Results of Chemical Weed Control on Sugar Beets in Areas of the Utah-Idaho Sugar Company

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Chemical weed control has shown that sugar beets can be grown with little or no hand labor. Space planting and/or mechanical thinning of sugar beets could have eliminated the need for hand labor had it not been for the ever-present weeds. Several programs have been adapted that have helped control weeds and have reduced the amount of labor needed. Effective chemical weed control should eliminate hand labor from spring work just as hand labor has been removed from fall work.

Tests were conducted in 1964 and 1965 by the Utah-Idaho Sugar Company to evaluate new herbicides and to compare them with those that were already being used. Some of the tests were extensive, replicated plots in the same field while others were strips through commercial fields which generally compared several herbicides that had already been proven effective.

Washington Tests

In Washington, trials were conducted to evaluate herbicides and to determine the effect of different depths of preplant incorporation. In the depth of incorporation tests the herbicides were applied and incorporated 1½ to 2 inches deep, ½ to 1 inch deep, or left undisturbed on the top of the soil. Adequate moisture was present for germination in all of the tests and there was not sufficient rainfall to affect either germination or herbicide control. Weed counts were from an area over the row 2-inches wide and 50-inches long. The results of these tests are shown in Table 1. Incorporation to a depth of 1½ inches to 2 inches gave the best control of weeds from all of the herbicides, giving an average of 79% control of all the weeds compared to 59% for the shallow incorporation and 55% for no incorporation. Shallow incorporation gave better weed control than did no incorporation except with the combination of Tillam and Avadex, and this herbicide gave better control than expected with no incorporation.

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Table 1.—Results of herbicide tests in the Toppenish and Moses Lake, Washington area showing effectiveness of depth of incorporation. Table shows percentage of weed control.

Method of application	Herbicides and Rates of Application									
	Tillam 4#	Eptam 1½#	Eptam 3#	R-2063 2#	R-2063 4#	Pyramin 4#	Eptam 1½# Pyramin 4#	Tillam 3# Avadex 1#	Average	Check
No incorporation	43	32	59	53	70	37	69	81	55	55.4
Light incorporation ½" to 1"	49	31	65	59	75	45	73	73	59	55.4
Deep incorporation 1½" to 2"	62	57	76	69	82	86	93	89	77	55.4

The herbicide evaluation trials compared eight herbicide treatments in five tests and twelve herbicides in four other tests. All treatments were replicated three times in each test.

In all of these tests the herbicides were applied and incorporated 1½ inches to 2 inches just prior to planting. No additional moisture was applied for germination or to activate the herbicide and there was not sufficient moisture to affect the results from the herbicides. Weed counts for these tests were also secured by counting the weeds in randomized areas over the rows 2 inches wide and 50 inches long. The primary weeds in these tests were red roots (*Amaranthus retroflexus*), lambsquarter (*Chenopodium album*), barnyard grass (*Echinochlos crus galli*), and mustard (*Brassica niger*). The results are shown

Table 2.—Results of herbicide tests in the Toppenish and Moses Lake, Washington areas showing number of weeds remaining after preplanting incorporation with various herbicides. (All herbicides incorporated to a depth of 1½" to 2").

Grower	Herbicides and Rates of Application								
	Tillam 4#	Eptam 1½#	Eptam 3#	R-2063 2#	R-2063 4#	Pyramin 4#	Eptam 1½# Pyramin 4#	Tillam 3# Avadex 1#	Check
Elmer Franz	13.5	18.2	13.5	14.6	12.6	10.8	8.8	6.1	22.9
Alvin Schaeffer	32.0	25.7	30.0	13.0	8.8	5.6	2.4*	9.0	42.4
Don Butcher	14.1	21.7	5.2*	12.0	5.5	15.0	5.2	5.7	81.6
Ken Miller	16.1	31.7	11.0	23.3	14.6	5.1**	2.0*	2.8	83.5
Walt Cullam	31.0	22.7	6.9*	21.7	7.5	3.0	1.5	5.8	46.7
Average	21.3	24.0	13.3	16.9	9.8	7.9	4.0	5.9	55.4
% Weed Control	62	57	76	70	82	86	93	89	55.4

* Stand of beets reduced below desired thinned stand.

**Some reduction in beet, though thinned stand still possible.

Table 3.—Results of herbicide tests conducted in Toppenish and Moses Lake, Washington showing the effect of herbicides in controlling different weeds. Table shows the percentage of weed control from preplant incorporation of herbicide.

	Herbicides and Rates of Application								
Weeds	Tillam 4#	Eptam 1½#	Eptam 3#	R-2063 2#	R-2063 4#	Pyramin 4#	Eptam 1½# Pyramin 4#	Tillam 3# Avadex 1#	Check-No. of weeds per 100 sq. inches
Red roots	81	72	84	39	94	73	89	69	6
Lambs-quarters	61	55	84	78	88	86	88	89	21
Barnyard grass	90	97	98	91	94	76	96	95	13
Other weeds (mostly mustard and Russian thistle)	44	33	54	49	67	93	96	88	21

All herbicides incorporated to a depth of 1½ to 2 inches before planting.

in Tables 2, 3 and 4. Table 2 shows the total number of weeds and the control from each of the herbicide treatments. Table 3 shows the control of each kind of weed present. Table 4 shows the results of the four tests where twelve treatments were applied.

Tillam at 3 pounds per acre plus Avadex at 1 pound per acre, and R-2063 at 4 pounds per acre gave the most effective weed control. Eptam at 1½ pounds plus 4 pounds of Pyramin and 4 pounds of Pyramin alone gave equally good weed control, but in some of the tests these treatments severely damaged the beets.

R-2063 at 4 pounds, Eptam at 1½ pounds plus Pyramin at 4 pounds, and Eptam at 3 pounds per acre gave the best control of red roots. However, of these three R-2063 was the only one that did not damage the stand of beets in at least one of the tests.

Lambsquarter was fairly well controlled by several of the herbicides tested. Tillam plus Avadex and R-2063 at four pounds per acre gave as good control as any of the herbicides without any damage to the beets. All other treatments that gave equally good control damaged the stand of beets in at least one location.

Barnyard grass control was excellent with all herbicides tested with the exception of Pyramin. When Pyramin and Eptam were applied together, good grass control resulted.

Mustard and Russian thistle (*Salsola kali*) comprised most of the weeds that are listed as "other weeds." Eptam plus Pyramin,

Table 4.—Results of herbicide tests conducted in Toppenish and Moses Lake, Washington in 1965. Table shows total number of weeds remaining after incorporating herbicides 1½" to 2" before planting.

	Herbicides and Rates of Application												
Grower	Tillam 4#	R-2063 2#	R-2063 4#	Pyramin 4#	H 282 2#	H 282 4#	CP31393 4#	CP31393 8#	CP45592 1#	CP45592 2#	Tillam 4# Avadex 1#	Pyramin 4# Eptam 1½#	Check-No. of weeds per 100 sq. inches
Walt Cullam	34	64	84	94			2	74*	21	73	88	97	47
Elmer Franz	7	65	85	72	35	67	49	89*	24	71*	4	72	24
Gordon Stover	44	49	74	78	9	28	89	93*	68	59*	59	91	27
U&I Sugar Co.	21	70	66	71	67	66	75	80	48	64	57	88	24
Avg. 4 tests	27	62	77	79			54	84	40	66	52	87	30
Avg. 3 tests	24	61	75	74	37	54	71	87	47	65	40	84	25

*Stand of beets seriously reduced.

Pyramin, and Tillam plus Avadex gave the best control of these weeds. Of these three only Tillam plus Avadex left a satisfactory stand in all of the tests. R-2063 gave effective control of red root, lambsquarter, and barnyard grass, but was not very effective in the control of mustard and/or Russian thistle.

Idaho Tests

The tests in Idaho were designed to measure the effect of herbicides on sugar beets and weed populations, on time and expense to thin the beets, and on yield and sucrose content of the beets. All of the herbicides in these tests were incorporated with a power incorporator 1½ inches to 2 inches deep in a band just prior to planting. There was sufficient moisture to germinate the seed though in some of the tests small amounts of rainfall were recorded. The results of these tests are shown in Tables 5, 6 and 7.

The tests shown in Table 5 indicate R-2063 gave the most reduction in weed populations, leaving only 16 as compared to 326 in the check or a 95% reduction. There was a small decrease

Table 5.—Herbicide trials in Idaho in 1965 showing the effect on weed populations beet stands, thinning required and yield of beets.

Herbicide	Weed populations	Time to thin hours/acre	Beet counts prethin	Beets at harvest	Percent sucrose	Yield per acre
			Per 100″	Per 100′ of row		
Check	326	52.9	20	73	16.3	17.65
R-2063 4#	16	12.5	26	83	16.0	19.37
CP 45592 1#	72	16.1	17	89	16.4	17.81
H 283 4#	24	10.7	18	78	16.6	19.27
Avadex 4#	46	12.3	15	74	16.3	18.39
Pyramin 5#	42	13.6	13	69	16.2	17.76

Table 7.—Results of tests conducted in Idaho showing effectiveness of herbicide in controlling weeds and the effect on the number and size of beets.

Herbicide	Leaf size	Beets		Percent of weed control				
		Number	Range	Red Root	Lambs-quarter	Kochia	Mustard	Grasses
Tillam	1.81	8.21	2-13	94	90	12	84	100
R-2063	2.37	11.77	7-17	82	100	47	100	100
Tillam & Avadex	2.03	10.21	5-13	61	100	12	100	73
Check				15.93*	.56*	.17*	.37*	2.80*

All figures are the average of 32 randomized counts 2″ wide and 50″ long.
*Average number of weeds.

Table 6.—Effect of herbicides alone and in combination on weeds, beets and tons per acre.

	Check	Tillam 4#	R-2063 4#	Avadex 4#	H 283 4#	CP 31393 6#	Tillam 2# CP 31393 3#	R-2063 CP 31393 3#	Pyramin 3.75# CP 45592 .5#	LSD 99:1
Weeds										
1½" x 100" band	330	25	33	67	46	20	22	18	32	55.74
Beets										
110" row prethin	22	21	22	18	19	15	13	21	19	9.38
Hourly earnings										
@ 12.50 per acre	.23	.98	1.00	1.02	1.17	1.58	1.78	1.89	1.17	
Yield										
Tons per acre	16.04	18.37	17.95	16.56	16.26	16.57	20.93	17.35	19.49	N.S.

in the stand of beets from all of the herbicides except R-2063. Pyramin at 4 pounds per acre reduced the prethin stand counts from 20 to 13 per 100 inches of row. As there was sufficient beets to thin the desired stand, the number of beets at harvest time did not reflect any advantage or disadvantage from any herbicide. Sucrose was not affected by any of the treatments.

The beets in the check area required 52.9 hours to thin an acre of beets. TD-283, Avadex, and R-2063 reduced the time to 10.7, 12.3, and 12.5 hours per acre, respectively. This is a reduction of from 80 to 76% of the time required to thin the untreated areas.

The check yielded 17.65 tons of beets per acre and the yield from the CP45582 and the Pyramin plots were about the same as the check. R-2063, TD 283 and Avadex increased the yield by 1.72, 1.62 and .74 tons per acre, respectively.

The results of the tests in Table 6 show that all of the herbicides significantly reduced the weed populations. This was an exceptionally weedy field and would probably have been lost had herbicides not been applied. CP 31393 alone or in combination with Tillam or R-2063 gave excellent weed control. This herbicide at 6 pounds per acre and at 3 pounds plus 2 pounds of Tillam per acre reduced beet stands from 22 per 100 inches in the check to 15 and 13, respectively. This was not a high enough reduction to seriously affect the thinned stand of beets, though it may have been, had less seed been planted or had there been poorer emergence. CP 31393 at 3 pounds plus 2 pounds of R-2063 per acre did not reduce the prethin stand of beets, indicating that CP 31393 can more effectively be combined with R-2063 than with Tillam. All of the other herbicides in the test reported in this table did not seriously affect beet stands.

The lowest yield was obtained from the check plots and all the herbicide treatments gave some increase with the highest of 4.89 tons resulting from an application of 3 pounds of CP 31393 plus 2 pounds of Tillam per acre. None of the yield increases were statistically significant.

The hourly earnings of the beet workers in this test was an important part of the test. Workers in the check or untreated areas made only 23 cents per hour when paid $12.50 per acre. In the treated areas the workers made 98 cents to $1.89 per hour when paid at the same rate per acre. The highest hourly wage was obtained on plots treated with 3 pounds of CP 31393 plus 2 pounds of R-2063 per acre.

In another test conducted in Idaho, three of the recommended herbicides were applied in replicated 6-row strips through grow-

ers' fields. Thirty-two randomized counts that were 2 inches wide and 50 inches long were taken to determine the number and species of weeds present and the number of prethinned beets. In addition leaf measurements were taken to help determine the size of the beets. The results of this test are shown in Table 7.

Each of the herbicides was applied at 4 pounds per acre and each gave fair control of all the weeds except kochia (*Kochia scoparia*). Tillam controlled the highest percentage of red root followed by R-2063 and then by the Tillam-Avadex combination. All gave in excess of 90% control of lambsquarter. The grasses were controlled 100% by Tillam and R-2063 and mustard was also controlled 100% by R-2063 and the combination of Tillam and Avadex.

The most striking information gained from this test was the difference in size of leaf area between the three treatments. When the leaves and petioles were extended and measured, the Tillam had an average width of 1.81 inches, the Avadex and Tillam combination was 2.03 inches, and the R-2063 averaged 2.37 inches. The difference was readily visible. The R-2063 treatments showed no toxicity and though the beets in the other treatments were not severely affected, the size and color difference in the R-2063 plots were easily discernable. Removal of the remaining weeds was easier in the areas with the larger beets.

Discussion

These tests would indicate that effective weed control can result from proper application of several herbicides. They would indicate that 1½ to 2 inches is the most desirable depth of incorporating most preplant herbicides. R-2063 gave less damage to the beets while giving as effective weed control as any other herbicide, however, several other herbicides gave good weed control and definitely some herbicides excelled in the control of certain weeds. Tillam, a combination of Tillam and Avadex, R-2063, and H 282 or H 283 have shown to be effective herbicides. Others gave effective weed control, but were too severe on the beets to be recommended for commercial applications.

These tests further demonstrated that there is much need for tests to find more effective herbicides and better methods of application. They also demonstrated that there are effective herbicides that will greatly reduce the number of workers needed for beet thinning and weeding providing an adequate program can be adapted to insure the best usage of these herbicides.

Areas of the Utah-Idaho Sugar Company that are having success with chemical weed control are areas that have adapted

and sold a herbicide program. The district manager and agricultural superintendent in the Idaho area of the Utah-Idaho Sugar Company, in 1960 and 1961, visualized the possibilities of chemical weed control. While others wondered which was the best herbicide, and which was the best method of application, these men decided effective weed control could be secured by applying Tillam with power incorporation. Because of the difficulties encountered in securing an adequate supply of clean water, the granular form of the herbicide soon became preferred to the liquid form.

Tillam may not have been the best herbicide they could have chosen and power incorporation of the granular material may not have been the most effective method of application, but a program had been adequately defined so that the grower knew exactly what to do. Once this decision was made, the growers soon became efficient in applying the right amount of herbicide.

Most other areas have since adapted a recommended program and effective weed control has resulted. If growers were left with a multiple choice of herbicides or methods of application, there was little or sporadic amounts of chemical weed control. A definite precise program must be adapted. Care must be exercised in selecting the best herbicide and the best method of application for each area, but once a decision is reached the program must be energetically pursued. Chemicals and methods can be changed as better herbicides are found or as more information is available, but the program must be definite enough that the growers do not become confused and, therefore, either do nothing or make mistakes in that which they endeavor to do.

Summary

The Utah-Idaho Sugar Company conducted tests in parts of Washington, Idaho and Utah in 1964 and 1965, to evaluate new herbicides and to compare them with those that are already being used. In addition trials were made to help determine the most effective depth of incorporating preplant applications of herbicides.

These tests indicated that most preplant herbicides should be applied 1½ to 2 inches deep and that many of the herbicides, if properly incorporated, would give effective weed control.

On the basis of these trials the following recommendations are made:

1. R-2063, Tillam, Tillam plus Avadex, H 282 or H 283, and Avadex will be recommended for commercial use.

a. Tillam will be the most widely recommended herbicide.

b. R-2063, as available, to replace Tillam.

c. Tillam plus Avadex to replace Tillam if lambsquarters or wild oats are present.

d. H 282 or H 283 to be used if kochia is present.

e. Avadex to be used where wild oats are the major problem.

2. Herbicides to be applied preplant and from 1½ to 2 inches deep with a power incorporator.

3. Fieldmen to make definite recommendations to aid growers in making decisions.