Salt Sprays for the Control of Weeds in Sugar Beets in the Pacific Northwest[1]

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SALTS WITH HIGH SOLUBILITY, such as sodium chloride and several of the common fertilizer materials which apparently kill plants by plasmolysis when sprayed or otherwise deposited on the leaves, have been successfully used to eradicate certain weeds from crop plants. Their effectiveness in killing weeds depends on several factors such as age of the plant, type of leaf surface, climatic conditions and type of growth. Their effectiveness in controlling weeds depends on the relative tolerance of the respective plants under conditions in which a kill can be effected.

Sugar beets and table beets have a relatively high tolerance to salt toxicity and the use of salt sprays may have some application in controlling broadleaf annual weeds in these crops. Sodium chloride has had more popularity than other salts for this purpose in some areas, but in the Pacific Northwest this material is of no value as a soil amendment, whereas the nitrogenous salts are useful as fertilizer materials in addition to whatever herbicidal effect they might have. A few tests have been made with some of these salts for the dual purpose of controlling weeds and obtaining the fertilizing benefits. Several other chemicals were included for comparative purposes.

Early Spring Trials in the Willamette Valley

The first trials were made in the Willamette Valley in February, 1947. The principal weeds were chickweed (*Stellaria media*), mustard (*Brassica arvensis*), and annual bluegrass (*Poa annua*). At this season humidity averages rather high and rainfall may be frequent. The beets were well advanced and the weeds rather large and tough. Several salts as well as other chemicals were sprayed on the leaves. Among these were: ammonium sulfate 320, 480, and 1,000 pounds[4], ammonium nitrate 320 and 480 pounds, sodium chloride 500 and 1,000 pounds, a mixture of ammonium sulfate 160 and Sinox 1 pound, a mixture of ammonium sulfate 500 and ammonium-ortho-secondary 3.5 dinitro-phenate 1 pound, a mixture of ammonium-ortho-secondary 3.5 dinitro-phenate 1 pound and Iso-propylpenyl carbamate 1 pound, a 1:1 mixture of kerosene and gasoline 60, 80 and 100 gallons, Stoddart solvent 80 gallons, and Avon weed killer 50 gallons. These were applied in rod-square plots in the middle of a field and not replicated. The

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[4]Figures show rates per acre.

adjacent area served as a check for observations. None of the materials were effective in killing weeds under these conditions although a temporary mild burning of leaves was caused by some treatments. Results might be consistently different at another time of year. The heavy rates of nitrogen salts had a marked fertilizing effect on both weeds and beets.

Trials in Central Oregon in April, 1947

On April 18 a number of materials were tried on beets near Redmond, Oregon. The principal weeds were vetch, (*Vicia* spp.), filaree, (*Erodium circutarium*), and quackgrass, (*Agropyron repens*). The weather was dry and cool at the time of the treatments. The beets had gone through the winter in the field, had started spring growth and were relatively tough. The vetch had made a vigorous growth and had a relatively large amount of leaf surface. Plots were made 1 rod square and not replicated. The treatments and percentage kill on beets and vetch are given in table 1. Beets at this age were tolerant to large amounts of salt and the vetch could be eradicated with moderate success by the heavier treatments. Ammonium sulfate was the least effective and also seemed to be the least selective of the nitrogen salts tried. Ammonium nitrate in the heavier rates "burned" back the beet leaves to some extent but the plants soon recovered. It was the most effective in killing vetch, although sodium nitrate or sodium chloride would effect a kill if used in sufficient amount. None of the other chemicals were sufficiently selective to be of any value. Filaree seemed to be just as tolerant as the beets to any of the materials used. Quackgrass was not materially injured. Figure 1 illustrates the general appearance of the plants after treating.

Table 1. Treatments and their effects on beets and vetch in the Central Oregon area.

Materials used	Rate per acre pounds	Approximate kill	
		Vetch percentage	Beets percentage
Ammonium sulfate	500	25	0
Ammonium nitrate	500	90	5
Ammonium nitrate	1000	100	10
Sodium chloride	500	60	0
Sodium chloride	1000	90	5
Sodium nitrate	1000	90	5
Sodium chlorate	4	0	5
Sodium chlorate	8	10	10
Sodium chlorate	16	50	25
A.S.B.Dn.P[1]	1	0	0
A.S.B.Dn.P[1]	2	10	10
A.S.B.Dn.P[1]	3	50	25
2-4,D	½	50	50
2-4,D	1	95	95

[1]Ammonium-O-secondary butyl 3,5 dinitro-phenate.

Figure 1. Salt sprays for weed control near Redmond, Oregon. Plot in foreground had ammonium sulphate at 500 pounds per acre. Lighter plot in center had ammonium nitrate at 500 pounds per acre.

Willamette Valley Trials in September, 1947

Further field trials were made later in the season on fall-planted beets when they were in the 4- to 6-leaf stage. The principal weed at this time was red-root pigweed (*Amaranthus retroflexus*), with some plants of lambsquarter (*Chenopodium album*), mustard (*Brassica arvensis*), vetch (*Vicia* spp.,) nightshade (*Solanum* spp.,) round-leaf mallow (*Malva rotundifolia*), and purslane (*Portulaca oleaceae*). Plots were 1 rod square and not replicated. The treatments used and approximate percentage kill of pigweed and beets are given in table 2. Figure 2 illustrates the general appearance after treating. The beets were at about the 6-leaf stage at the time of treating and the weeds were a little older than appeared desirable for the best kill. However, it was possible to eradicate effectively red-root pigweed with ammonium nitrate, sodium nitrate or sodium chloride. Ammonium sulfate was less effective. Lambsquarter, nightshade and mustard which were in these plots were not killed by the treatments as used. Vetch was killed where it was exposed so as to get good leaf coverage; however, most of the vetch was small and protected from the spray by beet or weed leaves. In another trial, where round-leaf mallow was abundant, it was not killed by salt sprays in similar amounts.

In small plots at the Talent Station in Southern Oregon where pigweed was very abundant, it was effectively eradicated from beets at about

the 4-leaf stage with a good coverage of approximately 40-percent solution of sodium nitrate. A similar concentration of ammonium nitrate killed both weeds and beets.

Table 2.—Results of Willamette Valley trials in September, 1947.

Materials used[1]	Rate per acre pounds	Approximate kill	
		Pigweed percentage	Beets percentage
Ammonium sulfate	400	50	5
Ammonium nitrate	400	100	10
Sodium chloride	400	90	5
Sodium nitrate	400	90	5

[1]No spreader was used with these materials which were mixed with 1 gallon of water per square-rod plot.

Figure 2.—Salt sprays for weed control near Salem, Oregon. Darker block at left center had ammonium nitrate at 400 pounds per acre. All pigweed was killed.

Greenhouse Results

In greenhouse trials tops of sugar beets at the 6-leaf stage when dipped in the solution were killed by 40-percent ammonium nitrate and slightly damaged by 40-percent sodium nitrate or 30-percent ammonium nitrate when no spreader was used. Vatsol added to the salt solution at the rate of 3 to 4 drops per 50 cubic centimeters decreased injury to the beets, but increased toxicity to lambsquarter. Thirty-percent sodium nitrate or 20-

percent ammonium nitrate when used with the spreader did not damage the beets.

Lambsquarter at 4 to 6 inches high was killed by 20-percent or stronger solutions of ammonium nitrate and 40-percent sodium nitrate either with or without the spreader. Sodium nitrate at 20-percent solution plus the spreader killed these weeds but when used without the spreader caused only a mild "burn."

Limited greenhouse tests with round-leaf mallow and mustard indicate that burning back the leaves with ammonium nitrate does not destroy them.

Summary

Salt sprays, even at high rates (1,000 pounds per acre), were relatively ineffective in killing weeds in the Willamette Valley in early spring. Apparently climatic conditions and the age of the plants were unfavorable at this season.

In central Oregon in late spring, vetch was readily eradicated from beets by heavy salt-spray treatments.

Salt sprays effectively eradicated certain annual broadleaf weeds from beets in the Willamette Valley and in the Medford area in early fall. Apparently it is important that the weeds be not too old.

Sodium chloride and sodium nitrate apparently could be used interchangeably with about equal effect. Ammonium nitrate was more toxic to both weeds and beets and should be used at a lighter rate. Ammonium sulfate was less effective than the other salts tried and seemed also less selective in action. Ammonium nitrate at 400 pounds per acre in 160 gallons of water effectively eradicated susceptible weeds and killed only 5 to 10 percent of the beets. Sodium chloride or sodium nitrate at similar rates eradicated the major part of susceptible weeds and were not harmful to the beets.

For Pacific Northwest conditions either of the nitrate salts would be preferable to the sodium chloride due to the residual fertilizer value. Only a few weeds seems to be susceptible to eradication by these salts. Red-root pigweed, if not too large, is readily killed. Vetch can be killed at most any size, provided the leaves are exposed so they can be treated. Lambsquarter, mustard, nightshade and round-leaf mallow are more resistant. Filaree seemed to be fully as salt tolerant as the beets. Grasses and perennial weeds were not appreciably injured by the salts.

Under greenhouse conditions, where the leaves were dipped in the salt solution, lambsquarter at 4 to 6 inches high was readily killed by 20-percent ammonium nitrate or 20-percent sodium nitrate plus a spreader. The spreader did not seem to add much effectiveness to the ammonium nitrate on the lambsquarter but made it less toxic on beets.

Such materials as sodium chlorate, 2-4, D and ammonium O-secondary-butyl-dinitro phenol seemed to be just as toxic on beets as on the weeds.

None of the materials tried were effective in eradicating annual bluegrass or established stands of quackgrass.