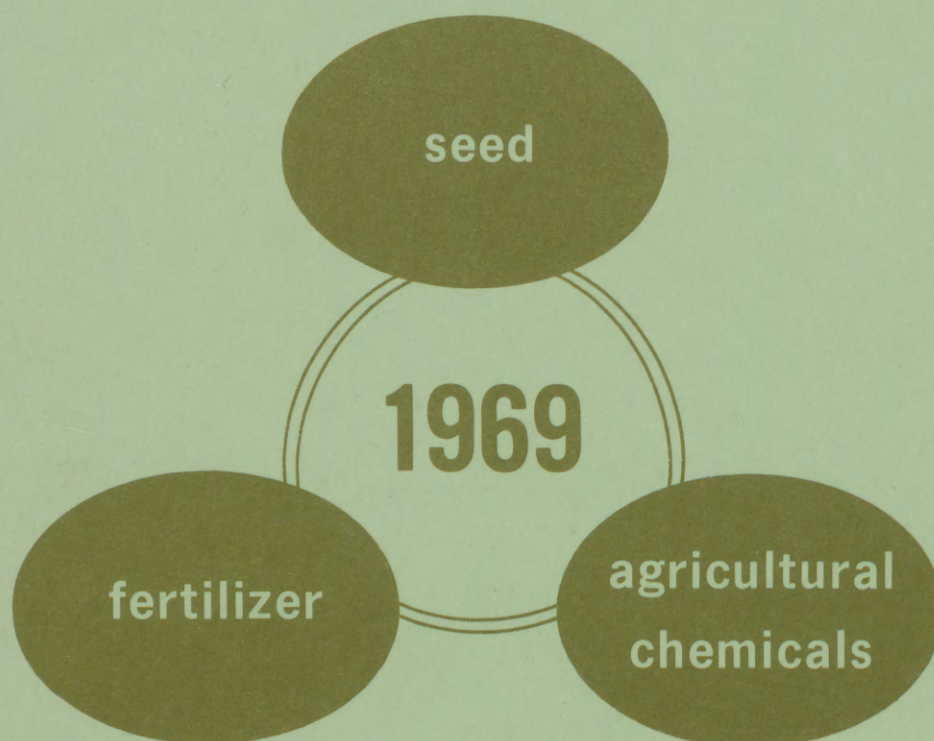


MN 2000
SR-12

SPECIAL REPORT 12

MINNESOTA

Retail Dealers Conference



conducted by
Minnesota Extension Specialists
in
Soils, Agronomy, Plant Pathology,
and Entomology
AGRICULTURAL EXTENSION SERVICE, UNIVERSITY of MINNESOTA

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Mention of trade names in this publication does not imply endorsement nor does failure to mention a name imply criticism by the Minnesota Agricultural Extension Service.

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

3M--11-68.

DEALERS GUIDE TO INSECTICIDES

Phillip K. Harein, extension entomologist,
and L. K. Cutkomp, professor, entomology

SAFETY

Storage Life of Pesticides

As a group, the chlorinated hydrocarbons are more stable than the organophosphorus pesticides. Storage at high temperatures, high humidity, or in direct sunlight speeds up the degradation of some pesticides especially in wettable powder or dust formulations. Some pesticides, especially those in liquid concentrates should not be stored at freezing temperatures which may result in crystallization or breakdown and the resulting material may be more toxic to animals or plants, may leave a higher residue, and is apt to be much less efficient.

It is not advisable to keep unsealed packages of powdered pesticides longer than 1 year. Some pesticides in liquid form packaged in airtight containers may retain their effectiveness for several years, but it is advisable to obtain new materials after a 2-year storage period.

Keeping Records of Pesticide Usage

The pesticide usage history is often as important as the cropping history of the land. This is especially true with weed killers and certain chlorinated hydrocarbons. Good records can be a guide to future crop planning and will help to:

- Improve pest control practices and efficiency and avoid pesticide misuse.
- Compare applications made with results obtained.
- Purchase only needed amounts of pesticides.
- Reduce inventory carryover.
- Establish proper use if residue questions arise in marketing your crop.
- Establish where and when error occurred, if any mistake was made.

The information collected should include:

- Pesticide used, including the names and percent of active ingredient, type of formulation, trade name, manufacturer, and lot number.
- Crop and variety treated.
- Pest(s) treated.
- Location and number of acres treated.
- Time of day, date, and year of application.
- Amount used per acre (total as well as active ingredients).
- Stage of crop development.
- Pest situation such as severity of infestation and presence of beneficial species.
- Weather - temperature, wind, rainfall.
- Harvest date.
- Results of application.

Pesticide Combinations

Generally it is more economical to combine pesticides and make a single application. One of the major problems, however, is the application of each pesticide in the right place at the right time. Even if this can be obtained, the question of chemical compatibility is the next major problem. Some mixtures of chemicals result in reactions that cause the formation of new compounds or a separation of the pesticide from the diluent. If one of these reactions occurs, one of the following may result:

1. Effectiveness of one or both compounds may be reduced or increased.
2. Precipitation or other physical change may occur and clog screen and nozzles of application equipment.
3. Phytotoxicity.
4. Excessive residues may result since related chemicals are additive.

Because of the risk involved, combinations of pesticides and/or other agricultural chemicals should not be used unless the specific combination has proven to be effective, tested for side effects, and accepted for registrations by the U. S. Department of Agriculture.

Proper Disposal of Pesticides

With present knowledge it is suggested that excess pesticides be buried at least 18 inches deep in areas where they will not contaminate water. This disposal route is not entirely satisfactory. Based on a recent survey of the members of the Minnesota Agricultural Chemical Association, it does not appear likely that the chemical companies will accept any unused pesticide (including their own products). This leaves the problem of improving disposal techniques. In an effort to develop better methods, the USDA granted the University of Mississippi \$111,864 to study pesticide disposal. Objectives of the research follow:

1. Determine the combustion temperatures and the volatile products of selected pesticides.
2. Investigate the use of chemicals as an aid to decomposition of pesticides and containers.
3. Investigate the use of microflora for decomposition of pesticides in the soil.
4. Determine requirements for pesticide containers that are readily combustible.
5. Develop specifications for an incinerator or other device for disposal of pesticides and containers.

Winter Storage of Pesticide Sprayers

The following steps are recommended for proper winter storage of pesticide sprayers:

Drain all material from the tank, pump, boom, and hoses.
Fill the tank with clear water and flush through the boom.
Repeat the second step with 1 ounce per gallon of household ammonia or trisodium phosphate added to the water.
Disassemble nozzles. Paint screens and store screens and nozzle parts dry or emerged in a jar of fuel oil.
Dry inside of pump and coat inside with a rustproofing material.
Rustproof the tank if needed.
Support the boom so it will not be damaged by other machinery or contaminated by soil or manure accumulations.
Remove hoses and store, coiled neatly or straighten out, on a shelf.

PEST AND PESTICIDE NEWS ITEMS IN 1968

Registrations Extended

The Pesticide Regulation Division reported in September that "no residue" registration for 226 pesticides had been extended. Of these, 51 pesticide chemicals were extended on the basis of pending petitions, the rest on the basis of studies being conducted. If the studies cannot be completed in 1968-- further limited extensions will be considered. Registrations for some 87 chemicals have already been cancelled.

DDT Residues

The Food and Drug Administration has plans to lower the allowable tolerance for DDT from 7 to 1 p.p.m. after the close of the 1968 growing season. European governments disclosed similar plans. The National Agricultural Chemicals Association questioned the reduction of tolerances to any level when available residue and toxicological data indicate no health hazard involved.

Advertising Pesticides

The Federal Trade Commission has proposed a trade regulation rule in which advertisements for economic poisons must be consistent with pesticide labels registered by the USDA.

Pesticide Tolerance for Milk

Establishment of tolerances for residues of pesticides in milk is inevitable in line with FDA's switch from zero to negligible residue.

The following tolerances have been established:

DDT, DDD, DDE
0.05 p.p.m. in milk
1.25 p.p.m. in milk fat

Coumaphos
0.02 p.p.m. in milk
0.50 p.p.m. in milk fat

INSECT CONTROL RECOMMENDATIONS

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

It is suggested that aldrin, dieldrin, DDT, chlordane or heptachlor not be used on dairy farms. Corn treated for soil insect control with aldrin or heptachlor should be grown for grain only and livestock should not be allowed to graze these treated fields.

Because of possible residues, wait at least 1 year before planting soybeans in soil treated for 5 consecutive years with aldrin or heptachlor. Illegal residues may result in potatoes, sugar beets, or carrots if they are planted in fields previously treated with heptachlor or aldrin.

INSECT CONTROL RECOMMENDATIONS ON FIELD CROPS FOR 1969

DO NOT USE AFTER 1969

Insect	Crop	Insecticide	Dosage	Limitations
Aphids	Small grain	malathion	1 lb.	7 days
			0.6 lb. ULV ⁺	
			by air	7 days
		methy1 parathion	4 oz.	No time limitations
		parathion	4 oz.	15 days
	Corn	malathion	1 lb.	5 days
		methy1 parathion	4 oz.	12 days
		parathion	4 oz.	12 days
phorate (Thimet)		1 lb.	Granular applied to whorl immediately before tasseling; do not apply if used as soil application	
Armyworms	Small grain	carbaryl (Sevin)*	1 lb.	Do not apply after heads are visible
		toxaphene	2 lb.	Do not feed treated forage. No restrictions on grain.

* Status uncertain. See introductory paragraph on page 4.

⁺ULV = ultra-low volume.

DO NOT USE AFTER 1969

Insect	Crop	Insecticide	Dosage	Limitations
Armyworms	Corn	carbaryl (Sevin)	1 lb.	No time limitation
		toxaphene	2 lb.	Do not feed stalks, leaves, and husks
Bean leaf beetle	Soybeans	carbaryl (Sevin)	1 lb.	No time limitations
		toxaphene	1 1/2 lb.	21 days before feeding treated plants
Beet webworm	Sugar beets	carbaryl (Sevin)	2 lb.	14 days (tops)
		endosulfan(Thiodan)*	1 lb.	Do not feed tops
		toxaphene*	3 lb.	60 days; do not feed tops
		trichlorfon(Dylox)*	1 1/2 lb.	14 days 28 days (tops)
Corn earworm	Sweet corn	diazinon	1 1/2 lb.	2 days for forage
		carbaryl (Sevin)	1 1/2 lb.	No time limitations
Corn rootworm larvae	Corn	Bux-Ten*	3/4 lb.	Rate given for 40-inch rows; band application at planting or cultivation, except by Bux-Ten, should be used at planting time only
		diazinon	1 lb.	
		phorate(Thimet)	1 lb.	
		Dasanit	3/4 lb.	
		Dyfonate	3/4 lb.	
Corn rootworm adults	Corn	carbaryl (Sevin)	1 lb.	5 days ULV ⁺ by air
		malathion	1 lb. or 0.6 lb.	
Cutworms	Corn	aldrin*	2 lb.	Preplant broadcast disked in
		heptachlor*	2 lb.	
		chlordane	4 lb.	
		diazinon	2 lb.	Band treatment at planting time

* Status uncertain. See introductory paragraph on page 4.

⁺ULV = ultra-low volume.

DO NOT USE AFTER 1969

Insect	Crop	Insecticide	Dosage	Limitations
Cutworms	Corn	toxaphene	2 lb.	
		trichlorfon(Dylox)	1 1/2 lb.	Postemergence with 40 days waiting period
	Small grain	toxaphene	2 lb.	Do not use straw
	Soybeans	carbaryl(Sevin)	1 lb.	No time limitations
		toxaphene	1 1/2 lb.	21 days
	Sugar beets	carbaryl (Sevin)	1 lb.	14 days (tops)
		trichlorfon	1 1/2 lb.	
European corn borer	Corn	carbaryl (Sevin)	1 1/2 lb.	
		DDT*	1 1/2 lb.	Do not feed forage
		diazinon	1 lb. granular	Do not feed to dairy animals; 90 days before slaughter
		toxaphene	2 lb. granular	grain only
		EPN	1/2 lb. as spray	14 days
			1/4 lb. granular	14 days
		Bacillus thuringiensis (as labeled)		No limitations
Grasshoppers	Alfalfa, clover, hay, and forage	carbaryl(Sevin)	1 lb.	5 days
		diazinon	1/2 lb.	7 days
		malathion	1 1/2 lb.	No time limitation
			or 0.6	5 days
		ULV ⁺ by air		(do not apply when in bloom)
	Corn	carbaryl	1 lb.	
		diazinon	1/2 lb.	
		malathion	1 lb.	5 days
		toxaphene	1 1/2 lb.	grain only

* Status uncertain. See introductory paragraph on page 4.

⁺ULV = ultra-low volume.

DO NOT USE AFTER 1969

Insect	Crop	Insecticide	Dosage	Limitations
Grasshoppers	Small grain	carbaryl(Sevin)*	1 lb.	Not after heads are visible
		malathion	1 lb. or 0.6 ULV ⁺ by air	7 days 7 days
		toxaphene	1 1/2 lb.	grain only
	Soybeans	carbaryl(Sevin)	1 lb.	No time limitations
		malathion	0.6 lb. ULV ⁺ by air	7 days
		toxaphene	1 1/2 lb.	21 days - beans only
	Grass (pasture, hay)	carbaryl(Sevin)	1 lb.	No time limitations
		diazinon	1/2 lb.	Do not graze on treated forage, wait 21 days before cutting for hay
		malathion	1 1/2 lb. or 0.6 lb. ULV ⁺ by air.	
		naled (Dibrom)	1/2 - 3/4 lb.	4 days for hay
Leafhoppers	Alfalfa	diazinon	1/2 lb.	7 days for hay; 4 days for grazing
		methoxychlor	1 1/2 lb.	7 days
Pea aphid	Alfalfa, clover	demeton(Systox)	4 oz.	21 days
		diazinon	1/2 lb.	7 days for hay; 4 days for grazing on alfalfa; 7 days for grazing on clover
		malathion	1 lb. 0.6 lb. or ULV ⁺ by air	No time limitations
		Parathion or methyl parathion	4 oz.	15 days

* Status uncertain. See introductory paragraph on page 4.

+ULV = ultra-low volume.

DO NOT USE AFTER 1969

Insect	Crop	Insecticide	Dosage	Limitations
Plant bugs	Alfalfa, clover	DDT*	1 1/2 - 2 lb.	Do not graze or cut for feed
		toxaphene*	2 lb.	Seed crop only
Sunflower moth	Sunflowers	endosulfan(Thiodan)	1 lb.	Not more than 3 applications
Sweet clover weevil	Sweet clover (plowdown)	toxaphene*	2 - 3 lb.	Do not graze or cut for feed
Thrips	Barley	parathion or methyl parathion	6 oz.	15 days
Wireworms	Corn, beans, Small grain	aldrin*, dieltrin*, heptachlor*, or lindane	1 oz. per bushel	Seed treatment
Wireworms and white grubs	Corn	aldrin* or heptachlor*	1 - 2 lb.	Soil treatment, row or broadcast
		chlordane	2 - 4 lb.	

* Status uncertain. See introductory paragraph on page 4.

INSECT CONTROL RECOMMENDATIONS ON LIVESTOCK FOR 1969

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

* Status uncertain. See introductory page 4.

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

* Status uncertain. See introductory page 4.

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

* Status uncertain. See introductory paragraphs on page 4.

⁺ULV = ultra-low volume.

Pest	Host	Insecticide	Rate	Limitations
Flies, (horn, stable, horse) and mosquitoes	Beef cattle	ronnel(Korlan)*	0.5% spray	8 weeks before slaughter
			1% in oil on backrubber	14 days before slaughter
		toxaphene	0.5% spray 5% in oil on backrubber 5% dust	28 days
		trichlorfon* (Neguvon)	1% spray	14 days before slaughter
Poultry mites, lice	Chickens,** Turkeys	coumaphos(Co-Ral)	1/2% dust 0.25% spray (1 gal.per 100 birds)	
		malathion	0.5% spray 4 - 5% dust	No time limitations No time limitations
		carbaryl(Sevin)	5% dust (1 lb. per 100 birds)	
			0.5% water mist spray (1 gal.per 100 birds)	
Sheep Keds	Sheep	coumaphos(Co-Ral)	0.25% spray 1/2% dust	15 days 15 days
		dioxathion(Delnav)	0.15% spray or dip	Not oftener than 2 weeks
		diazinon	0.03 - 0.06% spray or 2% dust	14 days 14 days
		malathion	0.5% spray	No time limitation
		methoxychlor	0.5% spray	
		ronnel(Korlan)*	0.25% spray	84 days
		toxaphene	0.5% spray 5.0% dust	28 days 28 days

* Status uncertain. See introductory paragraphs on page 4.

** Note: None of these materials has residue tolerance, other than zero, on

Pest	Host	Insecticide	Rate	Limitations
Swine mange mites (Sarcoptic) and lice	Swine	lindane	0.06% as spray or dip 1.0% dust 0.2% in oil on backrubber	Do not treat be- fore animals are 3 months old or sows within 2 weeks of farrow- ing; must be 30 days before slaughter, dips 60 days
		malathion	0.6% spray or dip 0.5% on rubbing devices; 5.0% dust	No time limita- tions
		toxaphene	0.6% spray or dip 5% dust 8.0% on rubbing devices	Do not treat before animals are 3 months old
Swine lice only	Swine	coumaphos (Co-Ral)	0.25% spray	No animals under 3 months old
		carbaryl (Sevin)	0.5% spray	No oftener than once every 4 days
		Ciodrin	0.25% spray	No oftener than once a week
		dioxathion (Delnav)	0.15% dip or spray	No oftener than once in every 2 weeks
		methoxychlor	0.5% dip or spray	No time limita- tions
		ronnel (Korlan)	0.25% spray or dip	No oftener than once in 2 weeks
			5% granular to bedding at 1/2 lb. per 100 sq. ft.	Remove from treat- ed bedding at least 2 weeks be- fore slaughter
		ronnel		Do not apply to animals receiving organophosphates from any other source

Corn rootworm plot data from Lamberton

The corn was planted May 10. Cultivation treatments were made June 21.

Insecticide	Dosage lb./A	Av.* Larvae	Root Ratings*	% Lodged	Yield bu./A
Check	-	4.7	5.8	9.2	120.0
Mocap P ⁺	3/4	2.0	3.8	0.3	132.8
Mocap C ⁺	1/2	6.3	4.5	2.3	130.6
Furadan P	3/4	0.8	0.0	0.0	138.7
Furadan C	3/4	0.0	0.0	0.0	133.8
diazinon P	1	2.5	2.3	1.0	124.0
Dasanit C	1/2	2.5	3.2	0.3	123.9
GA 428 P	1	2.0	3.5	1.5	129.8
Dyfonate P	3/4	3.2	2.3	0.0	126.9
Dyfonate C	1/2	4.0	2.5	2.8	131.6
phorate P	1	0.5	0.0	0.0	121.6
phorate C	1	0.8	0.5	0.0	120.9
Bux-Ten P	3/4	1.3	2.0	0.0	135.5
Baygon C	1/2	3.5	3.8	0.0	130.5
disulfoton P	1	0.8	3.2	0.3	133.4
disulfoton C	1	0.8	4.5	1.8	124.6

* Av. is total from five plants in each of four replications.

⁺ P = planting time; C = cultivation.

Soybeans Damaged by Thistle Caterpillar and Green Cloverworm

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

The thistle caterpillar prefers Canada thistle, but will feed on many other species of plants. Moderate to heavy populations were reported on soybeans in the Southwest, Southeast, South Central, and West Central districts of Minnesota in June. Few were observed on beans in the Central or East Central area. Sevin and toxaphene at 1 to 1 1/2 pounds/acre were recommended for control.

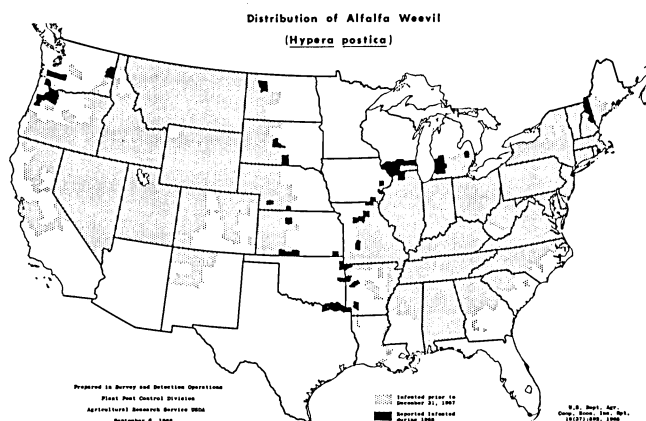
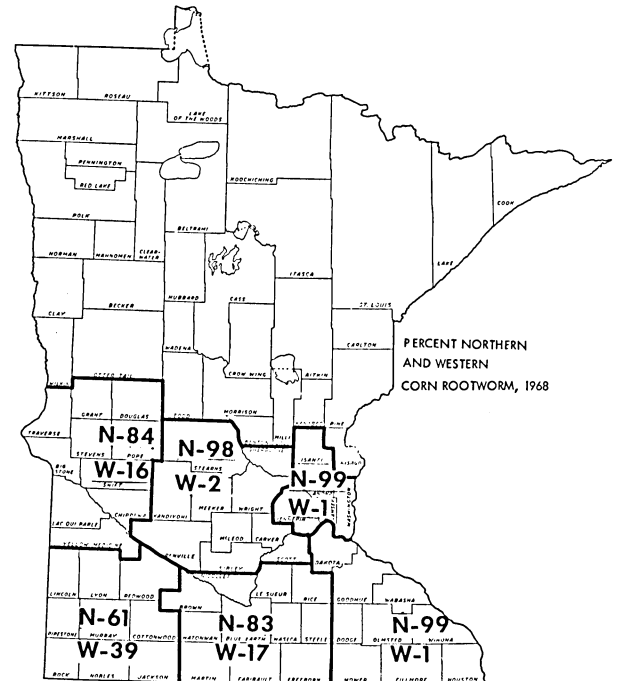
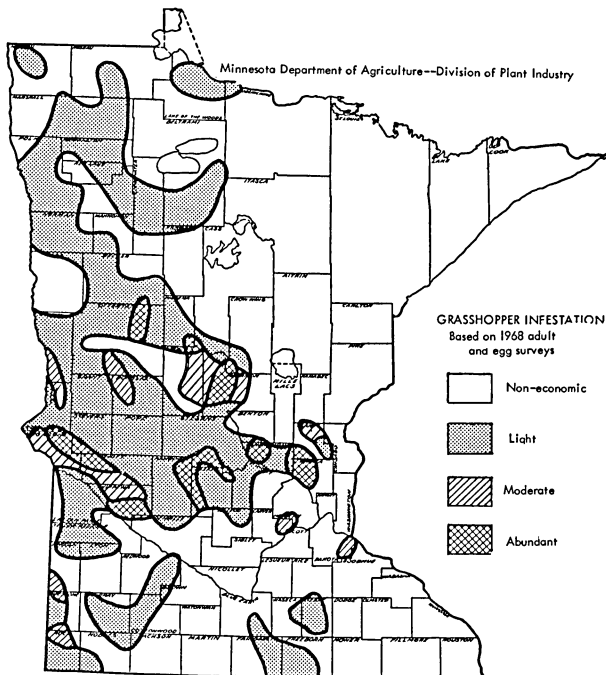
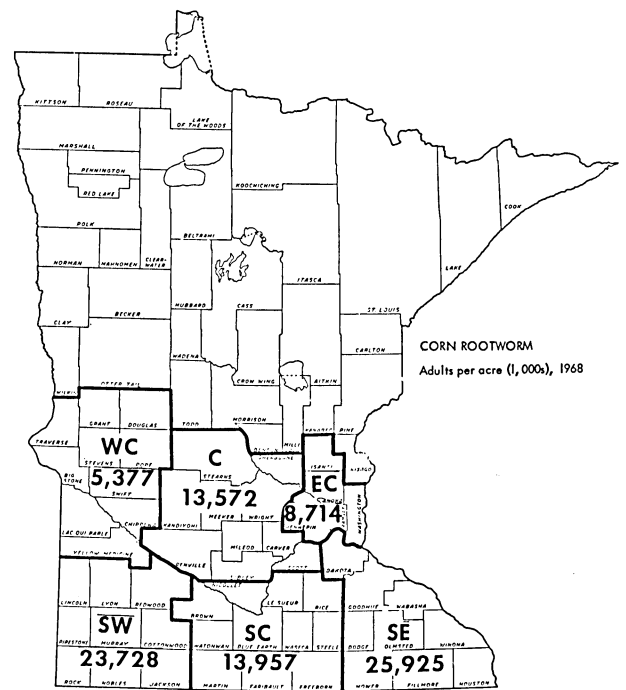
The green cloverworm Plathypena scabra (F) is distributed between the eastern U. S. A. to the Plains when it feeds on clover, alfalfa, garden beans, soybeans, cowpeas, strawberry, raspberry, and some other plants. The winter is passed in the pupal or adult stage. Adult moths are dark brown with a wingspan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

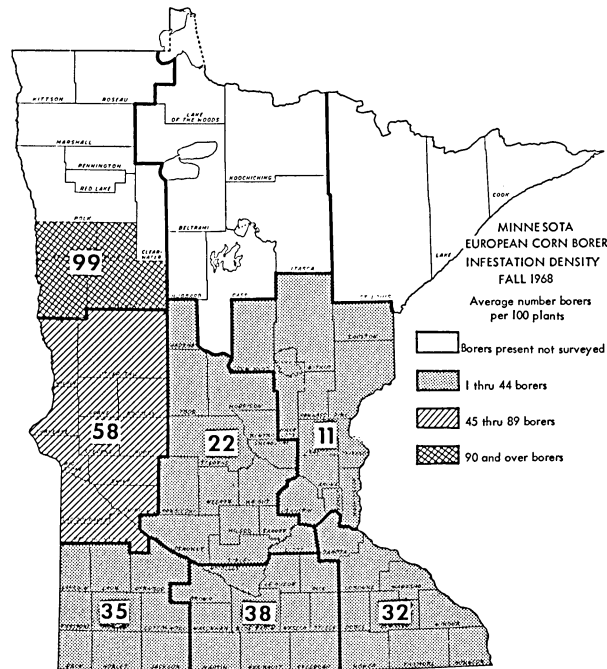
In early August young green cloverworms were found in relatively high populations in the Southwest, South Central, and Southeast districts of Minnesota. Economic levels of more than 6 worms per linear foot of row were found in these areas in mid-August. Field insecticide tests were conducted on soybeans in Lamberton.

Treatment		Cloverworms/foot of row			Defoliation (%)	
<u>Aug. 22</u>	<u>Rate/acre</u>	<u>Aug. 23</u>	<u>Aug. 28</u>	<u>Sept.10</u>	<u>Aug. 28</u>	<u>Sept.10</u>
Toxaphene	1.5	1.6	0.8	0.04	9.5	8.8
Carbaryl	1.5	0	0	0.04	7.8	6.1
Malathion	1.0	0.1	0.1	0	7.8	5.0
Diazinon	0.5	0.1	0.1	0	6.5	5.0
Check	--	5.1	4.1	1.1	14.1	18.5

CEREAL LEAF BEETLE UNIFORM STATE AND CANADIAN QUARANTINES

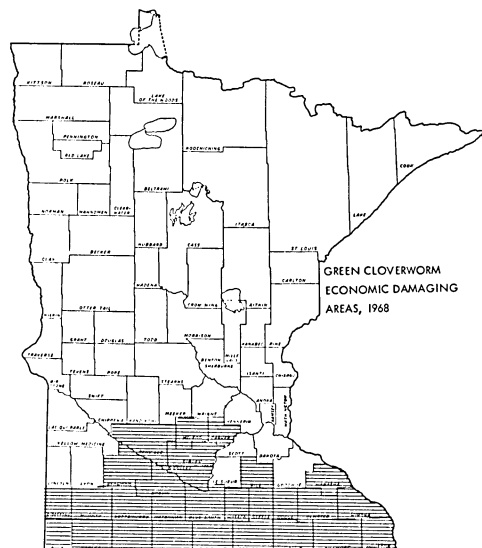
- Counties entirely colored are completely regulated; counties with black dot are partially regulated.
- Lined dot: Overall eradication treatments made; no quarantine regulations necessary.
- Certificates are required for movement of regulated articles from a black area into or through a white or lined area.





DISTRICTS	1963	1964	1965	1966	1967	1968
Southwest	117	62	21	66	19	35
South Central	132	35	12	51	16	38
Southeast	42	4	0.4	24	15	32
West Central	200	52	53	56	60	58
Central	57	15	8	26	37	22
East Central	25	8	2	15	18	11
Northwest	59	43	55	152	209	99
STATE AVERAGE	90	31	22	56	53	42

The above State of Minnesota, Department of Agriculture, Division of plant industry map and district figures represent the number of borers per 100 plants found during the fall abundance survey comparing previous years with 1968.



CROP DISEASES AND PROBLEMS IN MINNESOTA IN 1968

Herbert G. Johnson and Howard L. Bissonnette, extension plant pathologists

CORN DISEASES

Several diseases were found in corn in 1968 some of which rarely occurred before. Water damage was a major problem in many areas.

Early in the season scattered plants developed a rather loose rolling of leaves that delayed the emergence of some leaves and tassels. Most of these plants grew out of the trouble, but some of the leaves were light green to yellow until exposed to light for a few days. The percentage of affected plants varied from field to field and by hybrid. There is apparently a tendency for this in some hybrids, and the weather conditions were favorable for development of the symptom. The number of affected plants generally did not exceed 5 percent. The scattered distribution of affected plants indicated that chemicals were not a likely cause. Some tight rolling of leaves--often called "onion leaf symptom" was seen, and this is believed caused by the application of phenoxy herbicides under some conditions. Tassels and some leaves often do not emerge from these plants.

A rotting of the growing point occurred in some fields when plants were 1-2 feet high. The exact cause is not known, but may be the result of the growth of bacteria and fungi in the whorl during extended wet periods. The incidence was low, usually 1 percent or less, but affected plants died.

Leaf spot diseases were varied and common in the southeastern and south central part of Minnesota. At least five different leaf spots were recognized, but the cause not completely identified.

Holcus leaf spot - This leaf spot caused by a bacterium, occurred early in the season when plants were 6 inches to 2-3 feet high. The spots usually round, 1/8-1/4 inches in diameter, have a light gray to white center and often a distinctive purple margin, although the spots on some hybrids do not have this. Damage is insignificant.

Yellow leaf spot - This disease was reported in parts of Wisconsin adjacent to east central and southeastern Minnesota. A dead area about 1/4 inch in diameter with a yellow halo around it was the typical symptom. There was little of this in Minnesota.

Northern corn leaf blight - Its symptom is large oblong leaf spots, commonly 1/4-1/2 inches wide and 2-4 inches long. This disease occurs nearly every year in Minnesota, but seldom becomes serious. It can cause premature dying of leaves, but little of this occurred in 1968 although leaf spots covered a wide area of southern Minnesota.

Corn rust - This is one of the true rusts. Hybrids differ a great deal in susceptibility to this disease. It would be prevalent in some fields but absent in others. The rust spots or "pustules" are often 1/8-1/4 inches long and very narrow. The spot is an eruption of the leaf surface with a mass of

rust-colored spores on the surface. In late season the spores are black. Little if any significant damage occurred.

Eye spot - This disease occurred over a wide area of south central and southeastern Minnesota and adjacent parts of Wisconsin and Iowa. Plant pathologists and others in those states have been contacted and so far the exact cause has not been determined. It fits fairly closely the description of a fungus disease called anthracnose, but other causes have also been suggested by authorities on corn diseases. Eye spot disease consists of numerous small leaf spots that average about 1/16 of an inch in diameter and usually have a purple margin. The presence of the purple margin varies with different corn lines. The small leaf spots were very numerous on many hybrids and apparently resulted in premature dying of corn leaves in some fields. This gave the fields the appearance of being damaged by frost. There is a wide range of variation in corn hybrids in susceptibility and resistance to this disease. Many hybrids appear to be immune. These hybrids offer a good solution to the problem if the disease persists in future years. The disease is apt to be minor, but may have been present for a long time. It likely flared up this year because of unusually favorable weather conditions. Early maturing hybrids were generally more severely infected than later ones. This could be the result of greater susceptibility in early hybrids or the disease may be a type that attacks maturing plants more severely. Corn root rot and stalk rot are severe this year too, and these diseases may cause premature dying of plants. When this occurs, the dying plants are generally scattered in the field. Some degree of yield and quality loss may have resulted from the leaf spot in some fields - perhaps from the premature dying of leaves. Direct comparisons could not be made because situations differed.

OTHER CORN DISEASES

Cracking of corn stems - Some corn plants were found with a crack or cut part way across the lower part of the stem. This may have occurred during periods of high wind when the plants were brittle from phenoxy herbicide application or turgid from other conditions. Some plants broke off, but others grew normally to maturity. This symptom has been rare in previous years.

Stalk rot - This is the most serious disease of corn in Minnesota and causes the greatest monetary loss. Stalk rot and the resulting lodging was unusually severe in many fields in 1968. The wet fall with many warm days was a likely cause of much of the damage. The growth of the fungi which cause stalk rot is favored by moist plant tissue and moderate temperature. Once the plant is mature, it has little resistance to the growth of the fungi. The delay in harvest from wet weather gave the fungi increased time to grow.

SOYBEANS

Seedling blight - Several things went wrong in some soybean fields early in the season. Soil worked up very well and much seed was planted too deep. This would have been all right under dry conditions, but rains came and emergence was often poor. Fungus seedling blights often accounted for reduced stands. Fungicide seed treatment would have helped in many fields.

Hail injury - Severe hail injury is easily recognized and often damages soybeans beyond recovery. Light hail injury may go unnoticed for several

weeks until plants start to fall over. This situation usually results from small wounds in the stems followed by fungus infection which progressively weakens the injured area. As the plant grows taller and heavier, the weak spot eventually breaks and the plant falls and often dies.

Stem pigmentation - A stem darkening was found on many plants and requests for identification were frequently received. This is a natural pigmentation that occurs late in the season on many varieties. The coloring is smooth and lacks any distinctive structure as is found with pod and stem blight.

Late season leaf disorder - In late August and early September a spotting occurred on soybean leaves that did not fit the symptoms of any of the common fungus or bacterial leaf spots. The spots were in the leaf areas between large veins. This disorder is believed caused by a water shortage to the leaves resulting from a weather change. A similar collapse of leaf tissue from lack of water has been observed in other crops.

Delayed maturity of soybean plants - This condition occurred in 1967 and fields were rechecked for it in September 1968. In 1967 the delayed plants occurred to a great extent in southern Minnesota, but in 1968 reports of it came mostly from the Litchfield-Willmar area. The condition usually occurs as green plants in border rows after the plants in the bulk of the field have dropped their leaves. Scattered green plants sometimes occurred farther out in the field. The virus disease, bud blight, infects plants in a similar pattern. Individual plants and distributions of affected plants in fields were inspected, but bud blight did not appear to be the cause. Growing factors such as "border effect" more likely caused the trouble. Generally the green plants were distinctly and quite solidly along field borders. However in one instance, all affected plants were widely spaced which gave them light, water, and nutrient advantages.

ALFALFA

Black stem - In late May, several alfalfa fields in southern Minnesota were inspected following reports of dying plants. Individual stems rather than whole plants were dying. Dark lesions on these dying stems indicated its cause - black stem disease. This was not serious since the crowns and roots were healthy.

Dying plants were found and both Phytophthora root rot and bacterial wilt identified as causes. Phytophthora root rot destroys the tap root and the plant wilts from lack of water. Bacterial wilt results in a plugging of water conducting tissue.

The common fungus leaf spot diseases were prevalent and caused loss of leaves as usual. The frequent rains may have increased the general amount of these diseases.

CEREAL GRAINS

Seed treatment - Planting good quality disease-free seed in a well-prepared seedbed when the soil is warm and moist would eliminate the need for most seed treatment. However, these ideal conditions usually do not occur -

so seed treatment is needed to protect the seed from pathogenic organisms on the seed and in the soil.

The recent changes in pesticide regulations are creating a change in the chemicals being used for seed treatment. The sharp increase in the price of mercury is affecting its subsequent use, too. Several non-mercury dusts are now available as seed treatment chemicals. During the last few years of field testing these new chemicals have appeared favorable.

Several seed treatment chemicals are also available as drill box treatments. When used as directed, this type of treatment is effective in preventing damping-off and seedling blight.

Chemicals for seed treatment of small grains

Liquid seed treatment

* Mercury - Ceresan L
Mist-o-matic
Panogen

Special:

loose smut of barley

VITAVAX

+ Drill box treatment

AGSCO DB
Ceresan M-DB
Panogen PX

* Note - High moisture seed may be injured with mercury seed treatment.

+ Note - Drill box treatment will reduce the chance of treated seed finding its way into the harvested crop.

Loose smut of barley - This seedborne disease can be stopped with the systemic seed treatment chemical VITAVAX. This material has clearance only for use on seed crops. Grain produced from VITAVAX-treated seed cannot be sold into the commercial food channels.

An embryo test for loose smut detection may be obtained through the State Department of Agriculture. Send about one pint of seed representative of the lot, to:

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

There is a \$5 per sample charge which should accompany the sample. Make checks payable to the Minnesota State Treasurer.

Leaf spot - Cereal leaf spot diseases (Septoria leaf spot, leaf rust, and others) can be controlled with foliar applications of fungicides. The timing of application is most critical and cannot be neglected.

Cereal leaf disease control with fungicides		
	Wheat	Barley
1st application	Early heading - 1/4 of plants starting to head.	5 days to 1 week before heading. (Head can be felt in the boot.)
2nd application	10 days after first application	10 days after the first application.
Chemicals	Dithane M-45 Manzate 200 Zineb	Dithane M-45 Manzate 200
Spreader-sticker - 3/4-1 ounce/acre.		
Rates	All chemicals - 1 1/2-2 pounds of formulation per acre each application.	
Method	At present only aerial application has been worked out. A minimum of 5 gallons of water per acre must be applied. The aircraft must have the proper equipment and develop a uniform spray pattern.	

SUGAR BEETS

Cercospora leaf spot - This disease was light in most areas this year. Leaf spot spraying was successful in the Crookston and Appleton areas where the disease was more prevalent.

No leaf spot developed in the fungicide spray trials at the Rosemount Station this year.

Fungicides for leaf spot control
Dithane M-45
Fixed coppers (Kocide 101 and Tribasic)
Manzate - 200
Polyram

POTATOES

Seed Piece Decay - Poor quality seed, poorly stored, treated improperly and planted in cold soil resulted in some very poor stands. Seed Piece Decay may be caused by a variety of fungi and/or bacteria. Chemical seed treatment along with proper seed handling will reduce the loss caused by the Seed Piece Decay organisms.

Good potato seed handling

1. Before planting, warm seed at 60° - 70° F. for 1 1/2-2 weeks.
2. Do not handle seed until warm.
3. Plant cut seed immediately in warm (50° F.) moist soil.
4. If cut seed must be held:
 - a. Store in well-ventilated area for suberization at 60° - 70° F. with a relative humidity of 85 percent. Hold for 1 week; then lower temperature to 50° - 60° F.

For seed treatment

1. Dip warm whole seed in organic mercury - dry after treatment.
2. Cut dried seed.
3. Apply organic fungicide dust. Plant immediately in warm (50° F.) moist soil.

NOTE: Acid Mercury - cannot legally be used to treat potatoes. This chemical does not have a tolerance label from the USDA and FDA.

Black leg - A bacterial disease, it was very common in the Elk River-Big Lake irrigation area. In mid-July stand losses as high as 20 percent were observed. Better seed handling and seed treatment (as suggested here) would have reduced these losses.

Late Blight - Conditions were favorable for Blight in the valley; however, the disease did not develop until late in the season. Blight was found throughout the Fosston area. Some storage rot follows. Regular application of fungicide in the Fosston area could have checked the spread of Blight.

In the Blight plots at the Potato Research Farm near Grand Forks, no significant differences were found among the various fungicides tested. The incidence of Blight (Early and Late) was insignificant.

Fungicides for use on potatoes

<u>Seed piece treatment</u>	<u>Blight and foliage disease</u>
Semesan Bell S	maneb zineb
Polyram	Dithane M-45 Manzate 200
maneb zineb + antibiotic	Polyram
captan	Duter
<u>Rhizoctonia</u>	Copper (fixed)
PCNB	Spreader-sticker - should be used for better distribution and retention of the chemical.

COMPUTER FERTILIZER AND LIME RECOMMENDATIONS

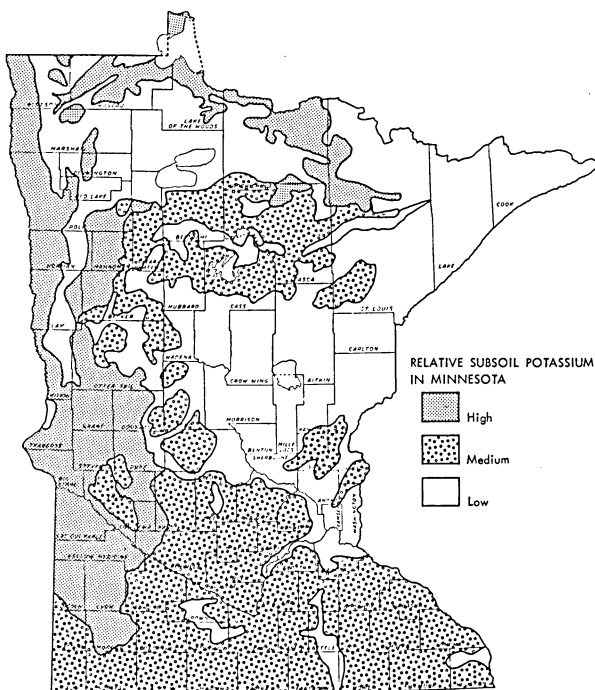
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extension soils specialists

Corrective Recommendation

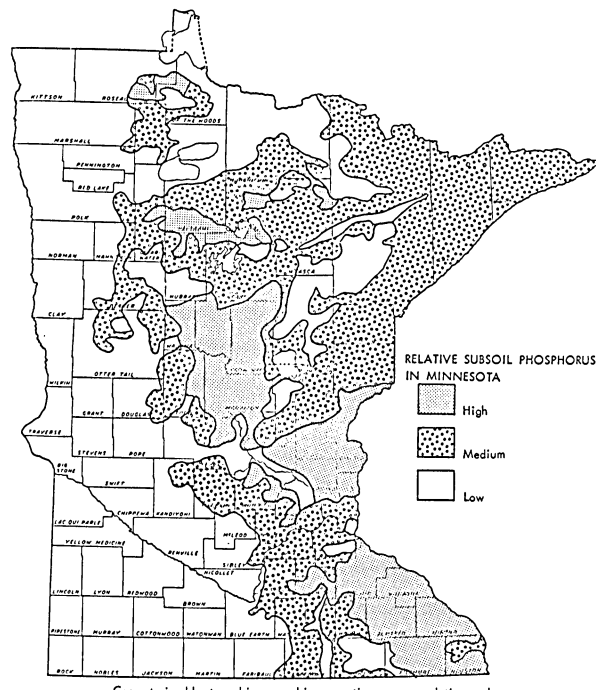
Certain minimum soil test levels are required to produce optimum crop yields. If your soil test indicates that the soil pH, phosphorus, and/or potassium are below these levels then corrective lime and/or fertilizer recommendations will be made. Soil tests should be taken every 3 years to see if additional corrective treatments are necessary. Corrective phosphorus and/or potassium recommendations are made only if alfalfa and/or corn are in the cropping system. Corrective lime recommendations may be made for any crop. The corrective recommendation should be applied when it can be incorporated into the soil.

Maintenance Recommendation

This fertilizer recommendation is based on the soil test and refers to the amounts of nitrogen, phosphorus, and potassium which should be applied for the crop to be grown. The maintenance recommendation is required each year the particular crop is grown.



Computerized by township - used in corrective recommendations only.



Computerized by townships - used in corrective recommendations only.

Table 1. Corn: corrective potassium recommendations (apply only when yield potential is greater than 100 bu./A)

Areas I and II: see map page 30.

Potassium (K) soil test (lb./A)	Relative subsoil potassium (K) level*		
	Low	Medium	High
	Plant nutrients (lb./A)		
	K ₂ O	K ₂ O	K ₂ O
0-100	150	120	90
101-175	120	90	60
175-250	90	60	0
over 250	0	0	0

* See subsoil map page 24.

Table 2. Corn: corrective phosphorus recommendations (apply only when yield potential is greater than 100 bu./A)

Areas I and II: see map page 30.

Phosphorus (P) soil test (lb./A)	Relative subsoil phosphorus (P) level*		
	Low	Medium	High
	Plant nutrients (lb./A)		
	P ₂ O ₅	P ₂ O ₅	P ₂ O ₅
Low (0-10)	80	60	40
Medium (11-20)	60	40	0
Over 20	0	0	0

* See subsoil map page 24.

Table 3. Corn: maintenance phosphorus and potassium recommendations*

Area I: see map page 30.

Yield potential (bu./A)	Soil texture	Phosphorus (P) soil test (lb./A)	Potassium (K) soil test (lb./A)		
			0-150	151-300	over 300
			Plant nutrients needed (lb./A)		
			P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O
Greater than 100	fine and medium	0-20	60 + 60	60 + 40	60 + 20
		over 20	40 + 60	40 + 40	40 + 20
	coarse	0-20	40 + 40	40 + 20	40 + 0
		over 20	20 + 40	20 + 20	20 + 0
Less than or equal to 100	fine and medium	0-20	40 + 40	40 + 20	40 + 10
		over 20	20 + 40	20 + 20	20 + 10
	coarse ⁺	0-30	30 + 60	30 + 30	30 + 0
		over 30	20 + 60	20 + 30	20 + 0

* To be applied each year crop is grown.

+ Irrigated soils receive fertilizer recommendation listed under Fine textured soil of greater than 100 bu./A yield.

Table 4. Corn: maintenance phosphorus and potassium recommendations*

Areas II and III: see map page 30.

Yield potential (bu./A)	Soil texture	Phosphorus (P) soil test (lb./A)	Potassium (K) soil test (lb./A)		
			0-150	151-300	over 300
			Plant nutrients needed (lb./A)		
			P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O
Greater than 70	fine and medium	0-20	50 + 50	50 + 30	50 + 20
		over 20	30 + 50	30 + 30	30 + 20
	coarse	0-20	40 + 40	40 + 20	40 + 0
		over 20	20 + 40	20 + 20	20 + 0
Less than or equal to 70	fine and medium	0-20	30 + 30	30 + 20	30 + 10
		over 20	20 + 30	20 + 20	20 + 10
	coarse ⁺	0-20	30 + 40	30 + 20	30 + 0
		over 20	20 + 40	20 + 20	20 + 0

* To be applied each year crop is grown.

+ Irrigated soils receive fertilizer recommendation listed under Fine textured soil of greater than 100 bu./A yield listed for Area I.

Table 5. Corn: nitrogen recommendations

Yield potential	Organic matter level	Manure applied	Nitrogen recommendation (lb./A)				
			Previous crop				
			Corn, potatoes, sugarbeets, small grain, idle	Poor alfalfa or clover stand, black fallow	Good alfalfa or clover stand	Soybeans	Corn failure
(1) 130-160 bu./A*	L - M	0	200	150	100	180	150
		10 T/A	150	100	50	130	100
	H	0	170	120	70	150	120
(2) 101-129 bu./A	L - M	10 T/A	120	70	20	100	70
		0	150	100	50	130	90
	H	0	100	50	15	80	40
(3) 70-100 bu./A	L - M	10 T/A	120	70	20	100	60
		0	70	20	15	50	15
	H	0	100	50	15	80	70
(4) Less than 70 bu./A	L - M	10 T/A	50	15	15	50	40
		0	15	15	15	15	15
	H	0	40	15	15	40	30
		10 T/A	15	15	15	15	15

* If irrigated, 200 lbs. of N.

Maintenance corn fertilization is to be applied each year corn is grown.

Apply fertilizer as starter

1. If soils are fine or medium textured and tend to warm up late in the spring.
2. If only small amounts are required.

Apply fertilizer as broadcast plus seed-placed (pop-up)

If soils are fine or medium textured and tend to warm up late in the spring. (Caution: Do not apply more than a total of 15-20 pounds of N + K₂O as seed-placed.)

Fertilizer may be applied as either broadcast or starter

1. If soils are well drained and rainfall is normally limiting.
2. If the soil is coarse textured and not low in P & K.

For Area I: If no yield potential is given:

On medium and fine-textured soils give N recommendation for 101-129 bushels per acre.

On coarse textured soils give N recommendation for 70-100 bushels per acre.

For Areas II and III: If no yield potential given:

On medium and fine-textured soils give N recommendation for 70-100 bushels per acre.

On coarse textured soils give N recommendation for less than 70 bushel per acre.

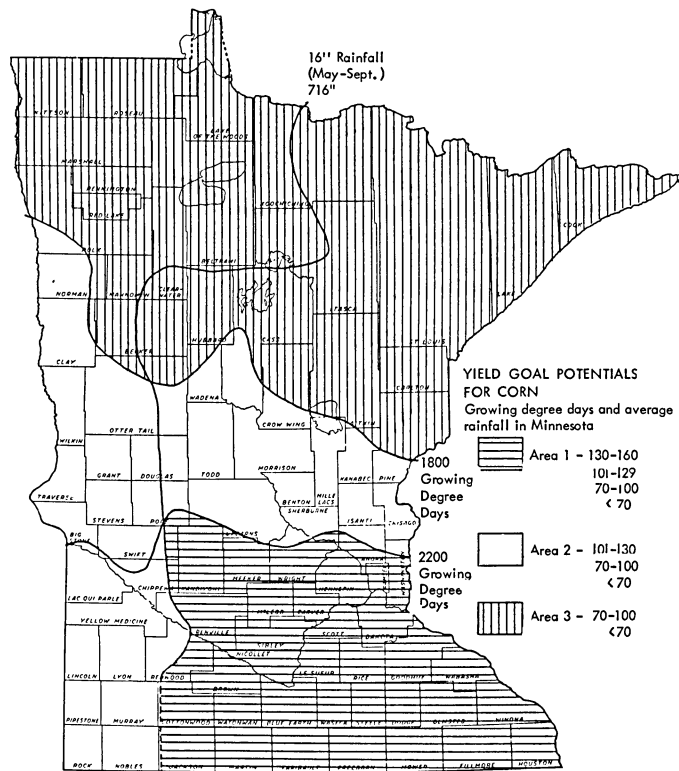


Table 6. Soybeans: maintenance phosphorus and potassium recommendations

Phosphorus (P) soil test (lb./A)	Potassium (K) soil test (lb./A)		
	0-100	101-200	over 200
	Plant nutrients (lb./A)	Plant nutrients (lb./A)	Plant nutrients (lb./A)
	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O
0-20	30 + 100	30 + 30	30 + 0
over 20	0 + 100	0 + 30	0 + 0

Table 7. Alfalfa: corrective potassium recommendations
Apply corrective fertilizer prior to establishing the seedbed

Potassium (K) soil test (lb./A)	Relative subsoil potassium (K) level*		
	Low	Medium	High
	Plant nutrients (lb./A)		
	K ₂ O	K ₂ O	K ₂ O
0-75	360	240	120
76-125	240	180	90
126-175	180	120	60
176-225	120	90	0
over 225	0	0	0

* See subsoil map page 24.

Table 8. Alfalfa: corrective phosphorus recommendations
Apply corrective fertilizer once prior to establishing the seedbed

Phosphorus (P) soil test (lb./A)	Relative subsoil phosphorus (P) level*		
	Low	Medium	High
	Plant nutrients (lb./A)		
	P ₂ O ₅	P ₂ O ₅	P ₂ O ₅
Low (0-10)	80	60	40
Medium (11-20)	60	40	0
Over 20	0	0	0

* See subsoil map page 24.

Table 9. Alfalfa: maintenance recommendations--topdress treatment annually for fine-textured soils

Phosphorus (P) soil test (lb./A)	Potassium (K) soil test (lb./A)			
	0-100	101-200	201-300	over 300
	Plant nutrients needed (lb./A)			
	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O
0-10	60 + 120	60 + 60	60 + 30	60 + 0
11-20	40 + 120	40 + 60	40 + 30	40 + 0
21-30	30 + 120	30 + 60	30 + 30	30 + 0
over 30	0 + 120	0 + 60	0 + 30	0 + 0

Table 10. Alfalfa: maintenance recommendations--topdress treatment annually for coarse-textured soils

Phosphorus (P) soil test (lb./A)	Potassium (K) soil test (lb./A)			
	0-100	101-200	201-300	over 300
	Plant nutrients	Plant nutrients (lb./A)	Plant nutrients (lb./A)	Plant nutrients (lb./A)
	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O
0-10	60 + 180	60 + 120	60 + 60	60 + 0
11-20	40 + 180	40 + 120	40 + 60	40 + 0
21-50	30 + 180	30 + 120	30 + 60	30 + 0
over 50	0 + 180	0 + 120	0 + 60	0 + 0

Table 11. Small grains: maintenance phosphorus and potassium recommendations for barley, buckwheat, millet, oats, rye, sorghum-sudan, and wheat

Phosphorus (P) soil test (lb./A)	Potassium (K) soil test (lb./A)*					
	0-100		101-200		over 200	
	Plant nutrients (lb./A)		Plant nutrients (lb./A)		Plant nutrients (lb./A)	
	Row ⁺	Broadcast	Row	Broadcast	Row	Broadcast
	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O	P ₂ O ₅ + K ₂ O
0-10	40 + 40	60 + 60	40 + 20	60 + 30	40 + 15	60 + 0
11-20	30 + 40	40 + 60	30 + 20	40 + 30	30 + 15	40 + 0
21-50	20 + 40	30 + 60	20 + 20	30 + 30	20 + 15	30 + 0
over 50	20 + 40	0 + 60	20 + 20	0 + 30	20 + 15	0 + 0

* If the small grain is a companion crop for legume hay seeding and the corrective recommendation is applied, the maintenance P₂O₅ and K₂O recommendation for the small grain need not be applied.

+ Do not exceed 50 pounds of N + K₂O per acre in the row. It may be desirable to apply 10 or 20 pounds of K₂O in the row and broadcast the remainder.

Table 12. Small grains: recommendations*

				Nitrogen recommendations (lb./A) ⁺					
Crop	Yield goal	Lodging problem	Manure applied	Previous Crop					
				Corn, potatoes, sugarbeets, small grain idle acres		Alfalfa, clover, fallow, organic soil		Soybeans	
				Row**	Bdcst.	Row	Bdcst.	Row	Bdcst.
Barley			0	50	50	20	20	30	30
Buckwheat									
Millet	--	NO	10 T/A	20	20	10	0	15	20
Oats									
Rye			0	20	20	15	20	20	20
Sorghum-sudan		YES	10 T/A	10	0	10	0	10	0
	Greater than 50 bu./A	--	0	80	80	40	40	60	60
			10 T/A	40	40	20	20	30	30
Wheat	Less than 50 bu./A	--	0	50	50	20	20	40	40
			10 T/A	25	25	10	0	20	20

* If the small grain is a companion crop for a legume hay apply only 30 pounds of N per acre.

+ It may be desirable to apply only 10 or 20 pounds of N in the row and broadcast the remainder.

** Apply no more than 40 pounds of N in the row. If row recommendation exceeds 40 pounds apply remainder as broadcast.

Lime Needs in Minnesota*

Lime improves crops principally by promoting desirable biological activity. Such benefits are realized through higher yields and better quality.

Bacteria in legume root nodules supply nitrogen to these crops in plentiful quantities if soil acidity is reduced sufficiently. Other types of bacteria step up their activity in rotting residues and soil organic matter if adequate lime is present.

In addition to stimulating biological activity dolomitic lime (as is generally available in Minnesota) supplies calcium and magnesium. Addition of the latter is an important advantage in soil areas that tend to be low in magnesium. Liming acid soils will also make soil phosphorus more available to plants.

Table 13.

LIME RECOMMENDATIONS Effective January 1, 1968

Lime Required (Tons/Acre)(1)				
Where SMP Buffer Applies (soil-water pH values below 6.0) SMP Buffer Index	To Raise Soil-Water pH to 6.5		To Raise Soil-Water pH to 6.9	
	Area 1	2	Area 1	2
6.8	3.0	2	5.0	NR(2)
6.7	3.0	2	5.0	NR
6.6	4.0	2	6.0	NR
6.5	4.5	2	6.5	NR
6.4	5.0	2.5	7.0	NR
6.3	5.5	2.5	7.5	NR
6.2	6.0	3.0	8.0	NR
6.1	6.5	3.0	8.5	NR
6.0	7.0	3.5	9.0	NR
5.9	7.5	3.5	9.5	NR
5.8	8.0	4.0	10.0	NR
5.7	8.5	4.0	10.5	NR
5.6	9.0	4.5	11.0	NR
Where SMP Buffer does <u>Not</u> Apply (soil-water pH values of 6.0 and higher)				
<u>Mineral Soils</u>				
<u>Soil-Water pH</u>				
6.5	0(3)	0	2(3)	NR
6.4	0	0	2	NR
6.3	3	0	5	NR
6.2	3	0	5	NR
6.1	4	0	6	NR
6.0	4	2	6	NR
Organic Soils (peats and mucks) (4)				
<u>Soil-Water pH</u>				
5.4	2	2	2	2
5.3	2	2	2	2
5.2	2	2	2	2
5.1	2	2	2	2
5.0	2	2	2	2
4.9	3	3	3	3
4.8	3	3	3	3
4.7	4	4	4	4
4.6	4	4	4	4
4.5 and lower	5	5	5	5

(1) 6-inch plow depth

(2) NR = Not Recommended

(3) These lime rates at water pH 6.0 or above need not be applied where alfalfa is not grown in the cropping system.

(4) Only limed to pH 5.5

* From University of Minnesota Soils No. 10 Fact Sheet by W. E. Fenster, C.J. Overdahl, and J. Grava, extension soil scientists.

The SMP Buffer Test

Since January 1, 1968 a buffer test called "SMP buffer" has been used to better determine lime needs in Minnesota.

1. What the SMP buffer test is and what it does:

The SMP buffer test for lime was developed by 3 soil scientists (Shoemaker, McLean, and Pratt) from Ohio State University. This test (currently being used quite widely in the midwest) allows us to determine total soil acidity and more accurately predict lime needs. With only the soil-water pH, (this is the pH value we are all familiar with as the soil pH) we could only estimate the acidity on the organic matter and clay exchange sites. Two soils with exactly the same soil-water pH might vary quite widely in the amount of lime needed to raise the pH to 6.5 or 6.9, depending upon the amount of organic matter and clay content of each of the soils. The soil with the higher organic matter and/or clay content would require more lime due to the higher reserve acidity.

The pH of the SMP buffer solution itself is 7.5. When the SMP is added to a soil, the original pH of the SMP buffer will go down. Since we know how much acid is required to lower the SMP buffer to any given pH level, we can determine the total acidity of the soil. For example, a soil with a soil-water pH of 5.4 might bring the SMP buffer pH index from 7.5 to 6.3. If we turn to table 13, we see that it would take 5.5 tons of lime to raise the soil-water pH from 5.4 to 6.5.

There is a tendency to mistake the buffer index for soil pH. Even though the buffer index is a pH, it is not the soil pH. We call it buffer index to show that there is a difference. The buffer index is used only to determine lime needs and is in no other way connected with soil water pH.

2. SMP buffer is not used above pH 5.9.

If the soil-water pH (soil pH) is 6.0 or higher, the SMP buffer is not run. The relative error of the SMP buffer is too high in this soil pH range.

3. Soil-water pH and its relationship to the SMP buffer.

In order to become better acquainted with the soil-water pH and its relationship to the SMP buffer, table 14 is given to illustrate some typical soil pH values, the SMP buffer index, and the lime recommendations for 6- and 9-inch plow depths.

Table 13 contains lime recommendations for all Minnesota soils and is a convenient reference when interpreting lime requirements from pH tests.

Recommendations

1. Lime recommendations for corn and soybeans.

If alfalfa is not in the cropping system, pH levels of 6.0 or above are adequate without liming. If the soil pH is below 6.0, then apply lime at the rates needed to reach a soil pH of 6.5. High nitrogen rates used for corn on noncalcareous soils depress pH.

2. Limy subsoils call for less lime in western Minnesota.

In western Minnesota (area 2 on the map) no lime recommendations will be made for soil-water pH values of 6.1 and higher. Where lime is recommended in area 2 the tonnage will be one-half that recommended for area 1. In extreme southwestern Minnesota the Moody-Kranzburg-Vienna soil association has an acid plow layer. Frequently, these soils have adequate lime in the subsoil, and lime is recommended only if soil phosphorus and potassium test levels are medium or high and there is difficulty in establishing stands of alfalfa.

3. Lime recommendations have been raised.

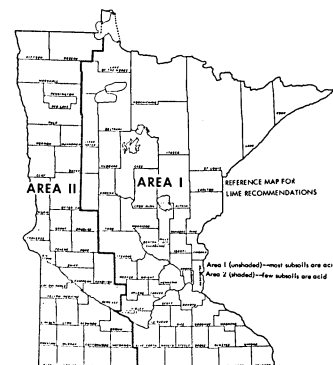
Incubation studies on the lime requirements for 35 Minnesota soils have been conducted and correlated with the SMP buffer test. It was found that higher amounts of lime were needed to attain the soil pH levels of 6.5 and 6.9. Also, a critical evaluation of the limestone in Minnesota showed that we had over-estimated its effectiveness. Therefore, larger amounts are recommended to compensate for this.

Some lime recommendations are in excess of 5 tons per acre. If this creates financial problems it may be desirable to apply 5 tons per acre the first year and the remainder 3 or 4 years later.

Table 14. Example lime recommendations

Soil Texture	Organic Matter Level (soil-water)	Soil pH	SMP Buffer Index	Lime Recommendations (tons/acre)			
				6 inch plow depth		9 inch plow depth (1)	
				To attain a pH of:		To attain a pH of:	
				6.5	6.9	6.5	6.9
<u>Eastern Minn.</u>							
Winona Sil	L	6.0	ND ⁽²⁾	4	6	6	9
Fillmore Sil	L	6.2	ND	3	5	4.5	7.5
Rice Sic1	M	5.7	6.0	7	9	10.5	13.5
Dakota L	M	5.5	6.0	7	9	10.5	13.5
Wabasha Sil	M	5.4	6.2	6	8	9	12
Houston Sil	M	5.4	6.1	6.5	8.5	9	12
Aitkin Ls	L	5.3	6.2	6	8	9	12
Chisago Sl	L	5.0	6.0	7	9	10.5	13.5
<u>Western Minn.</u>							
Brown Cl	H	6.1	ND	NR ⁽³⁾	NR	NR	NR
Pipestone ⁽⁵⁾ Sil	M	5.8	6.5	2	NR	3	NR
Redwood Cl	H	5.9	6.4	2.5	NR	3.5	NR
<u>Organic Soils</u>							
Anoka P	VH	5.6	ND	NR	NR	NR	NR
Anoka P	VH	5.1	ND	2 ⁽⁴⁾	NR	3	NR
Isanti P	VH	4.5	ND	5 ⁽⁴⁾	NR	7.5	NR

- (1) These recommendations reached by multiplying 6 inch plow depth recommendation by 1.5.
- (2) ND = Not Determined
- (3) NR = Not Recommended
- (4) To reach pH of 5.5
- (5) Lime for loess soils of southwestern Minnesota is recommended only where there is difficulty in establishing stands of alfalfa and phosphorus and potassium levels are medium or high.



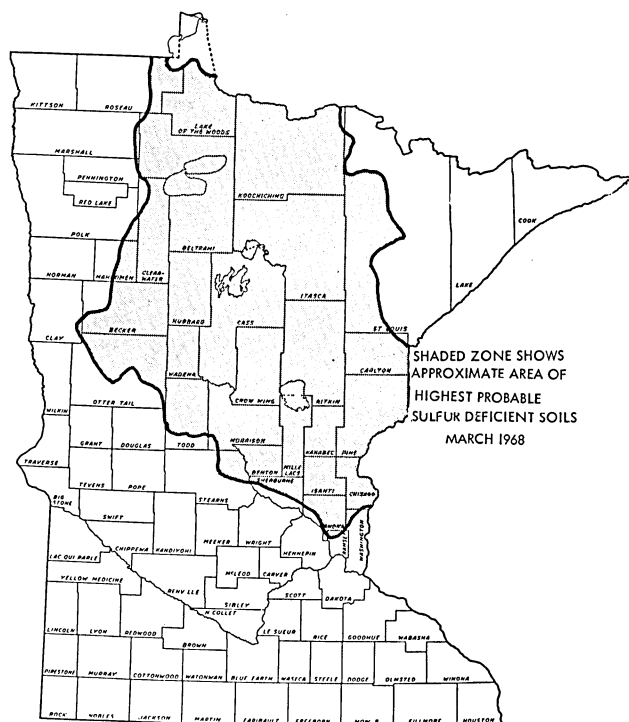
Sulfur soils tests for Minnesota*

Studies in Minnesota have shown the soils to vary greatly in their sulfur supplying capacity. In some soil areas, application of sulfur is of major importance for most efficient crop production; this is especially true with alfalfa. For this reason, a sulfur soil test was introduced in 1968 by the University of Minnesota Soil Testing Laboratory to assist farmers in determining which fields might be sulfur deficient.

The majority of the soils low in sulfur supplying power are in north central Minnesota (see accompanying map). All soils in the shaded area, however, are not sulfur deficient, nor are all soils in the nonshaded area sulfur sufficient.

Frequently, high subsoil sulfur contents complicate making recommendations in the nonshaded portion of the map. For this reason, sulfur is recommended on a trial basis only for this area.

Interpretation of the sulfur test in the two areas of Minnesota is as follows:



* Reprinted from Soil Fertility Notes, W.E. Fenster and C.J. Overdahl. Agricultural Extension Service, University of Minnesota, Institute of Agriculture, June 1968.

Table 15. For shaded area of map.

Extractable sulfur* S p.p.m.	Relative level	Yield increase expected from sulfur applications
Less than 7	Low	Highly possible
7 to 12	Medium	Possible
More than 12	High	Unlikely

* By turbidimetric determination with barium chloride in calcium phosphate extracts. P.p.m. means parts per million and can be converted to the approximate pounds per acre if multiplied by two.

1. If extractable sulfur is less than 7 p.p.m. (yield increase highly possible):

For alfalfa and clovers--At planting time broadcast 50 pounds/acre of sulfur. This application would require 50 pounds of elemental sulfur or 300 pounds of gypsum (18 percent sulfur)/acre.

Repeat application every 3 years.

For corn and small grain--Broadcast 20 pounds/acre of sulfur or apply 10 pounds/acre of sulfur in the row. Repeat application every year.

2. If extractable sulfur is between 7 and 12 p.p.m. (yield increase possible):

For alfalfa and clovers--Apply sulfur on a trial basis only. If a response is noted, then use recommendation in table 15.

For corn and small grain--No sulfur recommended.

3. If extractable sulfur is greater than 12 p.p.m. (yield increase unlikely):

For alfalfa and clovers--No sulfur recommended.

For corn and small grain--No sulfur recommended.

Table 16. For unshaded area of map.

Extractable sulfur* S p.p.m.	Relative level	Yield increase expected from sulfur applications
Less than 7	Low - medium	Possible
More than 7	Medium - high	Unlikely

* By turbidimetric determination with barium chloride in calcium phosphate extracts.

Sulfur Recommendations for Table 16

1. If extractable sulfur is less than 7 p.p.m. (yield increase possible):

For alfalfa and clovers--Apply sulfur on a trial basis only. If a response is noted, then use recommendation listed on previous page under heading.

For corn and small grain--No sulfur recommended.

2. If extractable sulfur is greater than 7 p.p.m. (yield increase unlikely):

For alfalfa and clovers--No sulfur recommended.

For corn and small grain--No sulfur recommended.

Table 17. Interpretation of extractable zinc content of Minnesota soils

Extractable zinc* Zn p.p.m.	Relative level	Yield increase expected from zinc applications
Less than 1.3	Low	Highly possible
1.3 to 2.0	Medium	Possible
More than 2.0	High	Unlikely

* Extracted with ammonium carbonate--EDTA and determined in the Perkin-Elmer 303 Atomic Absorption Spectrophotometer.

When interpreting extracted soil zinc values, four factors causing low zinc availability must be considered:

1. Soil pH--Minnesota soils having a pH of 7 or less are unlikely to be deficient in available zinc.
2. Soil phosphorus content--zinc availability is reduced as extractable soil P increases.
3. Preceding crop--if this was sugarbeets, the possibility of zinc deficiency increases.
4. Crop to be grown--Field corn is the crop most likely to be zinc deficient in Minnesota.

Deficiencies of available soil zinc are easily and economically controlled. Granulated zinc sulfate is approximately one-third zinc, and should be applied at rates of 20 to 60 pounds (8 to 20 pounds of zinc) per acre. Zinc in this form in 1968 cost about 40 cents per pound and the treatments recommended should be sufficient for 2 to 4 years, depending on the rate used. Zinc chelate is also effective, but may be more expensive.

Plowing under zinc materials appears to be more effective than row application.

THE SALINITY SCALE

NONSALINE	VERY SLIGHTLY SALINE	MODERATELY SALINE	STRONGLY SALINE	VERY STRONGLY SALINE
NO EFFECT ON CROPS	SENSITIVE CROPS RESTRICTED	MANY CROPS RESTRICTED	MOST CROPS RESTRICTED	FEW PLANTS TOLERANT
0	2	4	8	16

SPECIFIC CONDUCTANCE OF THE SATURATION EXTRACT OF SOIL,
MILLIMHOS PER CM. AT 25°C.

RELATIVE TOLERANCE OF CROPS TO SALT*

LOW SALT TOLERANCE 2-4 mmhos.	MEDIUM SALT TOLERANCE 5-10 mmhos.	HIGH SALT TOLERANCE over 10 mmhos.
<u>Field crops</u>		
Soybeans	Corn	Barley
Field beans	Wheat	Sugar beet
Peas	Flax	
Sunflowers	Rye	
	Oats	
	Sorghum	
<u>Forage Crops</u>		
Red clover	Reed canary grass	Birdsfoot trefoil
Alsike clover	Brome grass	
Ladino clover	Alfalfa	
Timothy	Sweetclover	
<u>Vegetable Crops</u>		
Celery	Spinach	
Radishes	Asparagus	
Cucumber	Garden beet	
Peas		
Onion		
Carrot		
Sweet corn		
Potatoes		

* Within each group the species are ranked in order of increasing salt-tolerance.

RECENTLY COMPILED SOILS RESEARCH DATA

C. J. Overdahl and W. E. Fenster, extension soils specialists

Table 18. Zinc experiment: Benson, Minnesota

Treatment (1965)	Zinc soil test (p.p.m.) (July 1968)				
	Reps.				Av.
	I	II	III	IV	
Check	1.6	1.6	0.9	0.9	1.2L
10 lb. Zn (ZnSO ₄)	.9	1.8	1.8	1.9	1.6M
20 lb. Zn (ZnSO ₄)	3.6	2.9	4.6	2.5	3.4H
40 lb. Zn (ZnSO ₄)	5.0	5.6	3.3	5.7	4.9H
10 lb. Zn (ZnMnS)	2.2	2.0	2.4	1.6	2.1H
.5 lb. Zn (Chelate) Row	1.5	1.1	1.1	2.0	1.4M
2.5 lb. Zn (Chelate)	4.1	1.9	1.1	1.4	2.1H

Soil test levels

Less than 1.3 p.p.m. = LOW

1.3 to 2.0 p.p.m. = MED

Greater than 2.0 p.p.m. = HIGH

Data by Gunderson and MacGregor, Soil Science Department, University of Minnesota.

Table 19. Corn NPK experiments: Waseca Experiment Station 1966-67

Table 17. Corn after alfalfa					
Treatment	Rate (lb./A)	Yield (bu./A)		Treatment effect (bu./A)	
		1966	1967	1966	1967
Continuous corn					
0 (Check)	0	76	72	--	--
N	160	117	148	41	76
P ₂ O ₅	160	81	76	5	4
K ₂ O	160	73	74	-3	2
Corn 2 years after alfalfa					
0 (Check)	0	104	64	--	--
N	80	108	96	4	32
P ₂ O ₅	80	106	60	2	6
K ₂ O	80	98	60	-6	6
Corn 1 year after alfalfa					
0 (Check)	0	109	101	--	--
N	40	109	113	.2	12
P ₂ O ₅	80	109	104	.1	3
K ₂ O	80	117	106	8	5

Data by Frazier and Randall, Soil Science Department, University of Minnesota.

Table 20. Corn NPK experiments: Waseca Experiment Station.
Effect of 12 years' treatment on soil test levels

Effect of 12 years' treatment on soil test levels				
Treatment	Rate (lbs./A) (annually)	Soil test values		
		pH	P	K
Continuous corn				
O	0	6.7	43	154
N	160	6.2**	43	190
P ₂ O ₅	160	6.6	150**	170
K ₂ O	160	6.7	44	312**
NPK+	320	5.6	355	517
2 years after alfalfa				
O	0	6.7	14	113
N	80	6.6	11	115
P ₂ O ₅	80	6.6	59**	129
K ₂ O	80	6.7	14	169**
NPK+	160	6.3	96	217
1 year after alfalfa				
O	0	6.6	22	127
N	40	6.4*	17	125
P ₂ O ₅	80	6.6	68**	113
K ₂ O	80	6.7	13	158*
NPK+	80+160+160	6.1	107	257

* Indicates statistically significant difference from check plot.

** Indicates highly significant difference.

No analysis made for NPK+ plots (incomplete factorial).

Data by Frazier and Randall, Soil Science Department, University of Minnesota.

Table 21.

NPK experiments: Morris Experiment Station 1956-1965

	Continuous corn	1st year corn	2nd year corn	Soybeans	Flax	Alfalfa (T/A)
Rate of N (lbs./A) (Adequate P&K)	160	60	80	20	60	20
Treatment effect (bu./A)	24.4	1.3	5.7	0.5	0.1	-0.11
Rate of P ₂ O ₅ (lbs./A) (Adequate N&K)	160	60	80	40	40	80
Treatment effect (bu./A)	-0.1	8.6	4.7	1.7	-0.3	1.25
Rate of K ₂ O (lbs./A) (Adequate N&P)	80	40	40	40	20	40
Treatment effect (bu./A)	-0.1	-2.6	-2.4	0.2	0.7	-.01
Soil test P = 10 lbs./A LOW K = 230 lbs./A HIGH						

Data by Evans and Caldwell, Soil Science Department, University of Minnesota.

Table 22. Alfalfa yield increases in tons/acre from annual topdressing of 120 and 240 lbs. of K₂O/acre. Morrison County, Minnesota

	Topdressing treatment by years					
	1965		1967		1968	
	120	240	120	240	120	240
Yield increase ton/A*	.84	1.24	2.34	2.79	3.47	4.05
Value of inc. \$15/T	\$12.60	\$18.60	\$35.10	\$41.85	\$51.75	\$60.75
Potash cost, 4¢/lb.	4.80	9.60	4.80	9.60	4.80	9.60
Topdress profit	7.80	9.00	30.30	32.25	46.95	51.15
K soil test	--	--	173	325	190	320
% K, tissue (1st cut)	2.33	3.11	1.96	2.25	1.96	3.12

* 20 observations/treatment

K soil test on check plots = 50, 30, and 30 lbs./A, respectively for 1965, 1967, and 1968.

% K in tissue on check plots = 1.24, .93 and .93, respectively for the same years.

Data by C. J. Overdahl.

Table 23. Effect of omitting one annual K topdressing on yield of alfalfa the following year. Morrison County, Minnesota

	Cutting	Annual treatments of K ₂ O (lbs./A)			
		0	120	240	
Yields T/A	1	.67	2.02	1.70*	2.23
1968	2	.62	2.01	1.68*	2.03
	3	.12	.85	.60*	1.20
	Total	1.41a	4.88c	3.98*b	5.46d
% K, tissue	1	.93	1.96b	1.48*a	3.12c
1968	2	--	1.44b	.90*a	2.24c
	3	--	.89a	.68*a	1.90c

* Topdressing omitted for 1968 crop after 3 previous applications.

Where letters differ, results are significantly different at the 5% level of confidence. Yields are from 10 observations per treatment.

Data by C. J. Overdahl.

CHANGES IN FIELD CROP VARIETY RECOMMENDATIONS FOR 1969

Harley J. Otto, extension agronomist

For complete information on "recommended," "not adequately tested," and "other" varieties, see University of Minnesota Miscellaneous Report 24, Varietal Trials of Farm Crops.

The following changes in crop variety recommendations have been made for 1969.

Oats--Portal was added to the list of recommended varieties; Tippecanoe and Minhafer, removed from the list.

Portal is medium late in maturity (between Garland and Lodi), has yielded very well, has average straw strength, good test weight and groat percentage, and some resistance to crown rust.

Tippecanoe has not performed well in tests in recent years. Both yield and straw strength have been poor in experimental trials. Although straw strength was one of the outstanding characteristics of Tippecanoe at the time the variety was released, it has performed poorly in this regard during the past few years.

Although Minhafer has been kept on the recommended list the last several years, it has been grown very little. Another recommended variety, Garland, is only slightly later in maturity and is higher yielding.

Eight varieties have been tested at least 3 years and will not be recommended in the state.

Holden and Portal are enough alike so they would compete for approximately the same areas. Holden has not yielded as well and is not as resistant to crown rust as Portal so will not be recommended.

Jaycee has produced good yields in tests, but has extremely weak straw and is very susceptible to crown rust.

Dawn and Wyndmere have produced fairly good yields but have weak straw. Neither offers any unique advantage for disease resistance. These varieties are not as attractive as many others in the field.

O'Brien is low yielding and has poor straw strength.

Stormont has the stiffest straw of any oat variety presently available, but has been below average for yield, test weight, and straw strength. It is also susceptible to crown rust.

Orbit has been high in yield but low in test weight and groat percentage.

Harmon is about the same maturity as Lodi but is poorer in yield, test weight, groat percentage, and lodging resistance.

Barley--Conquest was added to the list of recommended varieties and Parkland removed. Both are blue-aleurone varieties. Conquest is superior to Parkland in yielding ability and lodging resistance. It is the only commercially available variety with resistance to loose smut. Conquest is approved for malting.

Rye--Caribou and Elk were removed from the list of recommended varieties.

Caribou does not yield as well as Frontier and is equal in winter hardiness.

Pearl is superior to Elk in yielding ability and winter hardiness.

Wheat--Leeds durum wheat was added to the recommended list. Leeds has yielded less than Wells and Lakota during the past few years. However, Wells did not perform well in tests in 1968; in fact, Leeds produced higher yields at all test sites in the state. The advantages of Leeds are better test weight, better seed quality, and better disease resistance than Wells and Lakota.

Soybeans--Flambeau was removed from the list of recommended varieties because it has not yielded as well and is only slightly earlier than Clay. Clay was released by the Minnesota Agricultural Experiment Station in 1968.

Dry Edible Peas--Stral was removed from the recommended list. Century produces higher yield and seems to meet the needs of purchasers of this crop in Minnesota.

Sunflowers--VNIIMK 89.31 was added to the list of recommended varieties. It is a Russian variety with high oil content. It performs much the same as Peredovik.

Bromegrass--A new variety, Fox, was released by the University of Minnesota Agricultural Experiment Station in 1968. Seed was offered to growers in all counties and to members of the Minnesota Seed Dealers' Association. However, no seed was sold. A decision has been made to grant exclusive rights for seed increase of this variety. Foundation seed will be sold only to the recipient of these rights. They will be granted to a seed company, or growers association which can produce and market seed of this variety. No decision has been made on who will be granted these rights. Interested persons should contact the Director of the Agricultural Experiment Station.

VARIETAL PURITY IMPORTANT

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

Certified seed is not more than three generations removed from foundation seed and is known to be pure for variety. The Minnesota Crop Improvement Association supervises production and processing of certified seed.

In addition to varietal purity, certified seed must be high in germination and meet high standards for freedom from weeds, other crop seeds, and inert material. Within certified seed, a tolerance for these factors is allowed. For example, the minimum germination allowed in small grains is 85 percent, but individual lots may have higher germination. Thus, some certified seed is better than others; study the analysis tag to determine quality factors for each individual lot.

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. A dealer cannot afford to sell any seed which is not as good as the best available.

The complete list of recommended varieties for 1969 follows:

Barley: Conquest, Dickson, Larker

Oats: Garland, Lodi, Portal

Rye: Frontier, Pearl, VonLochow

Wheat: Hard Red Spring: Chris, Manitou, Polk
Durum: Lakota, Leeds, Wells
Winter: Minter

Millet: Turghai, Empire, White Wonder

Flax: Bolley, B5128, Nored, Summit, Windom

Soybeans: A-100, Chippewa 64, Clay, Corsoy, Grant, Hark, Merit,
Portage, Traverse

Sunflowers: Arrowhead, Mingren, Peredovik, VNIIMK 89.31

Dry Peas: Century, Chancellor

Birdsfoot Trefoil: Empire

Red Clover: Dollard, Lakeland

Sweetclover: Evergreen, Goldtop, Madrid

Bromegrass: Achenbach, Fischer, Fox, Lincoln

Timothy: Climax, Itasca, Lorain

CROP VARIETY MIXTURES

Harley J. Otto, extension agronomist

One of the most basic and important decisions a farmer can make in crop production is which varieties to plant. A production ceiling is set by this choice; hence returns from all other crop investments depends on it. As seed dealers, your assistance to farmers in choosing the best available varieties is a worthwhile service to them.

Seedsman and crop producers have shown increased interest in performance of crop variety mixtures versus that of single varieties. Mixtures of alfalfa varieties have been sold for many years. More recently, mixtures of varieties of self-pollinated crops, such as soybeans, have appeared on the market.

Crop producers will be interested in variety mixtures, if their performance is better than single varieties, to provide a good return on seed investment. Seed merchandisers are interested in selling variety mixtures if they provide better performance. Also, with mixtures, seedsman can advertise and sell products different from those of their competitors. Mixtures provide repeat markets that may not be available with pure varieties of self-pollinated crops.

The proportions of varieties in a mixture usually change when the seed is planted and a crop produced from it. Researchers at Iowa State University planted a mixture of equal proportions of Chippewa 64 and Hark soybeans. The harvested seed was 44 percent Hark and 56 percent Chippewa 64. If this seed was saved and planted, the same performance would not be expected as if the 50:50 blend were planted again. Single varieties of self-pollinated crops do not change like this and many farmers save seed from their crop for future planting.

Agronomists have conducted many crop research studies to compare variety mixtures with standard varieties. The researchers studied crop yield, stability (consistency of yield in different locations and years), and disease resistance. The research procedures involved comparing several varieties with mixtures of these varieties in several field trials.

Yield

In most studies, the yield of a mixture was about the same as the average yield of the varieties included in it. Sometimes the mixture yielded more than the average of the components. However, farmers are interested in mixtures only when they perform better than the best varieties available. Researchers have discovered very few examples of this. Most often the highest yielding entries in the studies have been single varieties.

D. C. Rasmusson, Department of Agronomy, University of Minnesota, conducted research with varieties and mixtures of barley. Some of the results obtained in 10 trials over a 5-year period follow:

<u>Variety or mixture</u>	<u>Yield (bushels per acre)</u>
Fox	46.3
Vantage	49.5
Traill	53.9
Fox + Vantage	49.5
Fox + Traill	51.6
Vantage + Traill	52.1
Fox + Vantage + Traill	50.3

The variety, Traill, produced the largest yield, followed by mixtures which contained this variety.

The most favorable report in recently published literature came from New York, where a mixture of five varieties of oats produced 4.4 percent higher yield than Garry, the highest yielding variety in the mixture.

Walter Fehr, Iowa State University, presented data on yield of soybean varieties and mixtures in the April 1968 issue of "Soybean News." In his studies, the following yields were obtained:

<u>Variety or mixture</u>	<u>Yield (bushels per acre)</u>
Corsoy	47
Amsoy	42
Hark	39
Corsoy (1/2) + Hark (1/2)	42
Amsoy (1/2) + Hark (1/2)	43

The Corsoy-Hark blend yielded slightly less than the average (42.6 bushels) of the two varieties and considerably less than Corsoy alone. The Amsoy-Hark mixture produced 1 bushel per acre more than Amsoy, the higher yielding variety in the mixture. However, farmers in the area where the varieties are adapted could have grown Corsoy and produced higher yields than from the Amsoy-Hark mixture.

After considering the results of many published studies, the conclusion is that the possibility of significantly increasing yield through variety mixtures is not great. Plant breeders have made continued progress in improving varieties for yield as well as other characteristics and the probability of continued success via this route seems greater than from an equal effort devoted to mixtures.

Stability of Yield

Greater stability or consistency of yield from one location or year to another, is claimed for variety mixtures in contrast to varieties. Some of the studies have shown increased stability for mixtures; however, many times the increased stability has been slight and of little consequence. Stability is likely to be greatest when there are large differences in factors such as

maturity, among the varieties in the mixtures. If large maturity differences are necessary for greatest stability, the accompanying problems of seed shattering, harvest losses, and quality deterioration must be considered.

It must be remembered that stability can be obtained at low, as well as high, yield levels. If farmers are forced to choose between high average yield and somewhat lower but more stable yield, they should choose higher average yields for highest income.

Agronomists in Nebraska found large differences among single wheat varieties for stability of yield. Ability to produce consistent yield under varying conditions appears to be an inherited characteristic much the same as plant height, maturity, and disease resistance. It seems possible to improve this characteristic as well as others in future conventional varieties or hybrids.

Disease Resistance

Some plant pathologists have long believed that variety mixtures would be helpful in controlling certain diseases such as cereal rusts. Many strains or races exist for most disease-producing organisms and it's not always predictable which will be important in a given field. Once a disease starts in a field, it spreads rapidly if conditions are favorable. If the field contains some resistant plants, the disease cannot build up as rapidly. Mixtures of plants with respect to disease resistance should help reduce losses from this source.

Multilines - mixtures of varieties which are essentially alike except for one character - have been proposed for controlling certain diseases. Examples are the oat multiline varieties, E68 and M68, released by the Iowa Agricultural Experiment Station, in the spring of 1968. Iowa multiline E68 consists of 10 lines which are alike for such characteristics as height, maturity, lodging resistance, stem rust resistance, and yielding ability but differ in crown rust resistance. Each of the 10 lines resists different races of the fungus causing crown rust. These lines are produced separately and mixed together in proportions determined by the relative amount of protection they would provide against prevalent rust races.

Although it has not been critically proven, in theory this variety should withstand the onslaught of crown rust better than a variety with resistance to only one race.

The important difference between multilines and variety mixtures is that a multiline varies for only one characteristic while a mixture differs for several.

Here are some other considerations:

1. Cost of producing seed will be higher for mixtures than for varieties because each component must be produced separately, then blended to assure the desired ratios.

2. Public experiment stations and extension services will not likely test the performance of all individual blends offered for sale. The possible number of blends is almost limitless. If five varieties are available, 26 blends could be produced, assuming all possible combinations and equal proportions of each variety in the mixture. With 10 varieties, 1,013 blends are possible. Add to this the possibilities by varying ratios of the varieties and the number becomes astronomical.
3. The federal seed law requires most kinds of agricultural seed be labeled with the variety name. Labels on variety mixtures must show the varieties and the percentage of each. As an alternative, the label may show the words "variety not stated" in place of the variety name or names. Since most seed companies selling blends do not wish to divulge the names of the varieties used, their labels will read "variety not stated." Blends are usually sold under trade, rather than variety, names.
4. Synthetic varieties are sometimes confused with variety mixtures. A synthetic variety is made by planting lines or clones of cross-pollinated crops, such as alfalfa, in a field and allowing plants to intercross. Seed harvested from such a field is a synthetic variety. Since many of the plants intermate, this forms new genetic combinations. When mixtures of self-pollinated crops are planted, the plants intercross so infrequently that new genetic forms are of little consequence.
5. Before purchasing seed of a variety mixture, insist on evidence of real superiority, including data from well conducted replicated tests representing several locations and years.

HERBICIDES

Gerald Miller, extension agronomist

This is a listing of some herbicides now sold for major crop use in Minnesota. The application rate refers to pounds of active ingredient or acid equivalent per acre on a broadcast basis. The information given is not intended to replace label instructions; follow label instructions closely. Refer to University of Minnesota Extension Folder 212, Cultural and Chemical Weed Control in Field Crops, for additional information.

Amiben

Use - Control of annual grasses and broad-leaved 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. Amiben is now cleared for use on corn at 2 pounds per acre, but experiment station tests showed a definite injury potential to corn and erratic weed control at this rate. Severe stunting of corn occurred in some fields following heavy rains. Do not use soybeans treated with amiben for forage.

Formulation - 2 pounds per gallon liquid; 10-percent granular.

Atrazine (AAtrex)

Use - Weed control in corn and sorghum and quackgrass control. Effective in controlling quackgrass with a fall and/or early spring application followed by spring plowing. Only corn can be planted following treatment. Used in mixtures with linuron, prometryne, or propachlor preemergence on corn.

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

Time of application for weed control in corn and sorghum - Preemergence or preplant in corn and postemergence in corn and sorghum. If applied postemergence, applications within 3 weeks after planting and before weeds are 1 1/2 inches tall are more effective than later applications. Addition of emulsifiable oil has improved performance of postemergence atrazine sprays on corn and sorghum.

Remarks - Susceptible crops have been injured in rotation following treated crop. To minimize injury to susceptible crops following corn, use the lowest rate possible consistent with good weed control; use band applications

rather than broadcast applications and thoroughly till soil before planting susceptible crops. Do not graze or feed treated sorghum for 60 days after application.

Formulation - 80 percent wettable powder.

Barban (Carbyne)

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

Rate of application - 1/4-3/8 pound per acre on small grains and flax; 3/4-1 pound per acre on sugar beets.

Time of application - Postemergence, when most 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 wild oats or crop. Time of application is critical.

Remarks - Flax and small grain injury sometimes occurs; injury on flax has been more severe.

Formulation - 1 pound per gallon liquid.

Bromoxynil (Brominil, Buctril)

Use - Annual broadleaf control in wheat and barley. Used in mixture with MCPA.

Rate of application - 3/8 to 1/2 pound per acre; 1/4 pound per acre in mixture with MCPA at 1/4 pound per acre.

Time of application - From two-leaf to early boot stage of wheat or barley. Early applications more effective on weeds.

Remarks - Controls wild buckwheat and smartweed better than MCPA. Expensive. Does not control perennials. Injures legumes. Some small grain injury has occurred at higher rates.

Formulation - 2 pounds per gallon liquid.

Benefin (Balan)

Use - Annual grass control in seedling legumes.

Rate of application - 1 1/8 to 1 1/2 pounds per acre.

Time of application - Preplanting.

Remarks - Must be incorporated into the soil by disking before planting.

Formulation - 1 1/2 pounds per gallon liquid.

Butylate (Sutan)

Use - Control of annual grasses in corn. Used in a mixture with atrazine for annual grass and broadleaf control.

Rate of application - 4 pounds per acre; 3 to 4 pounds per acre with 1 to 1 1/2 pounds per acre of atrazine.

Time of application - Preplanting.

Remarks - Must be incorporated into the soil. Proper incorporation can be accomplished by disking field twice, once in each direction, immediately after applying chemical.

Formulation - 6 pounds per gallon liquid, 10-percent granular.

C6989 (Preforan)

Use - Control of annual grasses and broadleaves in soybeans grown for seed.

Rate of application - 3.75 to 4.5 pounds per acre.

Time of application - Preemergence.

Remarks - Cleared only for soybeans grown for seed. Research results have shown good soybean tolerance and control of most annual grasses and broadleaves. Does not control velvetleaf.

Formulation - 3 pounds per gallon liquid.

CDAA (Radox)

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

Rate of application - 4-5 pounds per acre.

Time of application - Preemergence.

Remarks - Irritating to skin and eyes; handle with extreme caution. Has performed better on soils high in organic matter than on light-colored soils. Do not use on sandy soils because of possible injury and lack of weed control.

Formulation - 20-percent granular; 4 pounds per gallon liquid.

CDAA-T (Radox-T)

Use - Control of annual grasses and broad-leaved weeds in corn.

Rate of application - Approximately 3.5 pounds CDAA + 7 pounds TCBC per acre.

Time of application - Preemergence.

Remarks - Irritating to skin and eyes. Do not use on soybeans. Some cases of soil residue carryover and damage to soybeans following corn have occurred. Has performed better on soils high in organic matter than on light-colored soils. Do not use on sandy soils because of possible injury and lack of weed control.

Formulation - 3.1 pounds CDAA plus 6.3 pounds TCBC per gallon liquid; 11.7-percent CDAA plus 23.3-percent TCBC granular.

Chloroxuron (Tenoran)

Use - Control of certain annual broadleaves in soybeans.

Rate of application - 1 to 1 1/2 pounds per acre.

Time of application - Postemergence from time of first trifoliolate leaf to layby. Weeds should be no more than 2 inches tall. Early applications are more effective.

Remarks - Most effective against lambsquarters, mustard, and redroot pigweed. Other broadleaves are only partially controlled. Grasses are usually not controlled. Use a wetting agent, "Adjuvan-T" with the chemical. Some soybean leaf burn and delayed growth usually follow treatment.

Formulation - 50-percent wettable powder.

CP50144 (Lasso) - Caution: As of December 1968, this chemical is not cleared for any uses.

Use - Annual grass control in corn and soybeans, some broadleaf control.

Rate of application - 2 to 2 1/2 pounds per acre.

Time of application - Preemergence.

Remarks - Chemically related to propachlor (Ramrod). Corn and soybeans have good tolerance. Research results show good control of annual grasses, redroot pigweed, and lambsquarters. Control of other broadleaves was not consistent.

Formulation - 4 pounds per gallon liquid, 10-percent granular.

2,4-D and MCPA

Use - Broad-leaved weed control in corn, small grains, pastures.

Time of application - Postemergence. 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.

Remarks - Do not graze dairy cattle for 7 days after treatment of pastures with 2,4-D.

Formulation - Liquids of various concentrations.

Dalapon

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

Rate of application - (1) Flax: $3/4$ pounds per acre. (2) Sugar beets: 2-3 $1/2$ 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. Postemergence until sugar beets reach 6-leaf stage, directed from 7-leaf stage until beets are 14 inches. (2) Corn: directed when corn is 8-20 inches tall.

Remarks - Use 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 broad-leaved 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 limit corn yields.

Formulation - 74-percent soluble powder.

Diallate (Avadex) - formerly DATC

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

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

Time of application - Preplanting on flax or sugar beets; postseeding (preemergence) on barley. Fall application is a possibility.

Remarks - Quite volatile and must be incorporated soon after application. Incorporate preplanting applications with disk, cultivator, or harrow to a depth of 2 inches. In postseeding applications, incorporate chemical with two harrowings at right angles. Small grain injury has been observed, particularly with preplanting applications. Do not apply to field in ridged condition. This chemical irritates skin and eyes; use caution when handling.

Formulation - 4 pounds per gallon liquid.

Dicamba (Banvel)

Use - Control of broad-leaved weeds except mustard in wheat, oats, and corn. Especially useful for controlling wild buckwheat and smartweed in wheat and oats.

Rate of application - 1/8 pound per acre in wheat and oats; 1/8 to 1/4 pound per acre alone or with 2,4-D in corn.

Time of application - From 2- to 5-leaf stage of wheat and oats. Up to time corn is 3 feet tall.

Remarks - Can be combined with MCPA in wheat and oats for control of mustard and other broad-leaved weeds. Use as a postemergence spray in corn resulted in drift injury on soybeans in the vicinity.

Formulation - 4 pounds per gallon liquid; commercial combinations with MCPA are available.

Endothall

Use - Control of annual smartweed, wild buckwheat, and marshelder in sugar beets.

Rate of application - 3/4 to 1 1/2 pounds per acre.

Time of application - Postemergence.

Remarks - Excessive injury, especially to very small sugar beets, may occur if temperatures are above 80° F. Poor weed control may result at temperatures below 60° F.

Formulation - Liquid; concentrations vary.

EPTC (Eptam)

Use - Control of annual grasses and some broadleaves in sugar beets, seedling legumes, sunflowers, and dry edible beans.

Rate of application - 2 pounds per acre on sugar beets; 3 pounds per acre on seedling legumes, sunflowers, and dry edible beans.

Time of application - Preplanting.

Remarks - Must be incorporated to avoid loss of chemical by volatility.

Formulation - 6 pounds per gallon liquid; 10-percent granular.

Linuron (Lorox)

Use - Weed control in corn and soybeans. Used in mixtures with atrazine or propachlor preemergence on corn.

Rate of application - (1) Corn: 1/2-1 1/2 pounds per acre preemergence in combination with equal rates of atrazine active ingredient or with 3 pounds per acre of propachlor; 1 1/2 pounds per acre with wetting agent in postemergence directed spray applications. (2) Soybeans: 1/2-2 1/2 pounds per acre; rate differs with soil types.

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

Remarks - Use in postemergence directed spray applications does not eliminate early season competition between weeds and corn. This early competition can reduce yields. Linuron has caused injury (stand reduction and stunting) to corn and soybeans in some Minnesota trials. On corn, do not apply linuron within 60 days of harvest.

Formulation - 50-percent wettable powder.

Norea (Herban)

Use - Control of annual grasses and broad-leaved weeds in grain sorghum. Used in a mixture with atrazine or propazine preemergence on grain sorghum.

Rate of application - 2.4 pounds per acre; 2 pounds per acre with 1 pound per acre of atrazine or propazine.

Time of application - Preemergence.

Formulation - 80-percent wettable powder.

Propachlor (Ramrod)

Use - Annual grass control in soybeans grown for seed and corn. Used in mixtures with atrazine or linuron on corn.

Time of application - Preemergence.

Rate of application - 4-5 pounds per acre.

Remarks - More persistent than CDAA (Randox) and has given slightly better grass control. Less irritating than CDAA, but handle with caution. Caution: As of December 1968, propachlor is cleared to use on corn for grain, seed or forage, but on soybeans for seed only. Do not use propachlor-treated soybeans for food, feed, or oil. Cleared for use on corn in combination with atrazine or linuron.

Formulation - 65-percent wettable powder; 20-percent granular.

Propazine (Milogard)

Use - Control of annual grasses and broad-leaved weeds in grain sorghum.

Rate of application - 2 pounds per acre.

Time of application - Preemergence.

Formulation - 80-percent wettable powder.

TCA

Use - Control of annual grasses except wild oats in sugar beets, flax, alfalfa, sweetclover, and birdsfoot trefoil.

Rate of application - 6 pounds per acre in sugar beets; 5 pounds per acre in flax and legumes.

Time of application - Preemergence in sugar beets; postemergence in flax and legumes.

Formulation - Soluble powder or pellets and liquid; concentrations vary.

Triallate (Far-go) - formerly Avadex-BW or DATC-BW

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

Rate of application - 1 pound per acre on wheat; 1 1/4 pounds per acre on barley.

Time of application - Postseeding (preemergence) for wheat; preplanting or postseeding for barley (postseeding preferred). Fall application prior to barley is a possibility.

Remarks - Must be incorporated by two harrowings at right angles for post-seeding applications. Incorporate preplanting applications as described previously for diallate. In postseeding applications, seed crop to a depth of 2-3 inches. Do not apply to a field in a ridged condition. Do not plant domestic oats where triallate was used the previous year. This chemical irritates skin and eyes; use caution when handling.

Formulation - 4 pounds per gallon liquid.

Trifluralin (Treflan)

Use - Annual grass control in soybeans, dry edible beans, sunflowers, sugar beets.

Rate of application - 1/2 to 1 pound per acre, depending on soil type. Use lower rates on coarse textured soils and higher rates on finer textured soils.

Time of application - Preplanting on soybeans, dry edible beans and sunflowers; postemergence on 2- to 6-inch sugar beets after blocking or thinning and before new weeds come up.

Remarks - Must be incorporated into the soil immediately after application. Proper incorporation of preplanting applications can be accomplished by disking field twice, once in each direction, immediately after applying chemical. This chemical sometimes caused soybean stand reduction.

Formulation - 4 pounds per gallon liquid; 2 1/2 and 5-percent granular.

Effectiveness on major weeds of herbicides used in corn									
	Preplanting or Preemergence						Postemergence		
	atrazine (Aatrex)	butylate (Sutan)	CDA (Randox)	CDA-T (Randox-T)	propachlor (Ramrod)	linuron (Lorox)	2,4-D	dicamba (Banvel)	atrazine and oil
Corn tolerance	G	G	G	F	G	F	G	G	G
Grasses									
Giant foxtail	F	G	F	F	G	F	N	N	F
Green foxtail	G	G	G	G	G	F	N	N	G
Yellow foxtail	G	G	G	G	G	F	N	N	G
Barnyard grass	F	G	F	F	F	F	N	N	F
Crabgrass	P	G	G	G	G	G	N	N	P
Nutsedge	P	F	P	P	F	P	N	N	F
Quackgrass	G	N	N	N	N	N	N	N	G
Broadleaves									
Cocklebur	F	P	N	P	P	P	G	G	F
Lambsquarters	G	P	P	F	P	G	G	G	G
Mustard	G	P	N	P	P	G	G	F	G
Pigweed	G	P	F	G	F	G	G	G	G
Ragweed	G	P	P	F	P	G	G	G	G
Smartweed	G	P	N	F	P	F	P	G	G
Velvetleaf	F	P	N	F	P	F	G	G	F
Wild sunflower	P	P	N	P	P	P	F	G	F
Canada thistle	P	N	N	N	N	N	F	G	F

G - Good
F - Fair
P - Poor
N - No control

This is a general comparative control rating based on field observations. Under unfavorable conditions any of the herbicides may give unsatisfactory results. With favorable conditions control may be better than indicated.

Effectiveness on major annual weeds of herbicides used in soybeans

	Preemergence				Preplanting	Postemergence			
	amiben	C6989 (Preforan)	CDA (Randox)	propachlor (Ramrod)	linuron (Lorox)	trifluralin (Treflan)	vernolate (Vernam)	2,4-DB	chloroxuron (Tenoran)
Soybean tolerance	G	G	F	G	F	F	F	P	F
Grasses									
Giant foxtail	G	G	F	G	F	G	F	N	P
Green foxtail	G	G	G	G	F	G	F	N	P
Yellow foxtail	G	G	G	G	F	G	F	N	P
Barnyard grass	G	-	F	F	F	G	F	N	P
Crabgrass	G	G	G	G	G	G	P	N	P
Broadleafs									
Cocklebur	P	-	N	P	P	P	P	F	-
Lambsquarters	G	G	P	P	G	G	P	P	G
Mustard	F	G	N	P	G	P	P	P	G
Pigweed	G	G	F	F	G	G	P	P	F
Ragweed	G	G	P	P	G	N	P	P	P
Smartweed	F	G	N	P	F	P	P	P	P
Velvetleaf	F	N	N	P	F	P	P	P	P
Wild sunflower	P	-	N	P	P	N	N	P	-

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

This is a general comparative control rating based on field observations. Under unfavorable conditions any of the herbicides may give unsatisfactory results. With favorable conditions control may be better than indicated.

CORN AND SOYBEAN WEED CONTROL DEMONSTRATION RESULTS

Gerald Miller and Oliver Strand, extension agronomists

Tables 24 to 28 summarize results of weed control demonstrations conducted by Minnesota county agricultural agents. These data are the average results from a large number of trials on various soil types and under different weather conditions. They may assist in evaluating herbicides, but for information on herbicides, rates, and methods of use for specific situations, refer to University of Minnesota Extension Folder 212, Cultural and Chemical Weed Control in Field Crops, 1969.

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

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

Weed control was visually evaluated 3 to 7 weeks after chemicals were applied. A chemical was rated "good" if it controlled more than 75 percent of the weeds, "fair" if it controlled 50 to 75 percent of the weeds, and "poor" if it controlled less than 50 percent of the weeds. "Grasses" in the tables refers to annual grasses such as foxtail, barnyard grass, and crabgrass. "Broadleaves" refer to annual broad-leaved weeds such as redroot pigweed, lambsquarters, Pennsylvania smartweed, common ragweed, cocklebur, velvetleaf, and wild mustard. Perennial weeds such as Canada thistle and quackgrass were not included in the evaluations.

Table 24 summarizes early evaluations of herbicides that have been included for 2 years or more. These results are from uncultivated plots. 1968 results from uncultivated corn plots are in table 25; 1968 results from cultivated corn plots are in table 26. Table 27 summarizes the 1968 evaluations of herbicides on soybeans in uncultivated and cultivated plots. Corn yields for the last 4 years from several locations with replicated plots are given in table 28. Comparisons should be made within the same year or using averages of the same years since yearly yield levels vary considerably depending on weather conditions.

Table 24. Weed control demonstration results, several year summary, early evaluations, uncultivated

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

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

** Percent of spray volume.

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

Table 25. Weed control demonstration results, 1968, early evaluations, uncultivated

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

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

** Ten percent of spray volume.

Table 26. Weed control demonstration results, 1968, early evaluations, cultivated

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

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

** Ten percent of spray volume.

Table 28. Corn yields in county weed control trials, Minnesota

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

^{1/} Prepl = applied preplanting and disked in; pre = applied preemergence; post = applied postemergence.

^{2/} Rate is pounds per acre of active ingredient or acid equivalent broadcast.

^{3/} Yields are average of 13 locations in 1965, 15 in 1966, 7 in 1967, 6 in 1968; two replications at each location.

^{4/} Blank indicates the treatment was not included that year.

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