops have been injured in rotation following treated crop. (2) injury to susceptible crops following corn treated with atrazine can be minimized by using the lowest rate possible consistent with good weed control, using band applications rather than broadcast applications, and by thorough soil tillage before planting susceptible crops. (3) granular formulation is not available for use on corn in 1964. (4) do not graze or feed treated sorghum forage

Amiben:

Use - control of annual grasses and broadleaved weeds in soybeans.

Rate of application - 3 pounds per acre.

Time of application - preemergence.

Remarks - early stunting of soybeans has been observed under some conditions. But crop usually outgrows injury.

Linuron (Lorox):

Use - weed control in corn and soybeans.

Rate of application - (1)corn: 2 to $2\frac{1}{2}$ pounds per acre preemergence; $1\frac{1}{2}$ pounds per acre with wetting agent in postemergence directed spray applications. (2) soybeans: 2 pounds per acre.

Time of application - (1) corn: preemergence or directed spray postemergence when corn is at least 12 to 18 inches tall and weeds are 8 inches or less in height. (2) soybeans: preemergence.

Remarks - (1) use of this chemical in postemergence directed spray applications does not eliminate early season competition between weeds and corn. This early competition can cause yield reductions. (2) this has caused some injury (stand reduction and stunting) to corn and soybeans in some Minnesota trials. (3) on corn do not apply within 60 days of harvest. On soybeans do not feed treated forage to livestock.

Barban (Carbyne):

Use - control of wild oats in small grains, flax, and sugar beets.

Rate of application - 4 to 6 ounces on small grains and flax; 12 to 16 ounces on sugar beets.

Time of application - postemergence, when the majority of the wild oats are in two-leaf stage (from the time the second leaf first appears until the third leaf first appears) but not later than 14 days after emergence of the wild oats. Time of application is quite critical.

Remarks - (1) this was widely tested under farm conditions in Minnesota and North Dakota. (2) results were encouraging but in many cases wild oats were not adequately controlled. (3) flax and small grain injury has been observed in research plots. Injury on flax has been more severe than on small grains.

DATC (Avadex):

Use - control of wild oats in barley, flax, and sugar beets.

Rate of application - $1\frac{1}{4}$ pounds per acre on barley; $1\frac{1}{2}$ to 2 pounds per acre on flax and sugar beets.

Time of application - preplanting on flax or sugar beets; postseeding (preemergence) on barley.

Remarks - (1) chemical is quite volatile and must be incorporated soon after application. Incorporation in preplanting applications can be done with disk, cultivator, or harrow to a depth of 2 inches. In postseeding applications, chemical should be incorporated with two harrowings at right angles. (2) this chemical is more promising than Carbyne for use on flax. (3) small grain injury has been observed, particularly with preplanting applications. (4) do not apply to field in ridged condition. (5) this causes irritation of skin and eyes; caution must be used when handling this chemical.

DATC-BW (Far-go) - formerly Avadex-BW:

Use - control of wild oats in spring and durum wheat and barley.

Rate of application - 1 pound per acre on wheat; $1\frac{1}{4}$ pounds per acre on barley.

Time of application - postseeding (preemergence) for wheat; preplanting or postseeding for barley (postseeding is preferred).

Remarks - (1) this must be incorporated by two harrowings at right angles for postseeding applications. Preplanting applications should be incorporated as described previously for Avadex. (2) in postseeding applications, seed crop to a depth of 2 to 3 inches. (3) do not apply to a field left in a ridged condition. (4) do not plant domestic oats where Far-go was used the previous year. (5) this causes irritation to skin and eyes; caution must be used when handling this chemical.

2, 4-D and MCPA:

Use - broadleaved weed control in corn, small grains, pastures, etc.

Time of application - postemergence. The use of 2, 4-D in a preemergence application on corn is not recommended because of erratic results and injury to corn.

Rate of application - see University of Minnesota Extension Folder 212.

4-(2-4, DB):

Use - control of certain broadleaved weeds in alfalfa, red clover, birdsfoot trefoil, alsike clover, and ladino clover. It may be applied to small grains underseeded with these legumes.

Rate of application (amine formulation) - $\frac{1}{2}$ to $1\frac{1}{2}$ pounds, depending on susceptibility of weeds to be killed. Follow label instructions.

Time of application - postemergence when weeds are actively growing and annual weeds are less than 3 inches high, when seedling legumes are 2 to 3 inches tall and, if in small grain, when crop is 6 to 8 inches tall.

Remarks - (1) this is not as effective as MCPA or 2, 4-D on some weeds, particularly mustard. (2) do not pasture or harvest crop for feed within 30 days after application.

Dalapon:

Use - grass control in flax, sugar beets, and corn.

Rate of application - (1) flax: 3/4 pound per acre. (2) sugar beets: 3 to 4 pounds per acre. (3) corn: 1.5 pounds per acre.

Time of application - (1) flax and sugar beets: when grasses are not more than 2 inches tall. (2) corn: when corn is 8 to 20 inches tall.

Remarks - Use of this chemical in corn requires special leaf-lifting devices to keep spray off corn leaves. Unless applications are carefully made, corn can be severely damaged. Dalapon may be mixed with 2, 4-D to control both grasses and broadleaved weeds. Do not use this chemical on corn grown for seed.

As with other postemergence applications, this method of weed control does not eliminate the early season competition between corn and weeds. Research work indicates this competition may be fairly serious in limiting corn yields.

Trifluralin (Treflan):

Use - weed control in soybeans grown for seed.

Rate of application - 1 to 2 pounds per acre depending on soil type. Use lower rates on light-textured soils and higher rates on heavier-textured soils.

Time of application - preemergence.

Remarks - (1) chemical must be incorporated into the soil immediately after application. (2) this has caused serious soybean stand reduction in some cases.

1964 CROP VARIETY RECOMMENDATIONS

Harley J. Otto, extension agronomist

Complete information on "recommended," "not adequately tested," and "other" varieties can be found in Miscellaneous Report 24, Varietal Trials of Farm Crops.

For 1964 Dodge oats, Mingren sunflowers, Crim wheat, and Summit flax have been added to the recommended list. Arny and Marine 62 flax have been removed.

Dodge oats was developed at the Wisconsin Agricultural Experiment Station and released in 1961. It is medium early in maturity, has good lodging resistance, and produces yellow kernels with good test weight. Except for Portage, Dodge has the highest degree of resistance to leaf rust of any recommended variety. In addition, it is resistant to the prevalent races of stem rust and smut. Its yield is as good as other recommended varieties of comparable maturity. Ample quantities of certified seed are available.

The sunflower variety Mingren was released by the University of Minnesota Agricultural Experiment Station in spring 1963. It is a large seeded variety which was selected from the variety Mennonite. Mingren has produced slightly lower yields than Arrowhead, the other recommended variety. It is slightly taller and later than Arrowhead and does not stand as well. In University tests conducted over a 6-year period, about 30 to 35 percent of the Mingren seeds were large compared with 12 to 14 percent for Mennonite and 1 percent for Arrowhead. So Mingren is recommended for situations where a good market for large sunflower seeds is available.

Crim wheat, a bearded, hard red spring wheat, was released by the Minnesota Agricultural Experiment Station in spring 1963. It was named for the late professor Ralph F. Crim, longtime extension agronomist from Minnesota. Crim has good stem rust resistance, derived from a different source than other spring wheat varieties. So, this variety should help minimize the risk of devastating stem rust attacks. It is a high yielding variety with moderate resistance to lodging and moderate susceptibility to leaf rust and loose smut. It is of acceptable quality for milling and baking. About 900 bushels of foundation seed were distributed in 1963 and a fair supply of registered seed should be available for 1964 planting. Certified seed is expected to be available for 1965 planting.

Summit flax was developed and released by the South Dakota Agricultural Experiment Station. The variety is early in maturity; has high seed yield potential -- particularly when sown early; is medium in height; and has fair lodging resistance. Its pasmo tolerance is better than Windom and Redwood but poorer than Arny and Marine. Although low in oil content, its oil quality is fair. Summit has excellent wilt resistance and is immune to all known North American races of rust, including Race 300.

Foundation seed of this variety will be distributed in 1964.

New Race of Flax Rust

A new race of flax rust, Number 300, has been discovered in flax fields in Canada and North Dakota. The varieties Arny, Marine, Marine 62, Cree, Raja, and Sheyenne are susceptible. Since flax rust can overwinter and reproduce on flax straw, it is feared that if these susceptible varieties are planted on large acreages the rust will increase and possibly new races develop. If this happens, races may develop which will attack other varieties now immune to the disease. There would then be no source of resistance to this devastating disease in adapted varieties. It is, therefore, highly recommended that susceptible varieties not be planted in 1964. Arny and Marine 62 have been removed from the recommended list because of their susceptibility. The varieties Bolley, B5128, Redwood, Summit, and Windom are immune to rust and can safely be planted.

Removal of Arny and Marine 62 from the recommended list eliminates the varieties with best pasmo resistance. However, plant pathologists consider rust to be much more serious than pasmo as a potential flax production hazard.

Certified Seed Assures Varietal Purity and Seed Quality

Recommended varieties have demonstrated superior performance compared to other varieties tested. If a farmer is to obtain the benefits of these varieties, he must plant seed of known varietal purity. This assurance is best obtained by planting certified seed.

Certified seed is no more than three generations removed from foundation seed maintained by the University of Minnesota and known to be pure for variety. Production and processing of certified seed are supervised by the Minnesota Crop Improvement Association through field and laboratory inspections.

In addition to varietal purity, certified seed must meet high standards for freedom from weeds, other crop seeds, and inert material. It also must be high in germination. Within certified seed a tolerance for these factors is allowed. For example, the minimum germination allowed in small grains is 85 percent. Individual lots may have considerably higher germination. Thus some certified seed is better than others. So study the analysis tag for this information.

Seed cost represents only a small fraction of the total cost of producing an acre of a given crop. A crop producer cannot afford to take a chance on planting poor seed. It is wise policy to plant certified seed purchased from a reliable seedsman.

Varieties Recommended For Planting In 1964

Barley:	Larker, Kindred (L), Parkland, Traill, Trophy	
Oats:	Early:	Minhafer, Andrew
	Medium early:	Burnett, Dodge, Goodfield
	Medium late:	Ajax, Portage, Garry
	Late:	Rodney
Rye:	Adams, Caribou, Elk	

Wheat:	Hard red spring: Crim, Justin, Pembina, Selkirk Durum: Lakota, Langdon, Wells Hard red winter: Minter
Flax:	B5128, Bolley, Redwood, Summit, Windom
Soybeans:	Acme, Chippewa, Comet, Flambeau, Grant, Harosoy, Lindarin, Merit, Norchief, Ottawa Mandarin
Sunflowers:	Arrowhead, Mingren
Field Peas:	Chancellor, Strål
Millet:	Proso: Turghai Foxtail: Empire, White Wonder
Alfalfa:	Ranger, Vernal
Birdsfoot Trefoil:	Empire
Red Clover:	Dollard, Lakeland
Sweet Clover:	Evergreen, Goldtop, Madrid
Kentucky Bluegrass:	Park
Bromegrass:	Achenbach, Fischer, Lincoln
Sudangrass:	Piper
Timothy:	Climax, Itasca, Lorain

1963 VARIETY SURVEYS

Harley J. Otto, extension agronomist

The Minnesota Crop and Livestock Reporting Service conducted variety surveys on oats and barley during the 1963 growing season. Here are the results:

Oats

The four most popular oats varieties in the state were Rodney, Garry, Burnett, and Minhafer. These four varieties accounted for 79 percent of the oats seeded. (A similar survey was conducted in 1960.)

Minnesota Crop and Livestock Reporting Service
Oat Variety Surveys, 1960 and 1963

Variety	Percent of farms reporting		Percent of total oat acreage seeded	
	1960	1963	1960	1963
Rodney	48	52	47	54
Garry	16	15	12	11
Burnett	7	11	4	8
Minhafer	23	11	14	6
Ajax	8	5	5	3
Andrew	4	2	2	1
Goodfield	*	9	*	4
Portage	*	5	*	3
Nodaway	+	5	+	2
Dodge	+	2	+	1
Minton	7	*	3	*
Branch	4	*	3	*
Sauk	2	*	1	*
Cherokee	2	*	1	*
Others	14	14	8	8
Total acres seeded			3,952,000	3,453,000

* Less than 1 percent. + Not introduced by 1960.

Percent of Total Acreage Seeded to the 10 Most
Popular Varieties in Minnesota by Crop Reporting Districts, 1963

District	Seeded oat acreage	Percent of total acreage seeded to each variety										
		Rodney	Garry	Burnett	Minhafer	Goodfield	Portage	Ajax	Nodaway	Andrew	Dodge	Others*
	thousands											
Northwest, north central, and northeast	842	82	9	2	2	+	+	1	2	+	--	2
West central	822	56	14	7	4	4	6	2	1	1	+	5
Central	597	41	19	10	4	3	2	8	2	2	1	8
East central	133	65	7	2	2	4	3	12	1	1	1	2
Southwest	391	34	7	19	15	5	5	1	2	2	--	10
South central	303	24	12	15	15	8	2	2	2	2	2	16
Southeast	365	17	10	11	15	12	3	1	2	--	3	26
State total	453	54	11	8	6	4	3	3	2	1	+	8

* Other varieties include Beaver, Beedee, Bonda, Bonham, Bonkee, Branch, Cherokee, Clintland 60, Clinton, Garland, Gopher, Marion, Mindo, Minton, Missouri-0-205, Nehawka, Nemaha, Newton, Ransom, Russell, Sauk, Simcoe, Tonka, Vanguard, and unknown varieties.

\+ Less than 1 percent.

Barley

Trophy, Traill, and Kindred were the most popular varieties of barley in 1963. These three varieties accounted for 85 percent of the state's acreage.

Percent of Total Acreage Seeded to the Five Most Important Varieties in Minnesota, by Crop Reporting Districts, 1963

District	Seeded barley acreage thousands	Percent of total acreage seeded to each variety					
		Trophy	Traill	Kindred	Park-land	Larker	Other*
Northwest	500	34	26	22	11	5	2
West central	200	24	43	23	1	8	1
All other	55	7	62	11	--	11	9
State total	755	32	31	22	9	5	1

* Other varieties reported were UM570, Moore, Tregal, Yukon, and unknown varieties.

Percent of the Total Minnesota Acreage Seeded to Several Varieties in 1956, 1958, 1959, 1960, 1962, and 1963

Variety	1956	1958	1959	1960	1962	1963
Trophy*	--	--	--	--	1	32
Traill+	#	30	48	30	57	31
Kindred	97	47	31	36	31	22
Parkland	--	4	4	4	9	9
Larker*	--	--	--	--	#	5
Forrest	--	16	17	8	--	#
Other and unknown	2	3	#	2	2	1

* First seed distributed in 1962.
\+ First seed distributed in 1956.
\# Less than 1 percent.

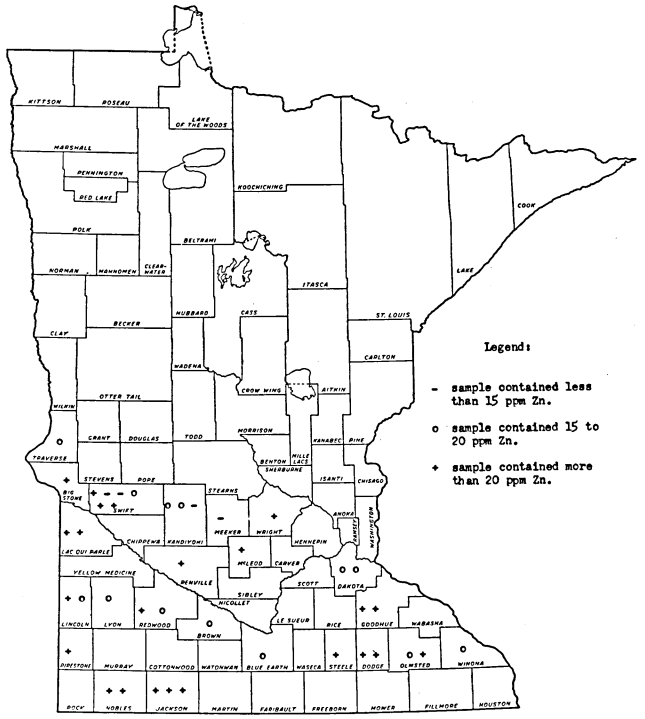


Figure 1. Areas sampled including the approximate "index leaf" Zn content of corn leaves of the 1962 Minnesota Zn survey.

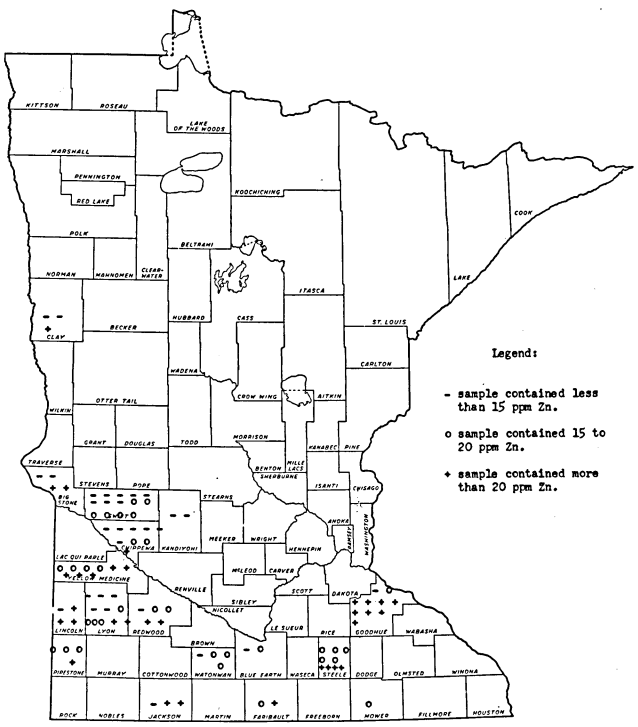


Figure 2. Areas sampled including the approximate "index leaf" Zn content of corn leaves of the 1963 Minnesota Zn survey.

REPORT OF ZINC SURVEY IN CORN - 1962 AND 1963

Lowell D. Hanson, extension soils specialist

A recent masters thesis by D. Bezdicek, University of Minnesota soil science department, includes results of a 2-year survey of the zinc (Zn) content in corn in southern Minnesota. This survey was the first systematic evaluation of Zn plant levels in the corn-growing area.

Figures 1 and 2 show the counties where leaf samples were collected and the relative level of zinc in the tissue. Data in figure 3 show that levels below 15 to 17 parts per million (ppm) of Zn in corn usually result in deficiency symptoms and reduced yields.

A number of soils in Minnesota are approaching the critical available level of Zn. During the past 4 years almost all problem fields occurred in the west-central part of the state. But recently, deficient fields were located as far north as Clay County and as far south as Faribault County.

Additional information on results of Zn field treatments and analytical methods are being evaluated by Bezdicek and J. M. MacGregor. This will be published in the near future.

At the present time recommendations are for a 5 to 10 pounds per acre rate of Zn plowed down for corn. This is meant for deficient areas, not on a farm or whole field basis. Zinc sulfate ($ZnSO_4$) is a commonly used carrier. It is 40 percent Zn so 15 to 25 pounds of $ZnSO_4$ per acre provide 5 to 10 pounds Zn.

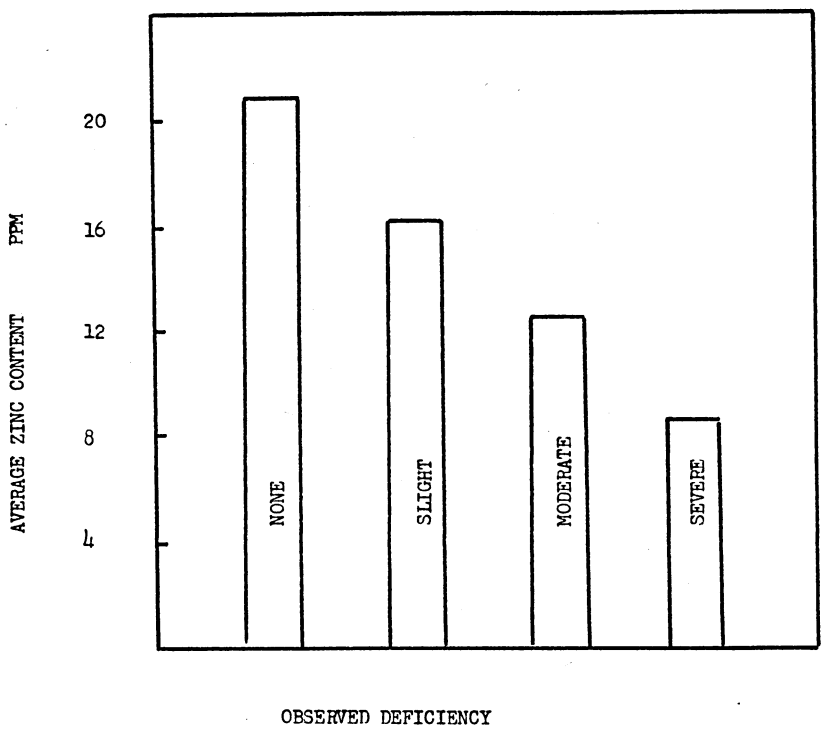


Figure 3. Average Zn content of the "index leaf" of the 1963 state survey in relation to the Zn deficiency observed during sampling.

The average Zn content of "index leaf" samples taken from corn growing on various soil series of great soil groups included in 1963 Minnesota zinc survey.

Great soil group and series	Average "index leaf" Zn content (ppm)	Number of fields sampled
Gray-Brown Podzolic	20.9	3
Hayden	19.3	1
Seaton	21.1	1
Fayette	22.4	1
Gray-Brown Podzolic-Brunizem	26.9	7
Lester	16.6	2
Downs	21.2	1
Racine	29.6	2
Kasson	33.6	1
Mt Carroll	33.9	1
Brunizem	21.9	6
Waukegan	12.8	1
Kingston	12.3	1
Kenyon	18.1	1
Nicollet	20.3	1
Port Byron	31.8	1
Ostrander	36.0	1
Humic Gley	20.6	15
Parnell	9.6	1
Harpster	15.2	1
Lura	15.4	1
Marna	16.5	1
Webster	16.9	2
Flom	18.0	3
Hatfield	19.5	2
Floyd	20.7	1
Glencoe	22.8	1
Lamoure	33.8	1
Blue Earth	37.9	1
Chernozem	17.5	11
Kranzburg	13.6	1
Barnes	15.6	4
Brookings	16.6	1
Aastad	17.9	4
Estelline	24.0	1
Calcium Carbonate Solonchak	15.0	31
Ulen	10.7	1
Borup	11.8	1
Colvin	14.3	14
Bearden	14.8	4
Vallers	18.3	9
Hamerly	20.3	2

EFFECT OF THE SEASON'S WEATHER VARIATION ON FERTILIZER RESPONSE

Curtis J. Overdahl, extension soils specialist

Fertilizer recommendations are based on averages from several years. For adverse years they might be slightly high; for ideal years they may be too low.

We have usually explained the yearly differences in fertilizer response by rainfall amount and distribution. For example, the effect of drought and hot weather at critical stages of plant growth has received considerable attention. But less has been said about the effect of soil temperature.

This article primarily concerns the effect of soil temperature during the early season's growth. Items considered are: (1) effect of soil temperature on activities of soil micro-organisms and subsequent release of nitrogen (N) and phosphorus (P) from organic matter, (2) effect of soil temperature on absorption of P and potassium (K), and (3) practical implications.

Nutrient Release From Organic Matter

Several factors, other than temperature, affect the activity of soil organisms and the rate at which they release nutrients. These are quantity of organic matter, soil pH, and relationship of air to water in the pore space.

Fine textured or so-called "heavy" soils hold more water and less air than sandy soils. These soils warm up more slowly in the spring because a great amount of heat is needed to melt ice and raise water temperature. Consequently, there is slower activity of soil organisms -- they release less P and N.

During moderately wet, cool springs, large increases from fertilizers have been measured even when soils were very high in organic matter. Where drought occurs, soil organism activity is also slow. But chances of big fertilizer responses are nullified because plants lack water for rapid growth.

Effect on Nutrient Absorption

Extensive studies have been made on P and K absorption under varying soil temperatures. These were primarily carried out in growth chambers where all factors were carefully controlled. Nielson and colleagues of the Canada Department of Agriculture, Ottawa, report that both yield and uptake of several nutrients were increased by increased soil temperature up to at least 67° F. Absorption of P at 54° F. was 42 percent less than at 80° F., even when P was added. The authors suggest that the temperature variation may reflect changes in P in the soil or merely a difference in the absorption behavior of plants.

The U. S. Department of Agriculture reports that very small differences in temperature can affect nutrient absorption. Frequently, purple corn plants have been observed in growth chambers where soil temperatures were held to a low level.

J. Weber of Minnesota found that K fertilization on a Floyd soil resulted in increased crop yields in cool, wet years and not in warm, moderately dry years. In growth chamber studies with the same soil he found little differences in yield related to moisture treatment. But he was able to ascribe temperature as the main contributing factor that reduced K absorption. Plant yields of sorghum on the untreated Floyd soil were increased nearly five times by increasing temperature from 60 to 90° F.; those on K-treated soils were only increased one and one-half times.

These data indicate that the temperature influence is greatly reduced when adequate amounts of K are added. Weber points out that it is not clear whether low temperatures cause K to be limiting in the soil solution or whether root growth is depressed. The good growth of sorghum with added K at the low temperature indicates that plants with adequate K levels will produce satisfactory growth even when soils are abnormally cold.

The following data show the effect of soil temperature, with and without added K, on the K content of sorghum harvested 20 days after emergence on Milaca and Floyd soils:

Temperature	K treatment per acre	Milaca sandy loam	Floyd silty clay loam
		percent of K in plants	
60° F.	no K	0.4	0.4
90° F.	no K	0.5	1.0
60° F.	498 pounds K	1.9	2.1
90° F.	498 pounds K	2.5	2.6

Increased soil temperature, on the zero K treatments, had little effect on K content of plants on the Milaca sandy loam. This indicates that plants obtained similar amounts of K at both 60° and 90° F. when no K was added. Apparently temperature is not an important factor in K uptake on coarse textured soils.

Small grains tolerate considerably cooler soil temperatures, perhaps 15° F., than corn. The ideal soil temperature at a 4-inch depth for corn is about 75° F. Just how serious soil temperature is for corn is described in the Agronomy Journal, Vol. 49, No. 6, 1957 by W. O. Willis, W. E. Larson, and D. Kirkham. In this Iowa study daily growth differences were measured where soil temperatures were regulated in the field by special heating devices. For example, 12 days following planting the extended leaf heights were as follows:

Temperature at 4-inch depth	Extended leaf height
60° F.	3.5 inches
69° F.	7.8 inches
76° F.	9.6 inches

Practical Implications

It is difficult to control soil temperature. And it is also nearly impossible to predict what will be the coming year's weather. Nevertheless, if you know what factors control plant growth and fertilizer response, you can understand why expected profits from fertilizer use are not always realized.

There are practices that farmers can use to improve soil conditions:

1. Reduce tillage operations to keep soil loose. Use chemical weed control as much as is practical.

2. Improve the soil's physical conditions through incorporation of crop residues. This is a long-range improvement. Considerable trash, particularly on the surface, may serve as mulch; this tends to slow the soil-warming process. Large amounts of residue may be a temporary disadvantage. Therefore, plow under residues as early as possible and incorporate nitrogen -- both methods should hasten decomposition of organic matter.

3. Use starter fertilizer for as many crops as possible. Starter serves its best purpose when soils are cold in the spring. This is particularly true on fine textured soils. Supplemental N and K also contribute greatly to plant growth on these soils. When the soil is in good tilth, moisture is adequate -- but not in excess, and weeds are under nearly complete control, use only moderate rates of N sidedressing.

4. Improve drainage as much as possible.

NORTH-CENTRAL AND NORTHEASTERN MINNESOTA FERTILITY NEEDS -- LIME, BORON, POTASSIUM, AND SULFUR

Curtis J. Overdahl, extension soils specialist

Description of Soils

The soil area discussed here lies north of the Twin Cities and of Highway 52 and as far west as Stearns County. These soils are medium to coarse textured, quite acid, low in nitrogen (N) and potassium (K), and relatively high in phosphorus (P).

Acidity and low fertility are the chief problems. Such physical factors as fragipans (hard pans), low organic matter, and poor drainage are also problems. Extended periods of dry weather on sandy textured soils usually slow acceptance of high fertilizer use.

Lime

Demonstration plots and field observations indicate that the lime need is perhaps the main limiting factor in alfalfa production in this area.

Thin stands were observed on many fields with pH values of 6 to 6.2. Frequently these fields were recently limed with 2 tons per acre. Most indications were that lime rates were not high enough. Where pH values were about 6.5 and other fertilizer needs were met, alfalfa production was good even when drought was serious.

In 1938 pH measurements were made on plots on a loamy sand in Anoka County where lime had been applied 17 years earlier. The plots with 8 tons per acre, the highest rate, still had a pH of 6.8; pH's of other treatments were lower than 6. Such long-term benefits make lime rather inexpensive. Since lime helps prevent winterkill, wherever seeding establishment is saved

approximately $6 worth of seed and $6 tillage costs are also saved. And don't forget the value of the hay lost during the reseeding period. For these reasons lime recommendations in this area have been increased.

Potassium

Wherever lime is adequate, K deficiencies are common on alfalfa. Alfalfa fields having had high rates of K, either through manure or other fertilizer, have excellent growth. Soil tests on such fields usually are uncommonly high.

K recommendations for a low soil test on these sandy textured soils have recently been increased to 240 pounds per acre of K_2O.

Boron

Low organic matter and dry soil contribute to boron (B) deficiencies. Alfalfa on sandy textured soils in this area usually shows widespread B deficiencies. This has been most frequent in July. Deficiencies are most readily observed on plants approaching the cutting stage rather than on new regrowth. The deficiency cannot be easily seen on fields where perhaps only 10 percent of the plants show symptoms because deficient plants are shorter and are covered by healthier ones.

Since the cost for correcting deficiencies is only about $1 per acre, B should be included in all fertilizer mixtures being used for alfalfa applications. Applications should be made at least on alternate years in this area. Borated fertilizer should not be applied with the fertilizer attachment on the drill when seeding small grains.

Sulfur

Sulfur (S) can be applied as gypsum or any S-containing material. Recommendations are to apply about 50 pounds of elemental sulfur (approximately 300 pounds of gypsum) per acre every 3 years on land where alfalfa will be the main crop. This recommendation is for S-deficient counties as described in the Agricultural Stabilization Conservation Service handbook for Minnesota.

Extensive research is underway in north-central Minnesota to study S rates, forms, rate of leaching, and effect on yield of alfalfa, corn, soybeans, and other crops.

Summary

The best method of legume fertilization probably is to apply a 0:1:3 or 1:3:9 mixture including B to adequately supply K and B. On low K tests bring the K levels up to adequate with 0-0-60. Lime should be used liberally until the pH is at or above 6.5. N rates for corn need not be high when following a legume crop. Otherwise N can be used quite liberally in areas where rainfall is not a chief limiting factor.

CROP DISEASES IN MINNESOTA IN 1963

Herbert G. Johnson, extension plant pathologist

Severity of plant diseases varies considerably from year to year. Many diseases are found every year, but they cause relatively little damage. Each year, however, some conditions cause certain diseases to occur in severe proportions.

Control measures must be geared to:

1. Potential loss from the disease.
2. Frequency of occurrence.
3. Cost of control and value of crop.
4. Timing -- when the disease is most easily controlled.
5. Forecasts and warnings.

Certain control measures are generally advisable:

1. Select disease-resistant varieties.
2. Obtain healthy seed and planting stock.
3. Treat seeds.
4. Follow crop rotation.
5. Plant and harvest at the proper time.
6. Have good cultural conditions.

The following plant diseases are important in Minnesota. Some cause serious crop damage and yield losses; some affect crops grown on a limited scale; some are important because good control measures are available even though losses caused are not always severe; others are spectacular and many people request information on them.

Corn stalk rot and lodging -- This is the most costly disease of our most valuable agricultural crop. In south-central Minnesota in 1963 stalk rot was present in about average amounts. However, lodging was not severe because of lack of high winds. The crop was harvested before storms occurred. See Plant Pathology Fact Sheet 3, Stalk Rot and Lodging of Corn, for additional information.

Northern corn leaf blight -- This disease was of little significance in 1963 after 3 years of relatively heavy infection. Trace to light amounts were easily found in southern Minnesota during the last half of the growing season, but heavy infections were not observed. This disease can be expected to occur in the southern one-fourth of Minnesota at irregular intervals. The use of disease-resistant hybrids is the only practical control known at present. The infrequent occurrence of leaf blight indicates that other desirable characteristics of corn hybrids should not be sacrificed for a high degree of leaf blight resistance.

Corn stunt -- This virus disease of corn has been present in California and Texas. In 1963 corn plants in southern Indiana and Ohio may have been diseased by this virus, but definite verification has not yet been received. Disease symptoms are: stunting, bushy plant growth caused by shoot growth from node buds, yellowish-green streaking of leaves, and formation of several small and poorly developed ears.

This disease can be confused with other troubles such as crazy top disease and nutrient deficiencies. The virus is transmitted by at least two species of leafhoppers. There is no reason to believe that the disease now exists in Minnesota and we do not know if it will get here. Everyone should watch for symptoms of this disease but avoid scare stories.

Loose smut of barley -- Incidence of this disease in 1963 averaged about 1 to 2 percent. This is down from a high of 6.5 percent in 1959. Much of this reduction is probably due to the elimination of heavily infected seed lots by use of the "embryo test." This test shows the percentage of barley seed embryos infected with the loose smut fungus. Procedure for obtaining tests on barley seed samples is:

1. Obtain a random and representative sample of the seed lot.
2. Send about 1 pint of the seed to:

   Division of Plant Industry
   670 State Office Building
   St. Paul, Minnesota 55101

3. Enclose $5 for each sample. Make check out to Minnesota State Treasurer.
4. Be sure that return address and sample identification are plainly marked on the package or enclosed.
5. Mark the package "Smut Test."

Test barley seed for loose smut before it is cleaned and graded to save expense in case the percentage of loose smut is too high to warrent use of the grain for seed. By all means do not apply seed treatment chemicals before testing since this would make the grain unfit for feed or industrial uses. Chemical seed treatment does not control loose smut of barley or wheat. Planting of barley seed with a low percentage of, or free from, infected embryos is the best control method. Plant Pathology Fact Sheet 6, Barley Smuts, gives additional information.

Scab of barley, wheat, and oats -- Scab is a fungus disease which infects the heads of cereal grains. Species of the genus Fusarium are always involved in this disease. In addition to causing discoloration and shriveling of grain kernels, the disease causes the formation of chemicals that are toxic to livestock. Hogs are especially sensitive to the toxic chemical. Yield was severely reduced in some fields of wheat and durum in 1962.

Frost injury to oats -- About a week after the freeze of May 20, 1963, light colored plants were seen in oat fields in west-central Minnesota. Distribution of affected plants was irregular. The most luxuriantly growing plants, which were often in seed fields, were most severely affected. All oat varieties were affected but not barley and wheat. The problem was not the minor damage caused but the uncertainty as to cause. Many farmers were ready to plow up the oat crops and plant soybeans if the trouble had been due to an infectious disease-causing agent.

Oat rusts -- Races of both crown rust and black stem rust of oats, present in the north-central region, can severely attack all of our present recommended varieties. The fact that rust was not severe on oats in 1963 does not mean that the threat does not exist -- weather during the 1963 growing season simply was not favorable for rust development. Rust is expected to cause trouble in future years. Resistant varieties are not readily available.

Flax rust -- For several years all important commercial flax varieties grown in the central part of North America have been immune to races of flax rust present on the continent. That situation has now changed. Race 300, which attacks the varieties Arny, Marine 62, Marine, and Cree, occurred at Morden and Winnipeg in Canada in 1962 and in parts of North Dakota in 1963. It will likely be found in Minnesota in 1964. The use of these susceptible varieties involves the risk of crop damage and also encourages development of additional new races of rust that may attack the remaining immune varieties.

Pasmo of flax - Pasmo is a disease caused by a fungus of the genus Septoria. Stems, leaves, and bolls are attacked; generally the disease is most severe as the crop nears maturity. Many seeds fail to develop or fill poorly because of the disease. High moisture conditions in 1962 promoted a high degree of infection. Plant Pathology Fact Sheet 7, Flax Diseases, gives additional information.

Alfalfa leaf spots -- Three or four different fungi cause leaf spots on alfalfa in Minnesota. No specific control exists for these diseases. The best recommendations are (1) cutting the crops on time according to good agronomic practices and (2) fertilizing according to recommendations and soil tests.

Alfalfa bacterial wilt -- The alfalfa varieties recommended by the Minnesota Agricultural Experiment Station have the highest degree of resistance to this disease of available varieties. Promote vigorous growth by good cultural practices and fertilizing as necessary.

Winter killing of alfalfa -- In spring 1961 extensive losses of alfalfa stands were reported from west-central Minnesota. All varieties were apparently affected. This was traced to the occurrence of an ice sheet on parts of fields. The ice sheet developed when snow cover partially melted and then froze again. This situation can occur at any time and place that proper conditions come about.

Black rot and blackleg of cabbage and related plants -- Control methods for these diseases are clear cut and practical, but every year many growers suffer severe losses. These losses can nearly always be traced to the omission of one or more necessary control measures. There are two phases to this control: hot water treatment of seed and crop rotation. Some counties have a day or two each spring when hot water seed treatment is done on a group basis. This treatment can be arranged for in other counties.

Bacterial diseases of tomato -- At least three different bacterial diseases can attack tomato in Minnesota. Bacteria causing these diseases are seed borne and can also overwinter for one season in crop refuse. Hot water seed treatment and crop rotation are recommended controls. Plants produced in southern states and shipped north to this area sometimes carry another bacterial disease that has killed entire plantings early in the season.

Damping-off of bedding plants -- Every spring several calls are received for help in controlling damping-off of vegetable and flowering plant seedlings. A complete program of soil sterilization and sanitation is the best procedure. Chemicals are sometimes helpful after the trouble has started. A sheet designated PL-11 and entitled Damping-off of Seedlings gives additional information.

Onion smut -- Light infestations of onion smut can be controlled with thiram fungicide pelletized on the seed. Heavy infestations have been satisfactorily controlled with formaldehyde run into the seed furrow at planting time. Details of the procedure are given in Special Report 5, Commercial Vegetable Pest Control Guide.

Sunflower diseases -- The acreage of sunflowers has been increasing in recent years -- but so have the diseases of this plant. At least one field was abandoned in 1963 because of a high incidence of plants diseased by downy mildew in an early stage of growth. The Sclerotinia fungus, which causes a stalk and root rot disease, was also found in several fields and was killing plants during the late summer. Both of these diseases can be highly destructive.

The Sclerotinia fungus is apparently present in small quantities in our fields even before sunflowers are planted the first time. It builds up with successive sunflower crops. Other crops and some weeds also may be hosts for the fungus. In Canada the Sclerotinia disease was severe on sunflowers following several crops of peas. The downy mildew fungus is carried with seed from infested fields; in this way it gets started in newly planted fields. Therefore, high quality seed from disease-free fields should be used on new land. The severity of both diseases can be reduced with long rotations of 4 to 5 years between sunflower crops.

Rust has been seen on sunflowers in Minnesota although it was not common in 1963. Resistant varieties are available to reduce losses from this disease.

Anthracnose of muskmelon -- Muskmelon is a relatively minor crop in Minnesota. But to those growing it as a market crop it can be important. Anthracnose can make an otherwise excellent crop unmarketable in a few days. This disease can be controlled by crop rotation and timely applications of fungicides.

Cucumber diseases -- Several diseases limit the production of cucumbers either by reducing yield or by damaging the fruits so that they are unsalable. Some of these diseases are: scab, angular leaf spot, anthracnose, bacterial wilt, mosaic, and powdery mildew. A disease control program including mercury treatment of seed, crop rotation, and fungicide application to the growing crop is needed to control all of these diseases. Details are given in Special Report 5, Commercial Vegetable Pest Control Guide.

Apple scab -- Commercial producers must control this serious disease of apples every year or losses may be severe. This disease has been severe on some ornamental flowering crabapple trees in recent years. It is controlled by fungicide application.

Cedar-apple rust -- This is one of the most spectacular plant diseases. In spring large, orange, gelatinous horns come out of the galls on the cedar trees. Then in late summer large red and yellow spots appear on apple leaves. The apple fruit is also attacked. Plant Pathology Fact Sheet 4, Cedar-Apple Rust, gives additional information.

CHEMICALS COMMONLY RECOMMENDED FOR USE IN MINNESOTA FOR CONTROL OF PLANT DISEASES

Herbert G. Johnson, extension plant pathologist

The following lists some fungicides that are recommended for use in Minnesota, some of their trade names, persons who are likely to use them, and some diseases that they control. Special Report 6, Commercial Fruit Pest Control Guide; Special Report 5, Commercial Vegetable Pest Control Guide; Pamphlet 184, Home Fruit Spray Guide, and other bulletins, folders, leaflets, and fact sheets give additional information on pest control. These publications are available from the Bulletin Room, University of Minnesota, Institute of Agriculture, St. Paul, Minnesota 55101 and from county extension offices.

Actidione -- this is a trade name. It is an antibiotic used to control certain fungus diseases such as: cherry leaf spot, powdery mildew, white pine blister rust, rust galls on cedar, and turf diseases.

Antibiotics -- some trade names are: Agrimycin 100, Agristrep, Miller Streptomycin Antibiotic Spray Powder, Ortho Streptomycin Spray, and Phytomycin. They are used primarily for control of bacterial diseases such as fireblight of fruit trees. They will control the blossom-blight phrase of fireblight but have not been too successful on the shoot-blight phase.

Captan -- some trade names are: Orthocide 50 Wettable, Orthocide Garden Fungicide, Stauffer Captan 50-W, and Stauffer Captan Garden Fungicide. It is used commercially by fruit growers and for control of many fungus plant diseases in the home, yard, and garden. It controls a wide range of fungus diseases including apple scab, graymold fruit rot of strawberry, and some "damping-off" and root rot in soil. It may be recommended for general use in control of leaf spot diseases on ornamentals.

Copper-zinc-chromate -- trade name Miller 658 Fungicide, produced by Miller Chemical & Fertilizer Corporation. Crops in this area for which it is cleared for use are: celery, grapes, potatoes, tomatoes, and cucurbits. It has given good control of late blight of potatoes. The three metals in this chemical are all trace elements which could give some benefits from that standpoint.

Dexon -- this is a trade name. It is produced by Chemagro Corporation. It is a fungicide for seed and soil treatment for control of Pythium, Phytophthora, and Aphanomyces diseases and others. It is often applied to soil in combination with PCNB.

Dodine -- trade name Cyprex, produced by American Cyanamid Co. This fungicide gives excellent control of apple scab. It has a long residual effect and is described as a local systemic. It penetrates the leaves killing some of the fungus that has already entered the leaf and protecting against infection from inside the leaf. It is cleared for use on commercial apples up to 7 days before harvest.

Dyrene -- this is a trade name. This new fungicide is produced by Chemagro Corporation. This material has been cleared for use on celery, potatoes, dry onions, and tomatoes. It is reported to give good control of various fungus diseases in many parts of the country.

Ferbam -- some trade names are: Black Leaf Ferbam Wettable Powder, Chipman Ferbam 76, Coromate, Ferberk, Fermate Ferbam Fungicide, Karbam Black, Lebanon 76% Ferbam, Niagara Carbamate, Nu-Leaf Black Fungicide, Orchard Brand Ferbam, and Penco Ferbam. It is used by some greenhouse operators, raspberry growers, and in home yards and gardens. It controls most fungus diseases of raspberry canes and leaves, rusts, and many leaf spots. It is one of the best materials for control of rust on apple. It contains iron which may correct iron deficiency in some crops when used as a foliage application.

Formaldehyde -- a good fungicide for many purposes. It is being recommended for soil fumigation, treatment of wood and other materials that may carry plant-disease organisms, and for control of onion smut in the field. The recommended form of material for all these uses is the 37 percent commercial formaldehyde (liquid).

Karathane or Mildex -- both trade names for the same material. It controls powdery mildew and is superior in some respects to sulfur for this purpose.

Lime sulfur -- an old material replaced by newer chemicals for many purposes. It is still recommended for raspberry disease control as a spray in early spring when leaves are one-fourth to one-half inch long. It is sold as either a liquid or wettable powder.

Maneb -- some trade names are: Dithane M-22 and Manzate Maneb Fungicide. It is used commercially be many tomato growers in other states. It controls five fungus leaf spot diseases of tomatoes. It has many of the same characteristics as zineb but is superior in some respects. The use of this fungicide is increasing for potato spraying in Minnesota. It gives better control of early blight of potato than zineb and is very good for control of rose black spot. It may be recommended for general use in control of leaf spot diseases on ornamentals.

PCNB -- trade name Terraclor. It is used regularly by many greenhouse operators, primarily as a soil treatment for the control of Rhizoctonia and Sclerotinia diseases, potato scab, club root of cabbage, and damping-off. It is most commonly sold as a 75 percent wettable powder but is available also as dusts.

Phaltan 50-W -- a new fungicide produced by the California Spray-Chemical Corporation. It controls black spot and powdery mildew of roses and many other plant diseases.

The following organic seed protectant materials are good for general seed treatment where protection from soil-borne disease organisms is desired.

Common Name	Some Trade Names
Captan	Captan, Orthocide
Chloranil	Spergon
Dichlone	Phygon
Thiram	Arasan, Thiram, Panoram

Sulfur -- for control of powdery mildew, rust, and some other fungus diseases. It is available as dusts and sprays.

Zineb -- some trade names are: Chemform Spray Zineb, Dithane Z-78, DuPont Fungicide A, Ortho Zineb Wettable, Parzate Zineb Fungicide, or liquid mixture Nabam (Dithane D-14, Ortho Nabam Liquid Spray, Parzate Liquid Nabam Fungicide, Thiodow-Liquid, etc.), plus zinc sulfate. It is used commercially by potato and tomato growers and for control of many fungus diseases in the home yard and garden. It controls a wide range of fungus diseases including early and late blight of potatoes and tomatoes and rusts. It is recommended in some states as a soil treatment for control of black root rot of strawberry. It may be recommended for general use in control of leaf spot diseases of ornamentals.

* * * * *

The above materials can be obtained as single materials or as proprietary materials in combination with other chemicals. As proprietary materials the size of the package is usually small and is adapted for home use. The single materials usually come in larger packages which are intended more for commercial use. Recommendations for use as shown on package labels and bulletins must be followed closely to avoid residues in food products. Precautions in handling must also be studied and followed closely to avoid accidents.

Materials that control a wide range of plant diseases such as captan, zineb, and maneb may be recommended for trial on ornamentals or vegetables on which they are approved for problems where the exact recommendation is not known. If one material does not control the problem, another may be tried. However, care must be used to recommend materials only for those food crops on which approval has been given.

Suggested fungicides for retail small-package line: See preceding list for descriptions of fungicides.

Spray or dust type fungicides: captan, ferbam, maneb.

Fungicides for control of powdery mildew: Acti-dione P.M., folpet, Karathane, sulfur.

Organic seed treatment fungicides: captan, chloranil, dichlone, thiram.

Soil treatment fungicides: PCNB, Dexon.

Other fungicides than those listed above may be preferred for specific purposes. Others may be cheaper and yet satisfactory for some purposes. Commercial growers and some home gardeners may require other fungicides in addition to these. Whether spray or dust materials or both should be kept in stock is a matter of customer preference in an area.

Available Publications on Plant Diseases

Single copies of up to 10 different publications may be obtained free from county extension offices or from Bulletin Room, Institute of Agriculture, University of Minnesota, St. Paul, Minnesota 55101. The publications (except USDA material) may be purchased in quantity; details on cost may be obtained from the Bulletin Room.

Scab of Cereals, USDA Leaflet 426, 1957.

White Pine Blister Rust, USDA Forest Pest Leaflet 36, May 1959.

Blight of Pears, Apples and Quinces, USDA Leaflet 187, 1960.

The Dutch Elm Disease, Univ. of Minn. Ext. F. 211, 1962.

Home Fruit Spray Guide, Univ. of Minn. Ext. P. 184, 1962.

Onion Diseases and Their Control, USDA Agr. Handbook 208, 1961.

Dodder and Its Control, USDA Farmers' Bull. 2117, 1958.

Maple Diseases and Their Control, USDA Home and Garden Bull. 81, 1962.

Reducing Virus and Nematode Damage to Strawberry Plants, USDA Leaflet 414, 1957.

Strawberry Diseases, USDA Farmers' Bull. 2140, 1959.

Control of Grape Diseases and Insects in the Eastern United States, USDA Farmers' Bull. 1893, 1961.

Cherry Leaf-Spot and Its Control, USDA Leaflet 489, 1961.

Care of House Plants, Univ. of Minn. Ext. Bull. 274, 1961.

Soybean Diseases, USDA Farmers' Bull. 2077, 1955.

The Home Lawn, Univ. of Minn. Ext. F. 165, 1960.

Lawn Diseases in the Midwest, Univ. of Minn. NCR Ext. Pub. 12., 1962.

Lawn Diseases, How to Control Them, USDA Home and Garden Bull. 61, 1960.

Late Blight of Potatoes, Univ. of Minn. Plant Path. Fact Sheet 1., 1959.

Disease Control for Strawberries, Univ. of Minn. Plant Path. Fact Sheet 2., 1959.

Stalk Rot and Lodging of Corn, Univ. of Minn. Plant Path. Fact Sheet 3., 1959.

Cedar-Apple Rust, Univ. of Minn. Plant Path. Fact Sheet 4., 1961.

Oak Wilt and Its Control, Univ. of Minn. Plant Path. Fact Sheet 5., 1960.

Barley Smuts, Univ. of Minn. Plant Path. Fact Sheet 6., 1961.

Flax Disease, Univ. of Minn. Plant Path. Fact Sheet 7., 1961.

Raspberry Diseases, Univ. of Minn. Plant Path. Fact Sheet 8., 1962.

Controlling Diseases in the Home Vegetable Garden, Univ. of Minn. Plant Path. Fact Sheet 9., 1962.

Leaf Spot Diseases of Trees, Univ. of Minn. Form PL-1 (rev.), 1962.

Cytospora Canker on Spruce, Univ. of Minn. Form PL-2., 1961.

Rust Diseases of Minnesota Pines, Univ. of Minn. Form PL-3., 1956.

Elm Wilts, Univ. of Minn. Form PL-4 (rev.), 1961.

Wetwood of Elm, Univ. of Minn. Form PL-5., 1960.

Elm Diseases, Univ. of Minn. Form PL-6., 1962.

Helminthosporium Leaf Blight of Corn, Univ. of Minn. Form PL-7., 1961.

Tree Fertilization, Univ. of Minn. Form PL-8., 1962.

Diseases Caused by Inanimate Agents, Univ. of Minn. Form PL-9., 1961.

Treatment of Gladiolus Corms for Disease Control, Univ. of Minn. Form PL-10., 1960.

Damping-Off of Seedlings, Univ. of Minn. Form PL-11., 1962.

Soil Fumigation With Formaldehyde, Univ. of Minn. Form PL-12., 1962.

Birch Dieback, Univ. of Minn. Form PL-13., 1962.

"Edible Wild Mushrooms," Reprinted from Horticulture, November 1960, Clyde M. Christensen.

Commercial Fruit Pest Control Guide, Univ. of Minn. Spc. Rept. 6., 1963.

Commercial Vegetable Pest Control Guide, Univ. of Minn. Spc. Rept. 5., 1963.

DEALERS' GUIDE TO INSECTICIDES

John Lofgren, extension entomologist

Regulations on Sale and Uses

The sale and use of insecticides are regulated by two federal acts and corresponding state laws. The federal regulations cover the interstate phases of insecticide labeling and sales and the interstate movement of treated foods or agricultural products. The state laws cover these activities within the state.

The federal acts are the Federal Insecticide, Fungicide, and Rodenticide Act, with amendments, and the Food, Drug, and Cosmetic Act as amended. The Insecticide, Fungicide, and Rodenticide Act is administrated by USDA. It provides that all pesticides sold in interstate commerce be registered and labeled according to its provisions.

The Food, Drug, and Cosmetic Act is administered by FDA. It provides for the establishment of tolerances for pesticides in or on agricultural commodities. This means that the applications of chemicals to crops and livestock must be done in such a way that residues left in or on the commodities are within established tolerances. This can be done by following to the letter suggestions as to dosage, time of application, crops or livestock to be treated, waiting periods between treatment and harvest, and other limitations stated in current recommendations and on current labels.

Forms of Insecticides

1. Dusts are dry powders ready for immediate use. They may contain ½, 1, 2, 3, 5, 10, or 20 percent of the actual chemical. The rest of the dust is a carrier, such as talc or pyrophyllite. Combination dusts with two or more insecticides or fungicides are available. Don't use dusts in sprayers because they do not mix properly with water or oil.

2. Wettable powders are dry powders which may be mixed with water to make sprays. Formulations containing 15, 25, 40, 50, and 75 percent of the actual ingredient are available. These powders contain a carrier plus a wetting agent which permits them to form suspensions when mixed with water. This formulation is useful on vegetation because it does not injure foliage as readily as do emulsions or oil solutions. High volume hydraulic sprayers with mechanical agitators are best suited for handling wettable powders.

3. Soluble powders. Only a few organic insecticides, made of newer materials, dissolve in water. Powders of these chemicals are called soluble powders. They may be mixed with water in the same way as wettable powders and used in the same type of sprayers that handle solutions or emulsions.

4. Emulsifiable concentrates are liquids which contain the insecticide dissolved in a suitable solvent and an emulsifier. This permits the concentrate to mix with water to form an emulsion. These concentrates may contain many different amounts of the active ingredient, but the label gives this information plus the weight of active chemical per gallon. For example:

25-percent DDT emulsifiable concentrate contains 2 pounds actual DDT per gallon; 18.5-percent dieldrin emulsifiable concentrate contains $1\frac{1}{2}$ pounds actual dieldrin per gallon; 57-percent malathion emulsifiable concentrate contains 5 pounds actual malathion per gallon. Emulsions may be used in low pressure, low-volume sprayers without mechanical agitation. Be sure the use on plants is specifically recommended or included on the label as emulsions damage some types of foliage. Some insecticides are available as "flowable" formulations. These may be handled in about the same way as emulsions.

5. Oil solutions are solutions, generally ready-to-use, of the insecticide in a suitable solvent and an oil carrier. Ready-to-use solutions usually contain from $\frac{1}{2}$- to 10-percent active ingredients. Some solution concentrates are available for further dilution with oil or to form oil sprays such as those used by aerial spray equipment, foggers, and mist blowers. Don't use oil solutions on plants or animals except for special uses with special formulations, such as fly sprays on cattle.

6. Granulated material is a ready-to-use preparation of the insecticide in or on particles of an insect carrier, such as attaclay or bentonite. The particles are usually from 25 to 60 mesh in size or from the consistency of granulated sugar to that of coffee grounds. Granules are particularly useful for controlling soil insects because they sift down through foliage and last longer than other formulations. The granulas are also effective for corn borer control because they roll down into the whorl of plants. They may be applied with fertilizer spreaders, seeders, or special granule applicators, ground or aerial.

7. Aerosol and spray bombs contain one or more insecticides, an oil solvent, and a propellant gas. These bombs produce a fine mist (an "aerosol") or a coarse spray, depending on the bomb's purpose. The fine mist aerosols are for the control of flying insects such as flies and mosquitoes in a closed room. The coarser spray bombs are used to apply a residual deposit of insecticide. You may use some spray bombs on certain plants, but check the labels carefully beforehand. Large aerosol cylinders are available for use in greenhouses, warehouses, etc.

8. Miscellaneous. In addition to the main insecticides, there are some special types. Use baits, insecticide-fertilizer mixtures, insecticide-herbicide mixtures, mothproofing agents, etc. according to recommendations and label directions.

Calculating Dosages and Application Rates

Most recommendations are given in terms of amount of actual insecticide per acre, percent active ingredient in the finished spray, or as recipes using a given formulation in 1, 5, 25, or 100 gallons of water. The following formulas and tables will help you calculate proper dosages. This is extremely important in order to avoid waste, excessive residues, or injury to treated plants or animals.

1. To figure amount of emulsifiable concentrate needed for a required amount of actual chemical to be mixed in a spray tank:

$$\frac{\text{Number of acres to be sprayed per tank} \times \text{pounds actual needed per acre}}{\text{Pounds actual per gallon in concentrate used}}$$

Example:

How many gallons of 25-percent DDT emulsifiable concentrate (2 pounds per gallon) are needed to give 3/4 pound actual DDT per acre, using a sprayer with a 50-gallon tank applying 10 gallons per acre (5 acres per tank)?

$$\frac{5 \times 0.75}{2} = 1.87 \text{ gallons of 25-percent DDT in 50-gallon tank}$$

2. To figure amount of wettable powder needed for a certain amount of actual chemical per acre:

$$\frac{\text{Number of acres per tank x pounds actual needed per acre}}{\text{Pounds actual chemical per pound of powder used}}$$

Example:

How many pounds of 50-percent DDT wettable powder are needed to apply 3/4 pound actual DDT per acre, using a sprayer with a 50-gallon tank applying 10 gallons per acre (5 acres per tank)?

$$\frac{5 \times 0.75}{0.5} = 7.5 \text{ pounds of 50-percent DDT in 50 gallons of water}$$

3. To figure amount of wettable powder needed to mix a spray containing a given percent of actual toxicant:

$$\frac{\text{Gallons of spray wanted x percent actual toxicant wanted x 8}}{\text{Percent active ingredient in powder used}}$$

Example:

How many pounds of 25-percent malathion wettable powder are needed to make 100 gallons of a 1-percent malathion spray?

$$\frac{100 \times 1 \times 8}{25} = 32 \text{ pounds}$$

4. To figure the percent actual toxicant in a spray mixture:

$$\frac{\text{Pounds of insecticide used x percent active ingredient in insecticide used}}{\text{Gallons of spray x 8}}$$

Example:

What percent DDT is in a spray in which 8 pounds of 50-percent DDT powder were used in 100 gallons of water?

$$\frac{8 \times 50}{100 \times 8} = 0.5 \text{ percent}$$

5. To figure the gallons of emulsifiable concentrate needed to mix a spray containing a given percent of active ingredient:

$$\frac{\text{Gallons of spray wanted x percent active ingredient wanted x 8}}{\text{Pounds active ingredient per gallon in insecticide used x 100}}$$

Dilution table - emulsifiable concentrates

Pounds of actual chemical per gallon of concentrate used	Desired pounds per acre of actual chemical						
	0.125 lb. (2 oz.)	0.25 lb. (4 oz.)	0.50 lb. (8 oz.)	0.75 lb. (12 oz.)	1 lb.	2 lb.	3 lb.
	pints of emulsion concentrate to apply per acre						
1	1.0	2.0	4.0	6.0	8.0	16.0	24.0
1½	0.67	1.3	2.6	4.0	5.3	10.6	16.0
2	0.50	1.0	2.0	3.0	4.0	8.0	12.0
3	0.34	0.67	1.3	2.0	2.7	5.4	8.0
4	0.25	0.50	1.0	1.5	2.0	4.0	6.0
5	0.20	0.40	0.80	1.2	1.6	3.2	4.8
6	0.17	0.34	0.67	1.0	1.3	2.6	4.0
7	0.14	0.30	0.60	0.90	1.1	2.3	3.4
8	0.125	0.25	0.50	0.75	1.0	2.0	3.0

Dilution table - wettable powders (for sprays)

Percent wettable powder used	Desired pounds per acre of actual chemical							
	0.125 lb. (2 oz.)	0.25 lb. (4 oz.)	0.50 lb. (8 oz.)	0.75 lb. (12 oz.)	1 lb.	2 lb.	3 lb.	4 lb.
	amount of wettable powder to use per acre							
15	13 oz.	1 lb., 12 oz.	3 lb., 5 oz.	5 lb.	6½ lb.	13 lb.	20 lb.	26½ lb.
25	8 oz.	1 lb.	2 lb.	3 lb.	4 lb.	8 lb.	12 lb.	16 lb.
40	5 oz.	10 oz.	1 lb., 4 oz.	1 3/4 lb.	2½ lb.	5 lb.	7½ lb.	10 lb.
50	4 oz.	8 oz.	1 lb.	1½ lb.	2 lb.	4 lb.	6 lb.	8 lb.
75	3 oz.	6 oz.	12 oz.	1 lb.	1 lb., 5 oz.	2 lb., 11 oz.	4 lb.	5 lb., 3 oz.

Dilution table - to obtain a finished spray containing a desired concentration of actual chemical

Formulation to be used in 100 gallons of water	Desired concentration of finished spray in percent								
	0.01	0.03	0.06	0.1	0.25	0.5	1.0	2.5	5.0
Wettable powders (percent)									
15	½ lb.	1½ lbs.	3 lbs.	5 1/3 lbs.	13½ lbs.	27 lbs.	54 lbs.		
25	1/3 lb.	1 lb.	2 lbs.	3 lbs.	8 lbs.	16 lbs.	32 lbs.		
40	1/5 lb.	3/4 lb.	1½ lbs.	2 lbs.	5 lbs.	10 lbs.	20 lbs.		
50	1/6 lb. (2½ oz.)	½ lb.	1 lb.	1½ lbs.	4 lbs.	8 lbs.	16 lbs.	40 lbs.	
75	1/10 lb. (1½ oz.)	1/3 lb.	2/3 lb.	1 lb.	2½ lbs.	5 lbs.	10 lbs.	25 lbs.	52 lbs.
Emulsifiable concentrate (in pounds per gallon)									
1	1 1/3 c.	1 qt.	½ gal.	3 qts.	2 gals.	4 gals.	8 gals.	20 gals.	40 gals.
1½	3/4 pt.	1/3 gal.	1/3 gal.	½ gal.	1 1/3 gals.	2 2/3 gals.	5 gals.	13½ gals.	27 gals.
2	2/3 c.	1 pt.	1 qt.	3 pts.	1 gal.	2 gals.	4 gals.	10 gals.	20 gals.
4	1/3 c.	½ pt.	1 pt.	1½ pts.	½ gal.	1 gal.	2 gals.	5 gals.	10 gals.
5	2 fluid oz.	6 fluid oz.	3/4 pt.	2 2/3 c.	3 pts.	3 qts.	1 3/4 gals.	4 gals.	8 gals.
6	1 3/4 fluid oz.	2/3 c.	1½ c.	1 pt.	2 2/3 pts.	5 pts.	1½ gals.	3 1/3 gals.	6 2/3 gals.
8	1 fluid oz.	¼ pt.	½ pt.	3/4 pt.	1 qt.	½ gal.	1 gal.	2½ gals.	5 gals.

Example:

How much 25-percent DDT emulsion concentrate (2 pounds per gallon) is needed to make 50 gallons of an 0.25-percent DDT spray?

$$\frac{50 \times 0.25 \times 8}{2 \times 100} = 0.5 \text{ gallon}$$

Reducing to 1 Gallon of Spray

For small jobs, it is often necessary to figure out how much insecticide to use for 1 gallon of spray. If the recommendation is given in terms of 100 gallons, use the following formulas for 1 gallon.

With wettable powder:

1 level tablespoon per gallon of water = approximately 1 pound per 100 gallons of water

With emulsion:

1 teaspoon per gallon of water = approximately 1 pint per 100 gallons of water

Table of Equivalents

1 level tablespoon = 3 level teaspoons
1 fluid ounce = 2 tablespoons
1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints or 32 fluid ounces
1 gallon = 4 quarts or 128 fluid ounces
1 gallon (United States) = 0.83 (approximately 4/5 gallon British or Imperial)
1 gallon (British or Imperial) = 1.2 gallons (United States)
1 gallon water (United States) = 8.345 pounds
1 pound = 16 ounces or 453.59 grams
1 gram = 0.0353 ounces
1 ounce = 28.3 grams
1 kilogram = 35.27 ounces or 2.2 pounds
1 milligram per kilogram = 1 part per million

Safety Precautions and First Aid

Precautions When Using Toxic Phosphates

Use natural rubber gloves to prevent absorption through the skin. Remove and wash contaminated absorbent clothing.

Avoid breathing any wettable powder dust or contacting an emulsion. If this is unavoidable, use a respirator specifically made for phosphates. A list of respirators can be obtained by writing to the Department of Entomology, Fisheries, and Wildlife, University of Minnesota, Institute of Agriculture, St. Paul, Minnesota 55101.

Phosphate-Poisoning Symptoms and Antidote

Many organic phosphate insecticides (TEPP, parathion, methyl parathion, tetraethyl dithiopyrophosphate, EPN, demeton, Phosdrin, phorate, Di-Syston, and schradan) are hazardous to man during mixing operations and application. Contact with recently treated plants or surfaces may also be hazardous. Certain organic phosphates are considerably less toxic: Malathion, Dicapthon, Co-Ral, and ronnel being much less toxic and Diazinon, Dylox, and Delnav being intermediate.

All of the organic phosphates discussed, including the least toxic, produce similar symptoms in human beings. All require the same antidote. The symptoms may be produced by absorption through the skin, inhalation, or swallowing. Signs of poisoning include blurred vision (pinpoint pupils), abdominal cramps, tightness of the chest, digestive upset, sweating and excessive salivation, restlessness, giddiness, headache, and twitching of facial and eye muscles.

If any of these symptoms occur:

1. Call physician immediately.
2. Remove contaminated clothing and wash skin thoroughly with soap and water.
3. If chemical has been swallowed, induce vomiting.
4. Keep patient quiet and warm.
5. Physician may administer atropine as an antidote.

If you have had these symptoms from organic phosphorous compounds, do not handle the compounds again until your physician determines by a blood analysis that your condition is satisfactory. If you use these compounds often, have analyses of the blood made at regular intervals.

Chlorinated-Hydrocarbon First Aid

For Chlorinated Hydrocarbons (such as aldrin, BHC, chlordane, dieldrin, DDT, endrin, heptachlor, lindane, methoxychlor, toxaphene, and thiodan):

1. If chemical has been swallowed, call physician immediately. If patient is conscious, induce vomiting with warm, salty water. Continue until vomit fluid is clear.

2. If chemical has been spilled on the skin or clothing, remove clothing. Wash skin thoroughly with soap and water. Do not use kerosene, gasoline, or other solvents.

3. Keep patient quiet and warm.

4. Physician may administer sedatives such as phenobarbital or other barbiturates to keep patient calm or to control convulsions.

Minnesota Poison Information Centers

These centers have been established by the Minnesota Department of Health. Their purpose is to provide information for physicians about pesticides and common household poisons, their antidotes, and treatments. Most centers operate on a 24-hour basis.

Acute oral and dermal LD_{50} values of organic phosphate and chlorinated hydrocarbon insecticides for male and female white rats*

	Oral LD_{50} (MG./KG.)		Dermal LD_{50} (MG./KG.)	
	Males	Females	Males	Females
Organic Phosphates:				
TEPP	1.05	-	2.4	-
Phorate (Thimet)	2.3	1.1	6.2	2.5
Phosdrin	6.1	3.7	4.7	4.2
Di-Syston	6.8	2.3	15.0	6.0
Parathion	13.0	3.6	21.0	6.8
Demeton	6.2	2.5	14.0	8.2
Methyl parathion	14.0	24.0	67.0	67.0
Phosphamidon	23.5	23.5	143.0	107.0
Guthion	13.0	11.0	220.0	220.0
Carbophenothion (Trithion)	30.0	10.0	54.0	27.0
EPN	36.0	7.7	230.0	25.0
Ethion	65.0	27.0	245.0	62.0
Co-Ral	41.0	15.5	860.0	-
Delnav	43.0	23.0	235.0	63.0
DDVP	80.0	56.0	107.0	75.0
Methyl Trithion	98.0	120.0	215.0	190.0
Diazinon	108.0	76.0	900.0	455.0
Dimethoate (Cygon)	215.0	-	400.0	-
Fenthion (Baytex)	215.0	245.0	330.0	330.0
Dicapthon	400.0	330.0	790.0	1,250.0
Trichlorofon (Dipterex) (Dylox)	630.0	560.0	2,000.0	2,000.0
Ronnel	1,250.0	2,630.0	-	-
Malathion	1,375.0	1,000.0	4,444.0	4,444.0
Chlorinated Hydrocarbons:				
Endrin	17.8	7.5	-	15.0
Dieldrin	46.0	46.0	90.0	60.0
Aldrin	39.0	60.0	98.0	98.0
Thiodan	43.0	18.0	130.0	74.0
Heptachlor	100.0	162.0	195.0	250.0
Lindane	88.0	91.0	1,000.0	900.0
Toxaphene	90.0	80.0	1,075.0	780.0
Chlordane	335.0	430.0	840.0	690.0
DDT	113.0	118.0	-	2,510.0
Kelthane	1,100.0	1,000.0	1,230.0	1,000.0
Chlorobenzilate	1,040.0	1,220.0	-	-
TDE (DDD)	3,400.0+	-	-	-
Perthane	4,000.0+	4,000.0	-	-
Methoxychlor	(6,000.0)	-	-	6,000.0

* From Clinical Handbook of Economic Poisons, U. S. Public Health Service.

\+ Sex of the rats not specified.

City	Address	Telephone
Bemidji	Bemidji Hospital	PL. 1-5430
Brainerd	St. Joseph's Hospital	2861
Crookston	Bethesda Hospital	AT. 1-4682
	St. Francis Hospital	AT. 1-2490
Duluth	St. Luke's Hospital 915 E. 1st Street	RA. 7-6636
Fergus Falls	Lake Region Hospital	523
Mankato	Immanuel Hospital	MA. 8-1605
Marshall	Lewis Weiner Memorial Hospital	2263
Minneapolis	Division of Special Health Services State Health Department	FE. 9-7751
	Abbott Hospital 110 E. 18th Street	FE. 9-8414
	Fairview Hospital 2312 S. 6th Street	FE. 2-0282
	Minneapolis General Hospital 619 S. 5th Street	330-3930
	North Memorial Hospital 3220 Lowry Avenue North	JU. 8-9451
	Northwestern Hospital 810 E. 27th Street	332-7266
Morris	Stevens County Memorial Hospital	1191
Rochester	St. Mary's Hospital	AT. 9-4581
St. Cloud	St. Cloud Hospital	BL. 1-2700
St. Paul	Ancker Hospital 495 Jefferson Avenue	CA. 2-7341
	Bethesda Hospital 559 Capitol Boulevard	227-8611
	St. John's Hospital 403 Maria Avenue	776-8595
	St. Joseph's Hospital 69 W. Exchange	222-2861
	St. Luke's Hospital 287 N. Smith Avenue	CA. 2-6644
	Children's Hospital 311 Pleasant Avenue	CA. 7-6251

City	Address	Telephone
Virginia	Virginia Municipal Hospital	Harwood 1-3340
Willmar	Rice Memorial Hospital	Belmont 5-4543
Worthington	Worthington Memorial Municipal Hospital	Worthington 2-5601

Summary of Insecticide Uses

Field Crops and Livestock

This summary is divided into two parts. First the crops and livestock are listed alphabetically. After each crop or livestock the common insects are listed. In the third column is an alphabetical list of the insecticides presently registered and recommended for each use.

Second, the insecticides are listed alphabetically in the first column with the currently recommended uses in the following columns.

This summary will give you a quick reference to the current uses of insecticides for the control of field crop and livestock pests. Information on dosage, time of application, restrictions, and limitations is extremely important. You can find this information on labels on containers, literature supplied by the manufacturers, and in current University of Minnesota publications (see list of references, page 43).

Crop	Insect	Insecticides
Alfalfa, clover	aphids	demeton (Systox) malathion parathion Phosdrin
	grasshoppers	diazinon dieldrin malathion sevin
	leafhoppers	diazinon methoxychlor
	plant bugs	DDT (seed crop) dieldrin (seed crop) endrin (seed crop) toxaphene
	sweetclover weevils	aldrin dieldrin toxaphene
Corn	armyworms	dieldrin endrin toxaphene
	aphids	parathion phorate (Thimet)
	northern corn rootworms	aldrin heptachlor
	western corn rootworms and resistant northern corn rootworms	diazinon phorate (Thimet) parathion (stabilized granules) compound 4072
Corn	cutworms	aldrin DDT dieldrin endrin heptachlor toxaphene
	European corn borers	DDT endrin EPN sevin toxaphene
	grasshoppers	aldrin diazinon dieldrin malathion sevin toxaphene
	white grubs	aldrin dieldrin heptachlor
	wireworms	aldrin dieldrin heptachlor lindane
Flax	crickets	dieldrin
	cutworms	DDT dieldrin endrin toxaphene
Small grains	aphids	malathion parathion Phosdrin

Crop	Insect	Insecticides
Small grains (Cont.)	armyworms	dieldrin endrin toxaphene
	cutworms	dieldrin endrin toxaphene
	grasshoppers	aldrin dieldrin toxaphene
	thrips (barley)	parathion
	wireworms	aldrin dieldrin heptachlor lindane
Soybeans	cutworms	DDT dieldrin endrin toxaphene
Potatoes	fleabeetles	DDT diazinon Dibrom Disyston endrin Guthion phorate (Thimet) phosphamidon (Dimecron) sevin Thiodan toxaphene
	leafhoppers	DDT demeton (Systox) diazinon Dibrom Disyston endrin Guthion malathion phorate (Thimet) phosphamidon sevin Thiodan toxaphene
	wireworms	dieldrin

Infested Buildings	Insect	Insecticides
Barns, sheds, shelters	flies	DDVP (Vapona) diazinon (except poultry and milkhouses) dimethoate (Cygon) naled (Dibrom) except milkhouse malathion Pyrethrins ronnel (Korlan) Dipterex
Barns, other than dairy or poultry or milkhouses	flies	Baytex Antiresistant DDT

Livestock	Insect	Insecticides
Beef cattle (and nonlactating dairy cattle)	cattle grubs	Co-Ral ronnel (Trolene) Ruelene rotenone
	flies	Co-Ral Ciodrin DDVP (Vapona) DDT (in backrubbers) Delnav malathion methoxychlor Pyrethrins toxaphene ronnel (Korlan)
	lice	Co-Ral Delnav lindane malathion methoxychlor ronnel (Korlan) toxaphene
Dairy cattle	cattle grubs	rotenone
	flies	Ciodrin DDVP (Vapona) Pyrethrins malathion dust methoxychlor dust
	lice	Pyrethrins rotenone
Poultry	mites, lice	Co-Ral malathion sevin
Sheep	keds ("Ticks")	Co-Ral Delnav DDT lindane malathion methoxychlor ronnel (Korlan) toxaphene
	wool maggots	screwworm smears Co-Ral Delnav lindane ronnel (Korlan)
Swine	mange, lice	lindane

Insecticide	Crops or livestock	Insects
aldrin	corn	cutworms rootworms white grubs wireworms grasshoppers
	small grains	grasshoppers wireworms
	soybeans	grasshoppers white grubs wireworms
	sweet clover	sweet clover weevils
Ciodrin	Cattle, beef, dairy	flies, lice
Co-Ral	beef cattle	lice flies screwworms grubs
	poultry	mites lice
	sheep	keds wool maggots
DDT	corn	European corn borers earworms cutworms
	alfalfa, clover (for seed)	plant bugs leafhoppers
	potatoes	Colorado potato beetles flea beetles leafhoppers
	beef cattle	hornflies (in backrubbers)
	sheep	keds ("Ticks")
DDVP (Vapona)	cattle, dairy, beef	flies
	barns	flies
demeton (Systox)	alfalfa	aphids leafhoppers
	potatoes	aphids leafhoppers
Delnav	beef cattle	lice hornflies
	sheep	keds wool maggots
diazinon	alfalfa, clover	leafhoppers grasshoppers

Insecticide	Crops or livestock	Insects
diazinon	corn	grasshoppers earworms corn rootworms
	potatoes	aphids Colorado potato beetles flea beetles leafhoppers
	barns	flies
Dibrom (naled)	potatoes	Colorado potato beetles flea beetles leafhoppers
	barns	flies
dieldrin	alfalfa, clover (for seed)	grasshoppers crickets sweet clover weevils
	corn	armyworms cutworms grasshoppers white grubs wireworms
	small grains	armyworms cutworms grasshoppers wireworms
	flax	crickets
	soybeans	cutworms grasshoppers white grubs
	potatoes	wireworms white grubs
Dipterex	barns	flies
Disyston	potatoes	aphids flea beetles leafhoppers
Dylox	sugar beets	webworms
endrin	alfalfa, clover (for seed)	plant bugs leafhoppers
	corn	armyworms cutworms European corn borers
	small grains	armyworms cutworms
	sugar beets	webworms cutworms

Insecticide	Crops or livestock	Insects
endrin (Cont.)	potatoes	aphids cutworms Colorado potato beetles flea beetles leafhoppers
EPN	corn (canning)	European corn borers
Guthion	potatoes	Colorado potato beetles flea beetles leafhoppers
heptachlor	corn	corn rootworms cutworms wireworms white grubs
	soybeans	white grubs wireworms
lindane	corn soybeans small grains (seed treater)	wireworms
	beef cattle	lice
	sheep	keds wool maggots
	swine	mange, lice
malathion	alfalfa, clover	aphids grasshoppers leafhoppers
	corn	grasshoppers
	small grains	aphids grasshoppers
	beef cattle	flies lice
	dairy cattle	flies (as dust only)
	poultry	mites lice
	sheep	keds ("Ticks")
	barns	flies
methoxychlor	alfalfa, clover	leafhoppers
	beef cattle	flies lice
	dairy cattle	flies (as dust only)
	sheep	keds ("Ticks")

Insecticide	Crops or livestock	Insects
parathion	alfalfa	aphids leafhoppers
	corn	corn rootworms
	small grains	aphids
	barley	thrips aphids
	potatoes	aphids leafhoppers
phorate (Thimet)	potatoes	aphids flea beetles leafhoppers
	corn	corn rootworms aphids
Phosdrin	alfalfa, clover small grains	aphids
Phosphamidon (Dimecron)	potatoes	aphids Colorado potato beetles flea beetles leafhoppers
ronnel (Korlan, Trolene)	beef cattle	cattle grubs lice flies
	sheep	keds wool maggots
	barns	flies
Ruelene	beef cattle	cattle grubs lice
sevin	alfalfa, clover	grasshoppers
	corn	earworms European corn borers grasshoppers
	sugar beets	webworms grasshoppers
	potatoes	Colorado potato beetles flea beetles leafhoppers
	poultry	mites lice
Thiodan (endosulfan)	potatoes	aphids Colorado potato beetles flea beetles leafhoppers
	alfalfa, clover (for seed)	plant bugs grasshoppers

Insecticide	Crops or livestock	Insects
toxaphene	corn	armyworms cutworms grasshoppers European corn borers
	small grains	grasshoppers armyworms
toxaphene	potatoes	Colorado potato beetles flea beetles
	beef cattle	lice flies
	sheep	keds ("Ticks") scab
Compound 4072	corn	corn rootworms

References - Insect Control - Insecticides

Insecticides and Their Uses in Minnesota. Ext. Bull. 263, Univ. of Minn., St. Paul, Minn. 55101

Commercial Vegetable Pest Control Guide. Spc. Rept. 5, Univ. of Minn., St. Paul, Minn. 55101

Commercial Fruit Pest Control Guide. Spc. Rept. 6, Univ. of Minn., St. Paul, Minn. 55101

Insecticide Recommendations of the Entomology Research Division. Agr. Handbook 120. ARS, USDA, Washington, D. C.

Entoma. Entomology Society of America, E. H. Fisher, Dept. of Entomology, University of Wisconsin, Madison, Wisconsin., Editor.

Home Fruit Spray Guide. P. 184, Univ. of Minn., St. Paul, Minn. 55101

Fly Control for Livestock. Ext. F. 192., Univ. of Minn., St. Paul, Minn. 55101

Entomology Fact Sheet Series, Univ. of Minn., St. Paul, Minn. 55101

1. European Corn Borer and Corn Earworm Control
2. European Corn Borer Control with Granular DDT
4. Insect Control on Forage Crops
5. Controlling Cattle Lice
7. Chemical Control of Soil Insect Pests of Corn
8. Indian Meal Moth Control in Stored Shelled Corn
9. Insects in Stored Grain
11. Controlling Insects in the Home Vegetable Garden
12. Armyworms
14. Controlling Corn Rootworms
17. Insect Pests of Poultry
20. The Apple Maggot
21. Cankerworms

THE WESTERN CORN ROOTWORM IN MINNESOTA

J. A. Lofgren, extension entomologist

The western corn rootworm is present throughout most of southern Minnesota and is firmly established in the southwest corner of the state (see map). It is expected to spread and increase and eventually become a pest of high economic importance in corn-producing counties. This insect is related to the common northern corn rootworm and has a similar life cycle: eggs are laid in the fall, larvae hatch in June, and adults emerge in July and August.

Concern over the western corn rootworm is due to the fact that crop rotations are not as effective in preventing infestations as they are for the northern corn rootworm. The western species readily becomes resistant to the commonly used soil insecticides, aldrin and heptachlor. Furthermore, when the western species becomes established in a field or a locality, the northern rootworms become less abundant and the western evidently becomes dominant. It is apparently more vigorous and damaging than the northern.

For fields in which western rootworms have become damaging, or for those few localized areas in which the northern species has become resistant to aldrin or heptachlor, the following suggestions may be helpful in minimizing losses:

1. Wherever practicable, rotate the badly infested fields to crops other than corn in the following year.

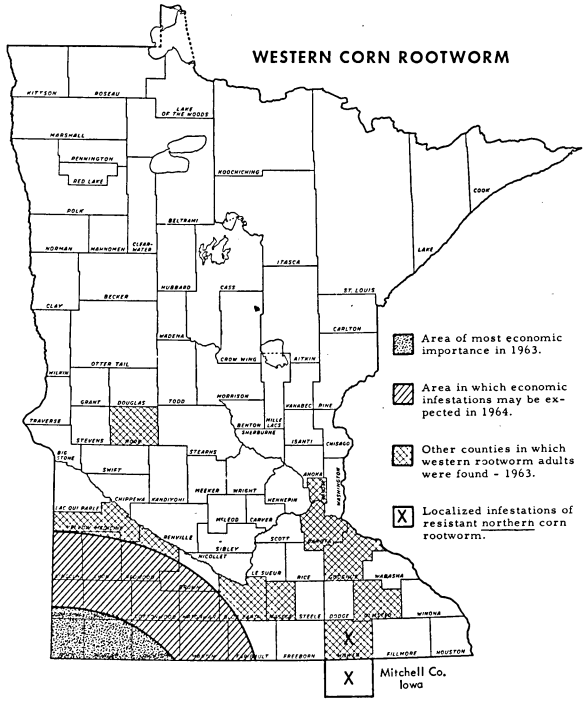
2. As a general rule, other factors being equal, late planted corn is more severely damaged than early planted corn. So avoid late planting dates for fields that are probably infested.

3. When corn is planted in those fields likely to be economically infested with western or resistant northern rootworms, the use of certain phosphate insecticides may reduce losses if the chemical chosen is properly applied. Chemicals which have label approval for the control of resistant rootworms are granular diazinon, phorate (Thimet), stabilized parathion, and compound 4072.

Aldrin or heptachlor is still recommended for the control of nonresistant populations of rootworms. (See Ent. Fact Sheet 14)

Rate of Application of Organic Phosphates

Apply 1 pound of actual chemical per acre. The commercially available form of diazinon, phorate, parathion, and 4072 to use for rootworms is the 10-percent granular formulation. Apply granules at 10 pounds per acre. That amount should be concentrated over the rows.



Placement of Insecticides

It is extremely important to apply the right amount of chemical in the right place. Use properly calibrated and adjusted granular applicators mounted on the corn planter. The granules should not be placed deep in the furrow with the seed. They should be in a 4- to 6-inch band over the seed and just covered by $\frac{1}{2}$ to $1\frac{1}{2}$ inches of soil. This can be done by using spreaders on the ends of the applicator tubes. Adjust the tubes to deliver the insecticide well behind the planter shoes, just ahead of the press wheels.

Postemergence Treatments

Experimental work in some north-central states shows that applications of these phosphate insecticides at 1 pound of actual chemical per acre in the row about the middle of June may give satisfactory control. Apply granules with an applicator mounted on the cultivator, directed at the bases of the plants, and covered with 2 to 3 inches of soil. This may be done with disk hillers on the cultivator. Good results will probably not be obtained if the treatment is made during droughty periods.

Caution!

Some organic phosphate insecticides are highly toxic and must be used with extreme care. Avoid exposure to the skin, lungs, and mouth. Wear protective clothing when directed to do so on the label. Do not breathe the dust or vapors; do not eat or smoke while handling the chemicals or until after washing thoroughly. When finished for the day, bathe thoroughly and change clothes. Follow these and other precautions given on the container labels to protect yourself.

DISTRIBUTION AND USE OF FERTILIZERS DURING A NATIONAL CIVIL DEFENSE EMERGENCY

Clifton F. Halsey, state rural civil defense agent

Preparation for the quick recovery of agriculture after a large-scale nuclear attack or other national emergency is vital.

Fertilizers will be important to agriculture's recovery and they probably will be scarce in an emergency. Therefore, the U. S. Department of Agriculture (USDA) has issued a standby order regulating their distribution and use. It will go into effect immediately following a nuclear attack or declaration of a national civil defense emergency by the President.

The purpose of the order is to conserve supplies with minimum hindrance to the production of essential crops. When the situation can be appraised, an orderly distribution program will be started.

The order affects fertilizers that are products or mixtures of products containing nitrogen, phosphorus, or potassium and which are prepared for plant nutrition. Excluded are unprocessed manures, peat, humus, and basic slag.

Dealers, manufacturers, distributors, and transporters should be familiar with the instructions in the order. Then they can help accomplish equitable distribution in postattack emergency conditions. They can obtain more information from their local Agricultural Stabilization and Conservation Service (ASCS) office.

Instructions to Dealers

You may sell or otherwise transfer fertilizers only if the user or his representative gives you a fertilizer use certificate like the one shown below. It must be signed by the user or his representative and approved by the ASCS office in the county in which the fertilizer is to be used. Certificate approval is necessary to insure that fertilizers will be used only for crops USDA considers essential.

If a user wants fertilizer but does not have a certificate, refer him to the local ASCS office. Attach each certificate to a copy of the purchase order; keep both until USDA advises otherwise.

Instructions to Manufacturers and Distributors

Continue shipping fertilizers to dealers within your trade area. Do this as equitably as possible; take into account disruptions of transportation, communication, and sources of materials caused by the emergency.

You may not make shipments outside your trade area unless you get approval from the ASCS in the state in which this distribution is planned. You must comply with any orders from USDA national headquarters or from your USDA regional defense representative.

Instructions to Transporters

If you possess a shipment of fertilizers when the standby order goes into effect, try to deliver it. If delivery is impossible because you cannot obtain information about the shipment's destination, notify ASCS county officials. They will assume responsibility and cost obligations for the shipment and arrange for redirecting or storing the fertilizers.

Above all, let officials in the ASCS state and county offices know what you are doing and what problems you are having. They will need your cooperation.

FERTILIZER USE CERTIFICATE

In accordance with the Defense Food Order and Suborder in force governing the distribution of fertilizer, I certify, subject to criminal penalties for misrepresentation, that all fertilizers covered by this certificate will be used on the following crops:

CROP	ACREAGE	GRADE OF FERTILIZER	TOTAL POUNDS
_____	_____	_____	_____
_____	_____	_____	_____

_____ _____ _____

(Signature of fertilizer user, or his name and the signature of his representative) *(Address of user)* *(Date)*

Use of above fertilizers to produce the specified crops is hereby approved.

Agricultural Stabilization and Conservation Service

By _____

_____ _____

(County and State) *(Date)*