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## Chemical Control of Weeds

South Dakota Agricultural Experiment Station

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# Chemical Control of Weeds \*

For several years sodium chlorate and borax have been used as chemicals for killing weeds, but recently 2, 4-D and the dinitro compounds have been receiving most attention. The purpose of this pamphlet is to present information pertaining to the use of all four herbicides in a weed control program. The chemicals 2, 4-D, borax, sodium chlorate, and the dinitro compounds will be discussed in that order.

The recommendations are based on the experimental results from cooperative tests in South Dakota and the summarized results reported at the North Central Weed Control conference. The tests in South Dakota include plots established throughout the state in 1945 and at the Weed Research Farm at Scotland, which was started in 1946.

## The Use of 2, 4-D as an Herbicide

Reactions of crop and ornamental plants to 2, 4-D. Most of the grasses are resistant to 2, 4-D when standard applications are made. Such grasses as small grain and corn have been tested extensively. It has been found that small grain may be treated before it has started to "joint" or after the grain is in the "dough stage" without damage to yield, quality, or viability. Corn, on the other hand cannot be safely treated before it has reached the "milk stage." After this stage of maturity, no ill ef-

fects have been noted as a result of the use of 2, 4-D.

To date there has been very little experimental work with 2, 4-D on such grasses as sudan, sorghum or millet. Any use of 2, 4-D on crops listed as "intermediate" should be done on an experimental basis.

\*This pamphlet was prepared by Lyle A. Derscheid, Graduate Assistant, Agronomy Department, South Dakota Agricultural Experiment Station and Dr. L. M. Stahler, Associate Agronomist, Bureau of Plant Industry, Soils and Agricultural Engineering, United States Department of Agriculture.

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Agronomy Department  
AGRICULTURAL EXPERIMENT STATION  
South Dakota State College, Brookings

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1. Crops and ornamentals tolerant to 2, 4-D

Oats	Wheatgrasses	Timothy
Wheat	Blue grass	Pines
Barley	Red top	Cedars
Rye	Reed canarygrass	Spruce
Brome Grass	Fescue	

2. Crops or ornamentals intermediate or indefinite in reaction to 2, 4-D

Flax	Buckwheat	Grapes
Corn	Millet	Gladiolus
Sudan grass	Strawberries	Iris
Sorghum	Rhubarb	Tulips
Potatoes	Asparagus	

3. Crops or ornamentals easily killed or severely injured by 2, 4-D

Soy beans	Tomatoes	Flowering ornamentals
Sugar beets	Most vegetables	
Alfalfa	All fruit trees	Creeping bent-grasses
Other legumes	Most bush fruits	
Peas	Broad-leaved shrubs	
Beans		

Reactions of weeds to 2, 4-D. The following list of weeds was compiled from experiments conducted during 1945 and 1946 in South Dakota. The weeds have been classified as "generally susceptible," "intermediate," and "tolerant" of 2, 4-D. It is obvious that a clear cut line cannot be drawn between classes for some weeds, such as Kochia and ragweed, which are listed as susceptible; but which are quite resistant when in bloom. The same is true for many others of the "generally susceptible" group. Further investigations may change the classification of weeds, especially in the "intermediate" group.

1. Generally susceptible (as easily killed as dandelion)

Annual sow thistle	False flax	Ragweed
Beggar's tick	French weed	Russian thistle
Bull thistle	Gumweed	Salt bush
Burdock	Kochia	Skeleton weed
Chick weed	Lettuce	Smartweed
Cinquefoil and other five-fingers	Loco weed	(lady's thumb)
Cockle bur	Mallows	Sunflower
Dandelion	Marsh elder	(annual)
Dragon-head mint (common)	Mustards	Sweet clover
	Pigweeds	Wild licorice
	Plantain	Yellow trefoil

2. Intermediate (More difficult to kill than dandelion, but may be eliminated by repeated applications)

Canada thistle	Pepper grass	Sow thistle
Carrot (wild)	(annual)	(perennial)
Dock	Plantain	Sumac
Goat's beard	(buckhorn)	Sunflower
Hedge bindweed	Poison ivy	(perennial)
Field bindweed	Shepherd's purse	Wild buckwheat
Horse tail	Other Smartweeds	Wormwood
Lamb's quarters	Poison sumac	Vervain

3. Tolerant of 2, 4-D

Asters	Horse nettle	Russian knapweed
Buffalo bur	Knotweeds	Sandbur
Buttercup	Milkweed	Spurge
Catchfly	Mullein	Switch grass
Corn cockle	Per. Pepper grass	Toadflax
Foxtail	(white top)	White cockle
Golden rod	Purslane	Witch grass
Ground cherry	Rose	Yarrow

Dates of treatment. Bindweed has been most effectively treated at first bloom stage. Treatments made during late summer are satisfactory if bindweed is growing vigorously. Retreatments should not be made in the year of application.

Canada or perennial sow thistle should be treated when the first flower stalks appear but before flower buds form. Retreatment of surviving plants should be made in August.

Other perennial weeds should be treated at appearance of first flower buds.

Annual and winter annual weeds should be treated as seedlings or in the rosette stage, when growing vigorously.

High soil moisture, good soil fertility, and high temperature (70° F or above) are conducive to a rapid rate of plant growth, which increases the effectiveness of 2, 4-D.

Rates and methods of application of 2, 4-D. There are several methods of application, but the use of a dust or a spray are the most practical methods. Sprays should be applied at pressures of from 30 to 80 pounds per square inch. Nozzles that produce a fan-shaped spray

should be used. Care should be taken to prevent drifting of the dust or spray into susceptible crops.

For use on such perennial weeds as field bindweed, Canada or sow thistle, 1¼ pounds of active 2, 4-D acid should be mixed in 100 to 160 gallons of water and applied to one acre. The amount of water used will depend on the equipment used, but all leaves must be covered with a finely divided mist. **A complete kill is an exception rather than the rule.** Most of the weeds will be killed, however, the remaining plants will be very much stunted, provided an even coverage with the above concentration is secured on weeds that are growing vigorously.

The following table is based on the amount of active ingredient found in commercial preparations of 2, 4-D and is designed to help determine how much chemical to use.

Percent of active 2, 4-D found in commercial preparations	Approximate amount of the chemical needed in order to apply 1¼ pounds of 2, 4-D per acre	
	Liquid	Powder
10	12 pints	12 pounds
20	6 pints	6 pounds
30	4½ pints	4 pounds 8 ounces
40	3 pints	3 pounds
50	2½ pints	2 pounds 10 ounces
60	2¼ pints	2 pounds 4 ounces
70	1¾ pints	1 pound 14 ounces
80	1½ pints	1 pound 8 ounces

For spraying lawns, the directions on the container should be followed in order to get the correct concentration, and one gallon of spray should be used for each square rod treatment.

For control of annual weeds in tolerant growing crops, ½ the amount of 2,4-D recommended for perennial weeds in the preceding table is sufficient. Boom type, low pressure field sprayers applying 80 to 120 gallons of spray solution per acre are essential to uniform coverage and good results.

**Recommendations for use of 2, 4-D.** Recommendations have been made for Production Marketing Administration payments to be

made for the use of 2, 4-D in a field bindweed and Canada and perennial sow thistle control program. A complete coverage with 1¼ pounds of active 2, 4-D should be applied to one acre of actively growing weeds with low pressure. Treatments must be made on pasture or other grasslands, in tolerant growing crops, along fence rows, or in grassed areas where erosion is a problem.

Other recommendations include the use of 2, 4-D on any weeds found under the classification of "generally susceptible" provided the treatment is made when the weeds are in an active state of growth. Treatments are recommended on lawns, fairways, pastures that are free of susceptible crops, and in tolerant growing crops. The use of 2, 4-D is also recommended for roadsides, fence rows, railroad rights of way, and for grassed areas where erosion is a problem. Some of the erodable areas are terrace and terrace outlets, ditch banks, and sod waterways. Practical use of 2, 4-D can also be made on susceptible weeds in areas of land that are too stony for cultivation.

Recommendations for use of 2, 4-D on pastures have been made since tests have demonstrated that no injury to livestock is to be anticipated from standard treatments.

**Precautions to be observed in the use of 2, 4-D.** Care must be taken that all of the 2, 4-D is removed from the sprayer before insecticides or fungicides are applied to susceptible plants with the same sprayer. Trisodium phosphate dissolved at the rate of 1½ ounces to the gallon of water has proved to be satisfactory for removing 2, 4-D from metal sprayers, but it is best to check the presence of residual 2, 4-D by making tests on a few susceptible plants, such as tomatoes, at least 24 hours before field use.

Crops should not be planted in soils that have been treated with 2, 4-D only a short time before as there is some toxic effect produced in the soil. However, injury is rarely produced in plants that have been seeded two months after the soil is treated with standard amounts of 2,

4-D. Leaching and decomposition removes the 2, 4-D in a relatively short time especially in humid areas. If normal rainfall and spring or summer temperatures have intervened, the less susceptible plants may be sown within a month. Under extremely dry conditions, the toxicity may remain much longer—perhaps a year.

**How much does 2, 4-D cost?** The cost should vary with the concentration of active 2, 4-D acid and with the carrier and solvent used in the compound. Present prices of the herbicide range from \$2.50 to \$7.50 per acre when 1¼ pounds of active 2, 4-D is used. When buying

2, 4-D, the concentration of active 2, 4-D acid should be noted carefully as the concentration varies from 4% in some compounds to 85% in others.

Commercial formulations of 2, 4-D are available as the sodium or ammonium salts in powders, and amines and esters in liquid forms. The powders are sometimes difficult to dissolve in hard waters. Under favorable conditions of application, all standard types of 2, 4-D appear equally effective. The esters have shown a slight advantage under certain unfavorable conditions of application.

### The Use of Borax as an Herbicide

Borax is recommended for use on small areas of leafy spurge. It may be applied by hand or with mechanical spreaders at the rate of 15 pounds to the square rod. **Even coverage must be attained in order to get the best results.**

Borax may also be used at the rate of 20 pounds to the square rod for spot treating other perennials such as Canada thistle, perennial sow thistle, perennial peppergrass (white top) and bindweed. P.M.A. payments are recommended for spot treatments.

### The Use of Sodium Chlorate as an Herbicide

Sodium chlorate is recommended for spot treating such perennials as bindweed, Russian knapweed, Canada thistle, perennial sow thistle, and perennial peppergrass (white top). Applications may be made by hand or with a chlorate spreader. **Complete coverage is essential.** It should be applied dry at the rate of 4 to 6 pounds to the square rod, but **caution must be observed, for it is highly inflammable.** Leafy

spurge may also be spot treated with sodium chlorate at the rate of 4 to 6 pounds per square rod, but borax generally gives better results. Atlacide, a commercial preparation containing sodium chlorate, used at the rate of 6 pounds per square rod, is as effective as sodium chlorate and may be applied either dry or in a spray solution. P.M.A. payments are recommended for spot treatments.

### The Use of Dinitros as Herbicides

The dinitro compounds (Sinox and Dow Selective) are recommended for **annual weed control** in flax, legumes and certain other crops. A boom type low pressure field sprayer is

essential to efficient use of these herbicides. Directions on containers should be followed closely in order to obtain the proper concentration and rate of application.