

Weed Control Studies on Sugar Beets^{1,2}

VIRGIL H. FREED AND RAY A. PENDLETON³

Introduction

Weed control in row crops such as sugar beets is one of the major problems of production. Hand weeding is slow and too expensive for extensive operations. As a consequence there is a need for a cheap, economical method of weed control. Chemical weed eradicators offer a possibility of realizing this end.

Trials on sugar beets have demonstrated the very limited value of present day selective herbicides for weed eradication in this crop. Certain plasmolytic, inorganic salts solutions such as sodium chloride or sodium nitrate are the only ones sufficiently selective to be useful. However, pre-emergent weed control with suitable contact sprays has been demonstrated to be effective. The weed problem in beets in Oregon varies with the season of the year when the beets are planted.

Materials and Methods

The weeds commonly encountered in late summer planted beets for seed production include:

Annual rye grass	<i>Lolium multiflorum</i>
Annual blue grass	<i>Poa annua</i>
Hairy vetch	<i>Vicia villosa</i>
Chickweed	<i>Stellaria media</i> and <i>Cerastium vulgare</i>
Groundsel	<i>Senecio vulgaris</i>
Pigweed	<i>Amaranthus retroflexus</i>

Spring planted crops for sugar production will usually have such weed problems as:

Lambsquarter	<i>Chenopodium album</i>
Pigweed	<i>Amaranthus retroflexus</i>
Mustard	<i>Brassica arvensis</i>
Mallow	<i>Malva rotundifolia</i>
Radish	<i>Raphanus raphanistrum</i>
Annual bluegrass	<i>Poa annua</i>
Barnyard grass	<i>Echinochloa crusgalli</i>
Green Foxtail	<i>Setaria viridis</i>

Chemicals selected for trial at the different times must, as a *priori*, be chosen for their property of controlling the weeds present. It does not necessarily follow that one chemical will be effective on all weeds. Consequently, the following trials were conducted with this in mind.

Trial 1. Pre-emergent treatments on Spring Planted Sugar Beets—

The seed bed for planting was prepared sufficiently ahead of time to

¹ For presentation at the Sixth General Meeting of the American Society of Sugar Beet Technologists, Detroit, Mich., Feb., 1950.
² Published as Technical paper No. 618 with the approval of the Director, Oregon Agricultural Experiment Station and Chief, U. S. Bureau of Plant Industry, Soils and Agricultural Engineering, on the basis of research conducted cooperatively.
³ Associate Agronomist, Oregon Agricultural Experiment Station, and Agronomist, Division of Sugar Plant investigations, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration, U.S.D.A.

favor germination of weed seed. Planting of sugar beets was made June 28, 1949, in rows spaced 20 inches apart with seeding at the rate of about 10 pounds per acre. Eleven days after planting, trials were established in a thrice replicated randomized complete block in plots of 8 rows 10 feet long. Eleven treatments were used, including 2 rates of a sodium salt of 2,4-D; 3 rates of TCA (trichloroacetic acid); 3 rates of emulsifiable IPC (isopropyl N-phenyl carbamate); one rate of Shell 20; one rate of a mixture of Dinitro general and diesel oil; and an untreated check. Four weeks later, four random .0001 acre quadrat counts of weeds per plot were taken and four random 2 foot segments of row were counted for stand.

TABLE 1. PRE-EMERGENT SPRAYS ON SPRING PLANTED SUGAR BEETS.

Material	Rate per acre	Beet plants per 100 feet of row ¹		Weeds per .0001 acre ²	
		number	% of check	number	% of check
Sodium salt of 2,4-D	1.0 lb. a.e. ³	575	70.6	12.5	49.5
Sodium salt of 2,4-D	1.5 lb. a.e.	655	87.3	6.5	25.7
Ammonium salt of TCA (trichloro-acetic acid)	10.0 lb. a.e.	680	90.7	19.9	78.9
Ammonium salt of TCA	20.0 lb. a.e.	725	96.6	17.4	69.0
Ammonium salt of TCA	40.0 lb. a.e.	640	85.3	12.5	49.6
Emulsifiable IPC	2.0 lb.	770	102.6	20.9	82.9
Emulsifiable IPC	4.0 lb.	995	119.3	24.2	96.0
Emulsifiable IPC	8.0 lb.	815	108.6	18.5	73.3
Shell 20	80 gal.	245	32.6	1.4	5.5
Dinitro general	1 qt.)				
Diesel oil	20 gal.)	805	107.3	4.0	11.8
Untreated check	750	100.0	25.2	100.0

¹ Average from 3 plots, four counts of 2 foot row segments per plot.

² Average of 3 plots with three quadrat counts per plot.

³ a.e. = Acid equivalent.

Trial 2. Selective grass control in fall planted beets—

As previously indicated, fall germinated grasses often are extremely troublesome in beets planted for seed. Preliminary trials had indicated that established beet seedlings of 4 to (3 leaf stage are tolerant of rates up to 5 pounds IPC per acre. Germinating beets will tolerate only up to 2 pounds per acre of IPC.

A trial was established in October of 1948 on beets which had been planted in early September to determine the feasibility of using IPC in the fall for grass control. Four row plots 10 feet long were established in randomized block design with 3 replications. Treatments consisted of 3 rates of wettable IPC, 3 rates of emulsifiable IPC and 3 rates of a mixture of emulsifiable IPC and diesel oil. At the time of treatment the beets had from 2 to 6 leaves and ranged up to 4" high.

Results and Discussion

The results of the effect of pre-emergent chemical treatments on both weeds and beets are summarized in Table I. These treatments were applied at volumes of 40 gallons per acre with the exception of two as noted in Table I.

The Dinitro (3,5 dinitro-O-secondary butyl phenol) general and diesel oil proved to be the best all around treatment. The beet stand on this plot averaged 107.3% of the check while giving a weed control of 88.2%.

The Shell 20 (an aromatic oil) gave the best weed kill but the "heavy ends" of this oil remained as a residue sufficiently long to kill emerging beet seedlings. Such has often been found true in pre-emergent use of oils possessing high boiling fractions.

The sodium salt of 2,4-D was quite effective in reducing the population of weeds and the remaining plants exhibited typical symptoms of 2,4-D poisoning. Even though there was no rain subsequent to the application,

TABLE 2. SELECTIVE GRASS CONTROL TRIALS IN SUGAR BEETS FOR SEED.

Material	Rate per acre	Weed control ¹	Observed effect on beets ²
	pounds	percent	
Wettable IPC	1	50	none
Wettable IPC	3	85	none
Wettable IPC	5	95	slightly retarded
Emulsifiable IPC	1	60	slight necrosis
Emulsifiable IPC	3	90	necrosis and retardation
Emulsifiable IPC	5	98	20% necrosis
Emulsifiable IPC+	1)		
Diesel oil	5 gal.)	90	slightly retarded
Emulsifiable IPC+	3)		(20% necrosis
Diesel oil	5 gal.)	95	(growth retarded
Emulsifiable IPC+	5)		(40% necrosis
Diesel oil	5 gal.)	100	(growth retarded

¹ Estimated control. Weeds mainly annual ryegrass and annual blue grass.

² Observations of two replicates December, 1948.

the beets showed strong symptoms of 2,4-D toxicosis and many of them were killed outright.

The ammonium salt of Trichloroacetic acid (TCA) was reasonably effective in killing most kinds of weeds that were present even though it is used primarily as a grass killer. The beet stand was not reduced seriously by this material, although it is suspected that had there been more moisture in surface soil more injury may have resulted.

IPC, at the rates tried, proved innocuous to the beets in this trial and as was anticipated did very little harm to the broadleaved weeds present. It has been found that IPC, while nearly specific for grasses, will suppress many dicotyledonous plants at time of germination. Soil moisture is perhaps the most critical factor in determining the effectiveness of IPC. If moisture is deficient the IPC has little or no effect. Conditions favorable to accelerated microbiological activity in the soil, such as optimum moisture and high temperature, speed the decomposition of IPC, likewise lowering its effectiveness.

Table 2 gives a summarization of the results obtained with IPC applied to sugar beets in the fall. No data on these plots were obtainable the following spring as unusually severe winter weather froze out the beets.

It will be noted that in general the three-pound rate of IPC gave satisfactory control of the weeds with a minimum effect on the beets. The five-pound rates of the emulsifiable IPC plus five gallons of diesel oil resulted

in injury to the beets whereas the wettable IPC at 5 pounds gave only a slight retardation of growth.

Field treatments of sugar beets were made with wettable IPC in the falls of 1948 and 1949 for grass control. The acre rate of application ranged from 4 to 10 pounds of actual IPC on beets having from 4 to 12 leaves. The results to date have been very satisfactory. Dosages of 4 to 6 pounds of IPC per acre have proven sufficient to give good grass control if applied before the tillering stage of the grass. Dosages above 6 pounds per acre or lesser amounts applied before the beets attained the four-leaf stage resulted in retardation of growth. However, the beets generally overcame this within a few months.

Summary and Conclusions

Weed control trials on sugar beets have indicated that this crop is very limited in its tolerance to chemicals. Pre-emergent treatment with suitable chemicals affords one of the best means of minimizing this problem.

Dinitro alkyl phenols with diesel oil gave promise of being one of the more satisfactory materials. The sodium salt of 2,4-D, while giving fair weed control, has too long a residual effect. Heavy aromatic oils are unsatisfactory for the same reason. In order to use such an oil, it would be necessary to assure a greater lapse of time between application and emergence to permit disappearance of the residue.

IPC has shown much promise for controlling grass in fall planted beets. The beets have shown considerable tolerance to this material after passing the four-leaf stage. Soil moisture is the most important limiting factor in using IPC.