Economic Comparison of Herbicides for Weed Control in Sugarbeets[1]

by
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Received for publication March 6, 1972

Introduction

Sugarbeet producers have a large arsenal of herbicides at their disposal to develop successful weed control programs (3, 4, 5, 6, 7, 10). Herbicide utilization to combat weeds has evolved as a result of scarcity and increased cost of labor and the need to increase production efficiency.

Little or no published literature is available regarding the economic comparisons of herbicide treatments. In order to determine the ultimate benefit from chemical weed control, the studies reported herein compare the economic impact of herbicides on sugarbeet production. Supplemental labor, herbicide cost and effectiveness of weed control are factors which affect net profits at harvest. Because several herbicides and herbicide combinations can result in effective weed control, economic comparisons of chemical treatments will facilitate great efficiency in producing sugarbeet crops.

The objectives of this study were to determine: 1) weed control effectiveness of preplant, postemergence and complementary preplant-postemergence herbicide treatments, 2) hand labor requirements necessary to remove remaining weeds after treatment, 3) variable costs related to herbicidal weed control, 4) gross and net returns for each herbicide treatment.

Material and Methods

Studies were conducted at the Agricultural Experiment Substation, Torrington, Wyoming. Soil texture at the plot location was sandy loam. The experimental plots were arranged in a three-replicated, split-plot design. Postemergence herbicides were applied after the preplant herbicides to obtain the complementary treatments. Nontreated checks were included for comparisons.

The major weed species present were black nightshade (*Solanum nigrum* L.), redroot pigweed (*Amaranthus retroflexus* L.),

[1] Published with approval of the Director, Wyoming Agricultural Experiment Station, as Journal Article No. 511.

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kochia (*Kochia scoparia* (L.) Roth) and green foxtail (*Setaria viridis* (L.) Beauv.). A lesser population of common lambsquarters (*Chenopodium album* L.), common purslane (*Portulaca oleracea* L.) and wild buckwheat (*Polygonum convolvulus* L.) infested the experimental area.

Plots were irrigated immediately after planting, and supplemental moisture was provided as required throughout the growing season. Percent weed control was obtained for the preplant treatments prior to postemergence herbicide application. Sugarbeet stand and weed counts were taken from an area 10 ft long and 3 inches wide (1½ inches on each side of the sugarbeet row.)

Postemergence and complementary treatments were evaluated 14 days after herbicide application. Sugarbeets were thinned to approximately one plant per foot. Any remaining weeds were removed by hand following the final weed counts. Time required to thin and weed each plot was recorded and computed on an acre basis. No subsequent labor was necessary to maintain a weed-free condition throughout the growing season.

Yield data were obtained by harvesting 10 ft from the two center rows of each plot. Sugarbeets were hand topped. Weight and percent sugar were determined at the Holly Sugar Corporation Factory, Torrington, Wyoming. Sugarbeet populations, percent weed control, and harvested sugarbeets were evaluated in permanently marked positions within each plot.

Results and Discussion

Herbicide Effectiveness

Percent weed control obtained with the complementary preplant-postemergence treatments containing cycloate (S-ethyl N-ethylthiocyclohexanecarbamate) was superior to all other treatments (Table 1). Cycloate at 3.0 lb/A preplant resulted in 93 and 98% control of broadleaved and grass weeds, respectively. The application of postemergence herbicides in sequence with cycloate increased the broadleaved weed control but sporatic emergence of green foxtail reflected a lack of complete control of this species. The annual grass which remained in the treated area were stunted and malformed.

Pebulate (S-propyl butylethylthiocarbamate) + diallate [S-(2,3-dichlorallyl) diisopropylthiocarbamate] at 3.125 lb/A preplant did not result in satisfactory control of either broadleaved or grass weeds. The application of postemergence herbicides only increased the percent control of the total weed spectrum but the resulting control was less than the control obtained when cycloate

was utilized as a preplant treatment. Phenmedipham (methyl m-hydroxycarbanilate m-methylcarbanilate) at 1.0 lb/A, pyrazon (5-amino-4-chloro-2-phenyl-3 (2H)-pyridazinone) + phenmedipham at 3.0 + 1.0 lb/A and pyrazon + dalapon (2,2-dichloropropionic acid) + wetting agent at 4.0 + 2.2 + 2.0 lb/A failed to give satisfactory control of the weed population present.

Effect on Yield and Quality

Yields from plots treated with cycloate at 3.0 lb/A and pebulate + diallate at 3.125 lb/A preplant were 4.3 and 2.4 tons/A higher, respectively, than the yields from nontreated plots (Table 1). Plots receiving only postemergence treatments produced 1.4 to 2.7 more tons/A of sugarbeets than the plots receiving no herbicide. Cycloate at 3.0 lb/A with pyrazon + dalapon + wetting agent at 4.0 + 2.2 +2.0 lb/A and pebulate + diallate at 3.125 lb/A with phenmedipham at 1.0 lb/A treated areas produced 29.4 and 29.2 tons/A, respectively. Plots treated with pebulate + diallate at 3.125 lb/A plus pyrazon + dalapon + wetting agent at 4.0 + 2.2 + 2.0 lb/A yielded 22.7 tons/A. The nontreated check plots yielded 22.3 tons/A.

Table 1.—Effect of preplant, postemergence and complementary preplant-postemergence treatments upon weed control, beets at harvest, tonnage yields and percent sugar.

Treatment	Rate lb/A	% Control		Beets[1] at harvest	Yield Tons/A	Percent sugar
		Broad-leaf	Grass			
Preplant						
cycloate	3.0	93	98	120	26.6	15.1
pebulate + diallate	3.125	67	82	124	24.7	15.3
Postemergence						
phenmedipham	1.0	85	44	114	23.8	15.7
pyrazon + phenmedipham	3.0 + 1.0	51	70	108	25.0	15.5
pyrazon + dalapon + W.A.	4.0 + 2.2 + 2.0	60	0	116	23.7	15.9
Complementary						
cycloate	3.0					
phenmedipham	1.0	99+	97	108	26.4	15.9
pyrazon + phenmedipham	3.0 + 1.0	97	97	119	26.6	15.2
pyrazon + dalapon + W.A.	4.0 + 2.2 + 2.0	94	98	120	29.4	13.9
pebulate + diallate	3.125					
phenmedipham	1.0	82	97	120	29.2	15.9
pyrazon + phenmedipham	3.0 + 1.0	99+	82	117	28.5	15.4
pyrazon + dalapon + W.A.	4.0 + 2.2 + 2.0	74	92	129	22.7	15.3
Nontreated check				73	22.3	14.5

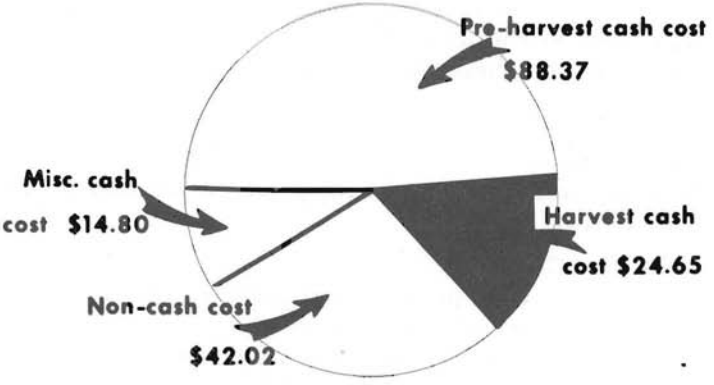
[1] Number of sugarbeets per 100 ft of row harvested.

The severe competitive effect of the annual weeds on the sugarbeet seedlings prior to thinning and weeding reduced vigor sufficiently that the mortality rate was substantial during the remainder of the growing season. Percent sugar in the harvested roots ranged from 15.1 to 15.9 except in those taken from plots treated with cycloate at 3.0 lb/A plus pyrazon + dalapon + wetting agent at 4.0 + 2.2 + 2.0 lb/A and the check plots.

Treatment Costs

Fixed production costs were determined by deleting 1) herbicide costs and 2) thinning-weeding labor cost from average sugarbeet production cost for Wyoming as reported by Stevens (8). Adjusted fixed cost was $169.84/A, including interest charge for cash and farm overhead (Table 2). The greatest investment in sugarbeets was preharvest cost for labor, equipment, real estate taxes, water and fertilizer. Non-cash cost of $42.02/A represents depreciation, interest and housing for machinery. Harvest costs vary, depending on sugarbeet yields which regulate transportation costs of the crop to a receiving station.

Table 2.--Average fixed costs to produce one acre of sugarbeets in Wyoming.



Total Fixed Costs - $169.84

Preplant herbicide costs were $3.82/A for cycloate at 3.0 lb/A and $3.47/A for pebulate + diallate at 3.125 lb/A (Table 3). Herbicide treatment expenditures for postemergence applications were phenmedipham $9.00/A, pyrazon + phenmedipham $14.00/A, and pyrazon + dalapon + wetting agent $10.88/A. The herbicide cost was based upon a 7-inch band application. Complementary treatment costs were comparatively higher as a result of combined expenses for preplant and postemergence herbicides. Application, incorporation and tillage equipment costs for preplant,

postemergence, complementary preplant-postemergence treatments were $20.40, $20.55, $21.90 and 22.25 per acre, respectively. Additional cost for herbicide application of complementary treatments are attributed to the preplant and postemergence sprayers required. The plots receiving no herbicides had a higher accrued cost as a result of the increased number of cultivations necessary for weed control.

Labor Costs

Labor required to thin and weed the plots reflects the weed control efficiency obtained with each herbicide treatment (Table 3). Plots treated with cycloate at 3.0 lb/A preplant plus phenmedipham at 1.0 lb/A postemergence required an expenditure of $8.20/A for hand labor ($1.65/hr basis) compared with $30.15/A to weed and thin the untreated plot. Complementary treatments except pebulate + diallate with pyrazon + dalapon + wetting agent required less labor input than the preplant treatments. Labor cost for working the postemergence treatments was greater than either the preplant or complementary treatments.

Lack of weed control obtained with the postemergence treatments increased the time required to remove the remaining weeds. Capital savings for labor resulting from the complementary treatments range from $15.40 to $21.95/A when compared to the untreated plots. The highest variable cost accrued was $54.55/A for plots treated postemergence with pyrazon + phenmedipham at 3.0 + 1.0 lb/A. Cycloate at 3.0 lb/A and pebulate + diallate at 3.125 lb/A treatments had total variable costs of $41.12 and $38.62/A, respectively, compared with $52.40/A variable expenditures for the check.

Total Production Costs

Total production costs per acre of sugarbeets were determined by the sums of variable cost and fixed costs (Table 4). Total costs deviated according to the variable cost accrued for herbicide treatment, application equipment, and hand labor.

Gross return per acre was determined by computing the sugar produced in relation to tonnage yield and percent sugar contained in the sugarbeet roots. The sugar produced was valued at $0.05 per pound. All herbicide-treated plots produced a greater gross return than the untreated controls (Table 4). Plots treated with pebulate + diallate at 3.125 lb/A plus phenmedipham at 1.0 lb/A had a gross return of $464.28/A. The lowest gross return for a herbicide treatment was computed for pebulate + diallate at 3.125 lb/A with pyrazon + dalapon + wetting agent at 4.0 + 2.2 + 2.0 lb/A, which reflects the reduced tonnage yields obtained from the plots.

Table 3.——Variable expenditures for preplant, postemergence and complementary preplant-postemergence treatments.

Treatment	Rate lb/A	Total[1] Herbicide Cost/A	Total Equipment Cost/A	Labor[2] Thinning & Weeding/A	Total Variable Cost/A
Preplant					
cycloate	3.0	$ 3.82	$20.40	$16.90	$41.12
pebulate + diallate	3.125	$ 3.47	$20.40	$14.75	$38.62
Postemergence					
phenmedipham	1.0	$ 9.00	$20.55	$19.35	$48.90
pyrazon + phenmedipham	3.0 + 1.0	$14.00	$20.55	$20.00	$54.55
pyrazon + dalapon + W.A.	4.0 + 2.2 + 2.0	$10.88	$20.55	$21.05	$52.48
Complementary					
cycloate	3.0 +				
phenmedipham	1.0	$12.82	$21.90	$ 8.20	$42.92
pyrazon + phenmedipham	3.0 + 1.0	$17.82	$21.90	$12.45	$52.17
pyrazon + dalapon + W.A.	4.0 + 2.2 + 2.0	$14.70	$21.90	$13.75	$50.35
pebulate + diallate	3.125 +				
phenmedipham	1.0	$12.47	$21.90	$13.75	$48.12
pyrazon + phenmedipham	3.0 + 1.0	$17.47	$21.90	$13.10	$52.47
pyrazon + dalapon + W.A.	4.0 + 2.2 + 2.0	$14.35	$21.90	$14.75	$51.00
Nontreated check			$22.25	$30.15	$52.40

[1] Approximate cost of herbicide applied on 7-inch band.

[2] Hand labor cost based on $1.65 per hou.

Table 4.—Costs and returns for preplant, postemergence and complementary preplant-postemergence treatments.

Treatment	Rate lb/A	Variable Cost	Total[1] Cost	Gross[2] Return/A	Net Return/A	Variation from Nontreated Check
Preplant						
cycloate	3.0	$41.12	$210.96	$401.96	$191.00	+$ 89.31
pebulate + diallate	3.125	$38.62	$208.46	$378.52	$170.06	+$ 68.37
Postemergence						
phenmedipham	1.0	$48.90	$218.74	$374.44	$155.70	+$ 54.01
pyrazon + phenmedipham	3.0 + 1.0	$54.55	$224.39	$387.34	$162.95	+$ 61.26
pyrazon + dalapon + W.A.	4.0 + 2.2 + 2.0	$52.48	$222.32	$376.51	$154.19	+$ 52.50
Complementary						
cycloate	3.0 +					
phenmedipham	1.0	$42.92	$212.86	$420.24	$207.38	+$105.69
pyrazon + phenmedipham	3.0 + 1.0	$52.17	$222.01	$404.17	$182.16	+$ 80.47
pyrazon + dalapon + W.A.	4.0 + 2.2 + 2.0	$50.35	$220.29	$408.94	$188.65	+$ 86.96
pebulate + diallate	3.125					
phenmedipham	1.0	$48.12	$217.96	$464.28	$246.32	+$144.63
pyrazon + phenmedipham	3.0 + 1.0	$52.47	$222.31	$439.52	$217.21	+$115.52
pyrazon + dalapon + W.A.	4.0 + 2.2 + 2.0	$51.00	$220.84	$347.16	$126.32	+$ 24.63
Nontreated check	—	$52.40	$222.24	$323.93	$101.69	—

[1] Sum of variable cost plus average fixed cost of $169.84 for producing one acre of sugarbeets in Wyoming (8) (Table 1).

[2] Gross returns computed for actual sugar produced at $0.05 per pound.

Net return from the nontreated check was only $101.69/A (Table 4). Net profits from herbicide-treated plots were from $24.63 to $144.63 *greater* than nontreated plots. The increased net return realized from herbicide-treated plots above the return from plots in which only hand labor was utilized reflects the benefits of a herbicidal weed control program. An investment of $3.82 for cycloate resulted in an additional return of $89.21/A. The expenditure of $12.47 for pebulate + diallate plus phenmedipham early in the growing season led to an increased profit of $144.63/A at harvest. Investigators (1, 2, 9, 11) have shown that annual weed competition results in decreased vigor of sugarbeets which can substantially reduce yields at the end of the growing season. Data from this study indicates that pebulate + diallate plus phenmedipham was the most efficient treatment for eliminating weed competition with minimum damage to the sugarbeet crop. Although plots treated with pebulate + diallate plus pyrazon + dalapon + wetting agent returned an additional $24.63/A, the dividends on the herbicidal cost of $14.35/A was 1.72 times greater than the original investment.

Summary and Conclusions

1. Labor requirements to thin and weed sugarbeet fields is related to the weed control obtained with herbicides. Variable costs were generally lower where herbicides were used. This results from lower labor requirements.
2. Gross returns from areas treated with herbicides were higher than from areas receiving no herbicides.
3. Additional profits of $24.63 to $144.63 were obtained from areas treated preplant, postemergence or complementary preplant-postemergence herbicide applications. Pebulate + diallate plus phenmedipham resulted in the greatest net returns per acre. The lowest net return realized with a herbicide treatment was from pebulate + diallate plus pyrazon + dalapon + wettings agent.
4. This sugarbeet study indicates that the return on investment for the purchase and use of herbicides results in increased profits, regardless of type of application.

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