Effects of Four Methods of Mechanical Incorporation on the Phytotoxicity of Pyrazon[1]

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Introduction

The herbicide, 5-amino-4-chloro-2-phenyl-3-(2H)-pyridazinone, hereafter referred to as pyrazon, has been effective as a pre-emergent treatment for weed control in sugar beets (*Beta vulgaris* L.). It is generally accepted that, to obtain satisfactory results in irrigated areas pyrazon must be physically mixed into the soil.

This study was undertaken to determine the effects of mechanical incorporation on the phytotoxicity of pyrazon. The objectives of this study were (A) to evaluate four methods of soil incorporation as they affect the activity of pyrazon, (B) to determine the effects of four methods of soil incorporation of pyrazon on the control of broadleaved and grass-weed species common to sugar beet fields, (C) to determine the effect of incorporation of pyrazon on the stand of sugar beets, (D) to determine the effect of methods of incorporation of pyrazon on sugar beet yields and sucrose content of the sugar beets and (E) to compare the effects of pyrazon and PEBC (S-propyl butylethylthiolcarbamate) on broadleaved and grass-weed species, sugar beet stands, tonnage yields and sucrose content of sugar beet roots.

Review of Literature

Sullivan et al. (6)[3] reported that pyrazon was effective in controlling broadleaved weeds on heavy-textured soils but was less effective on sandy soils. With high temperatures, adequate moisture and rapid growth, pyrazon treatments gave 80 to 100 percent control of broadleaved weeds. Pyrazon at 4 lb/A was as effective in controlling weeds as diallate (S-2, 3 - dichloroallyl N,N-diisopropylthiolcarbamate) + PEBC combinations with less reduction in sugar beet stand (2). Fisher (4) reported that the most effective time for postemergent treatment of weeds was in the cotyledon stage of growth. For effective weed control, 2 to 3 lb/A of pyrazon was sufficient in Europe. Alley et al. (1) found that pyrazon at rates as high as 8 lb/A used alone, failed to control green foxtail [(*Setaria viridis* L.) Beauv.]. However,

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[3] Numbers in parentheses refer to literature cited.

all ratios of the combinations of pyrazon + TCA (trichloroacetic acid) consistently controlled green foxtail. Pyrazon + PEBC gave excellent control of rough pigweed (*Amaranthus retroflexus* L.).

The combination of pyrazon + CP 32179 (2-bromo-6'-tert-butyl-o-acetotoluidide) almost eliminated competition by weeds and increased the dry weight of sugar beets (5). Pyrazon ± TD-282 [di: (N,N-dimethyltridecylamine) salt of endothall] and pyrazon + TCA reduced stands less than the pyrazon + diallate combinations (1). Crook (3) reported a 100% control of broadleaved and grass-weed species with slight stunting of sugar beets when the combination of pyrazon + TD-282 was applied. Addition of a surfactant to postemergent pyrazon applications increased weed control but also significantly increased injury to sugar beets (6).

Methods and Materials

This study was conducted at the Agricultural Experimental Substation, Torrington, Wyoming. Sandy loam-textured soil prevailed. The experimental plots arranged in a split-plot design, were treated and planted April 29, 1964.

Each experimental unit consisted of one chemical treatment four rows in width and 100 feet in length. Each treatment was replicated 12 times. The chemical treatments were (A) pyrazon at 5 lb/A[4], (B) pyrazon at 3 lb/A, (C) PEBC at 3 lb/A and (D) no chemical. PEBC was included as a comparison for pyrazon. The chemical formulation used in the study were pyrazon, a 50% wettable powder, and PEBC, six pounds active ingredient per gallon.

Mechanical incorporation methods were (A) roto-tiller (power incorporator), (B) sinner-weeder (or Russ-Ken consists of a row-crop ditcher shovel, 6 inches in width, with covering blades mounted behind), (C) finger-weeder and (D) rotary-hoe. The spray nozzle was attached to a steel rod welded to the front of all the incorporators. This allowed the chemical to be incorporated immediately after it was applied to the soil. The finger-weeder was placed directly behind the sugar beet planter. Single-packer wheels, 3 inches in width, were placed over the center of the sugar beet row behind the planting units.

The herbicides were incorporated in a 7 inch band, 1¼ to 2½ inches in depth, over the center of the sugar beet row. The check plots received the same mechanical treatments as the chemically treated rows. The chemical application, incorporation and sugar beet planting were all accomplished in one operation.

[4] All chemical treatments were calculated on a full-coverage basis for a 7-inch band.

Weed and sugar beet counts were taken from an area 10 feet in length and 3 inches in width, 1½ inches on either side of the beet row. The counts were taken when the sugar beets were in the 2-to-4-leaf stage of growth. The plant population was classified as to (A) sugar beets, (B) broadleaved weeds and (C) grass-weed species.

Yields were determined by selecting at random 10 feet of row from each plot. Weights and percent sucrose of the sugar beet roots were determined at the Holly Sugar Corporation factory at Torrington, Wyoming.

Results and Discussion

Sugar beet stands were reduced from 7.9 to 19.2% with pyrazon at 3 lb/A and 5 lb/A, respectively. The sugar beets which emerged were slightly stunted but showed no signs of malformation.

PEBC at 3 lb/A caused a reduction between 0 to 27.6% of emerged stand of sugar beets. The leaves of the sugar beet seedlings which emerged from PEBC plots were thick, waxy, necrotic and in some cases malformed. The stunted sugar beet seedlings recovered ten to twelve weeks after planting.

The percent weed control, percent stand of sugar beets, yields per acre and percent sucrose of the sugar beet roots are presented in Table I. Check plots were considered to have no weed control and 100% stand of sugar beets. PEBC at 3 lb/A, when incorporated with the sinner-weeder, resulted in the greatest percent control of broadleaved and grass species of weeds. However, the largest reduction in sugar beet stand occurred with this treatment. Pyrazon at 3 lb/A and 5 lb/A incorporated with all methods tested resulted in 80 to 92% emerged stand of sugar beets. Pyrazon at 3 lb/A with all methods of incorporation resulted in the lowest percent control of grass species. In most cases, the percent broadleaved weed control obtained with pyrazon at 3 lb/A was less than pyrazon at 5 lb/A and PEBC at 3 lb/A.

The sinner-weeder method of incorporation of pyrazon at 3 lb/A, pyrazon at 5 lb/A and PEBC at 3 lb/A resulted in 15.5 tons/A, 14.6 tons/A and 17.2 tons/A, respectively. Rototiller incorporation of PEBC at 3 lb/A resulted in a yield of 20.5 tons/A as compared to 17.6 tons/A for the same mechanical treatment in the check plot. Although the sucrose content of the sugar beet roots ranged from 14.5% to 16.2%, there were no significant differences between the incorporation methods or chemical treatments.

Table 1.—Effect of four methods of incorporation and chemical treatment on percent weed control, precent stand of sugar beets, tons per acre, and percent sucrose of the sugar beet roots.

	No chemical				Pyrazon 5 lb/A				Pyrazon 3 lb/A				PEBC 3 lb/A			
	FW	RT	SW	RH	FW	RT	SW	RH	FW	RT	SW	RH	FW	RT	SW	RH
Percent control of grasses	0	0	0	0	68.0	76.1	81.7	69.9	1.5	3.5	42.7	7.4	26.9	37.8	85.0	47.3
Percent control of broadleaves	0	0	0	0	44.6	90.5	78.9	73.5	44.8	77.5	72.9	71.6	76.5	86.0	7.4	89.1
Percent stand of sugar beets	100	100	100	100	92.1	81.9	80.8	88.8	90.2	83.4	84.3	85.4	92.4	100.0	72.4	92.5
Tonnage per acre of sugar beet roots	19.2	17.5	16.9	16.4	18.8	18.0	14.6	19.2	18.2	17.1	15.5	19.0	18.9	20.5	17.2	16.6
Percent sucrose in roots	15.4	16.3	15.2	15.0	15.0	14.9	14.5	15.5	14.7	14.6	15.8	14.7	15.5	15.0	15.3	15.1

FW = finger-weeder, RT = roto-tiller, SW = sinner-weeder, and RH = rotary-hoe

The effect of mechanical incorporation on number of broadleaved and grass species of weeds, number of sugar beets, yield and sucrose content of the roots is presented in Table 2. The sinner-weeder method of incorporation resulted in significantly more grass control than the other three methods. Finger-weeder incorporation gave significantly less broadleaved-weed control. The sinner-weeder and roto-tiller showed a significant reduction in sugar beet stand when comparing all incorporation methods. Tonnage yields were significantly decreased where the sinner-weeder was employed.

The effect of chemical treatments on number of broadleaved weeds and grass species, sugar beet stands, yields and sucrose content of the sugar beet roots is shown in Table 3. Plots treated with pyrazon at 5 lb/A and PEBC at 3 lb/A contained an average of 7.3 and 14.2 grass plants per 10 feet of row, respectively. Broadleaved weed populations were significantly reduced by pyrazon at 3 and 5 lb/A and PEBC at 3 lb/A when compared with the check. Even though pyrazon at 5 lb/A and PEBC at 3 lb/A significantly reduced the sugar beet stands, the yields were slightly higher than the check plot and pyrazon at 3 lb/A. There were no significant differences in percent sucrose content of sugar beet roots among chemical treatments.

Table 2.—Comparison of four methods of mechanical incorporation on number of weeds, number of sugar beet plants, tons per acre, and percent sucrose of sugar beet roots.

Incorporation method	Grass numbers	Broadleaf numbers	Sugar beet stand	Tons per acre	Percent sucrose
Finger-weeder	21.4[2] a[1]	49.8[2] a	24.5[2] a	18.8 a	15.1 a
Roto-tiller	19.9 a	33.4 b	21.3 b	18.3 a	14.6 a
Sinner-weeder	12.8 b	33.0 b	20.4 b	15.8 b	15.1 a
Rotary-hoe	18.8 a	36.1 b	23.6 a	18.3 a	15.1 a

[1] Means in the same column which have the same letter are not significantly different at the .05 level.

[2] Average number of plants per 10 feet of row.

Table 3.—Comparison of chemical treatments on number of weeds, number of sugar beet plants, tons per acre and percent sucrose of the sugar beet roots.

Chemical treatment	Grass numbers	Broadleaf numbers	Sugar beet stand	Tons per acre	Sucrose content
Check	27.8[2] a[1]	87.9[2] a	24.0[2] a	17.5	14.9 a
Pyrazon 5 lb/A	7.3 b	24.3 b	20.7 b	18.0	15.1 a
Pyrazon 3 lb/A	24.0 a	29.0 b	23.6 a	17.5	14.6 a
PEBC 3 lb/A	14.2 ab	11.1 b	21.5 b	18.0	15.2 a

[1] Means in the same column which have the same letter are not significantly different at the .05 level.

[2] Average number of plants per 10 feet of row.

No visible differences existed between chemical treatments or incorporation methods at the end of the growing season. The sugar beet plants appeared to have no stunting as a result of toxic damage from the chemicals by the end of the growing season.

Summary and Conclusions

(1) The sinner-weeder was the best method of incorporation for the control of grass-weed species.

(2) Significantly greater control of broadleaved weeds was obtained with roto-tiller and sinner-weeder incorporation. PEBC at 3 lb/A and pyrazon at 5 lb/A resulted in the greatest percent control of broadleaved weeds.

(3) Sinner-weeder and roto-tiller significantly reduced the sugar beet stand; however, only the sinner-weeder method of incorporation resulted in reduction of sugar beet yields. Although pyrazon at 5 lb/A and PEBC at 3 lb/A caused significant reduction in sugar beet seedling stand, both treatments had slightly higher yields than the check.

(4) Sucrose content of the sugar beet roots was not significantly affected by either method of incorporation or chemical treatment.

(5) Pyrazon at 3 lb/A did not give adequate weed control in this study.

(6) With all factors taken into consideration, the power driven roto-tiller was the most effective of the four methods of mechanical incorporation of pyrazon.

Literature Cited

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