Response of Sugarbeet, Common Sunflower, and Common Cocklebur to Clopyralid or Desmidipham plus Phenmedipham[†]

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ABSTRACT

A three-year experiment was conducted near Scottsbluff, NE, to evaluate the selectivity of clopyralid, desmedipham plus phenmedipham, and the combination for common sunflower and common cocklebur control in sugarbeet. Clopyralid provided 81 to 98% control of common sunflower and 95 to 98% control of common cocklebur while desmedipham plus phenmedipham provided poor control of both weeds. Combinations of clopyralid plus desmedipham plus phenmedipham provided good control of both weeds but in some years the treatment increased sugarbeet injury over that observed when clopyralid was applied alone. Common sunflower and common cocklebur at densities of 5 plants/9 m of crop row reduced sugarbeet root yield 31 and 28%, respectively. Clopyralid's efficacy on common sunflower and common cocklebur was reflected in sugarbeet root yields similar to those observed in a handweeded control.

Additional Key Words: Competition, interference, root yields.

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Weeds are a major problem in sugarbeet *(Beta vulgaris* L.) production. Weeds that emerge soon after planting sugarbeet are more competitive than late- emerging weeds (Dawson, 1965; Weatherspoon and Schweizer, 1971), and broadleaf weeds generally are considered more competitive than grasses (Brimhall, Chamberlain, and Alley, 1965; Zimdahl and Fertig, 1967).

Broadleaf weeds are most competitive after they begin to shade the crop (Dawson, 1965). As few as one kochia [*Kochia scoparia* (L.) Schrad.] per 3 m of row (Weatherspoon and Schweizer, 1971) or one redroot pigweed (*Amaranthus retroflexus* L.) per four sugarbeet (Brimhall, Chamberlain, and Alley, 1965) have reduced sugarbeet root yields by 24 and 21%, respectively.

Common sunflower (*Helianthus annuus* L.) at densities of 6, 12, 18, and 24 plants/30m of crop row reduced sugarbeet root yield 40, 52, 67, and 73%, respectively (Schweizer and Bridge, 1982). At equal densities of 18 plants/30m of crop row kochia, common lambsquarters (*Chenopodium album* L.) and common sunflower reduced sugarbeet root yields 36, 38, and 67%, respectively (Weatherspoon and Schweizer, 1971; Schweizer, 1983; Schweizer and Bridge, 1982). In most situations common sunflower is a taller plant and produces more biomass than kochia and common lambsquarters which accounts for its greater interference with sugarbeet. Weed interference with sugarbeet can be prevented if sugarbeets are kept free of weeds for 8 weeks after planting (Wicks and Wilson, 1983). With the cost of handhoeing increasing, the interest in chemical weed control has increased. The objectives of these experiments were to compare the effectiveness of postemergence applications of clopyralid (3,6-dichloro-2-pyridinecarboxylic acid) or desmedipham (ethyl{3-[[phenylamino)carbonyl]oxy]phenyl]carbamate) plus phenmedipham (3- [(methoxycarbonyl)amino]phenyl (3-methylphenyl)carbamate) for selective control of common sunflower and common cocklebur (*Xanthium strumarium* L.) in sugarbeet.

MATERIALS AND METHODS

Field experiments were conducted in 1991, 1992, and 1993 at the University of Nebraska Panhandle Research and Extension Center near Scottsbluff, NE. The plots were located on a Glenberg fine sandy loam (Ustic Torrifluvents) with a pH of 8.0 and 1.0% organic matter content. The experimental design was a randomized complete block with 12 treatments and four replications (Table 1). The experiment was replicated over 3 years. Year by treatment inter-

Table 1. Response of common sunflower and common cocklebur to desmedipham + phenmedipham, clopyralid, and herbicide combinations.

Treatment	Rate	Weed size at time of herbicide treatment		Weed density 20 DAT†						Weed control					
				Common sunflower			Common cocklebur			Common sunflower			Common cocklebur		
		Common sunflower	Common cocklebur	1991	1992	1993	1991	1992	1993	1991	1992	1993	1991	1992	1993
	(kg/ha)	(cm)		(plants/9 m of crop row)						(%)					
untreated control	-	-	-	5	5	5	5	5	5	0	0	0	0	0	0
handweeded	-	-	-	0	0	0	0	0	0	99	98	99	99	98	99
desmedipham + phenmedipham	0.27 + 0.27	7	5	5	5	5	3	3	5	5	0	5	26	0	8
desmedipham + phenmedipham	0.27 + 0.27	15	10	4	5	5	5	5	5	21	9	7	15	0	9
clopyralid	0.1	7	5	3	1	0	2	1	0	92	98	97	95	98	98
clopyralid	0.1	15	10	2	5	0	3	5	0	91	81	94	97	96	96
clopyralid	0.2	7	5	1	0	0	1	1	0	94	98	98	95	98	98
clopyralid	0.2	15	10	3	3	0	4	5	0	91	93	96	95	97	97
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.1	7	5	2	2	0	2	3	0	93	98	97	99	98	97
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.1	15	10	3	5	0	4	5	0	87	84	96	95	96	96
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.2	7	5	0	1	0	0	0	0	96	98	98	96	98	98
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.2	15	10	3	5	0	2	2	0	87	94	96	96	98	96
LSD (0.05)				2	1	1	3	4	1	28	5	3	26	3	3

† Abbreviation: DAT = days after herbicide treatment.

actions were significant; therefore, the data for each year were subjected to separate analyses of variance. Treatment means were compared with a least significant difference test at the 5% level of significance.

Plots were located in a different field each year. Each field was moldboard plowed and roller-harrowed before planting. Sugarbeet ('Hilleshog Mono-HY 55') were planted to stand during the second week of April at a rate of 3 seeds per 30 cm of row. Sugarbeet rows were spaced 56 cm apart. Individual plots were six sugarbeet rows wide by 9 m long, common sunflower was planted in three rows and common cocklebur in the other three rows. Two days after sugarbeet planting, four seeds of common sunflower or two seeds of common cocklebur were planted every 1.5 m in the sugarbeet row. In 1991 sugarbeet, common sunflower, and common cocklebur were replanted May 31 due to severe weather which reduced weed and sugarbeet stands. After common sunflower and common cocklebur emergence weeds were thinned to 1 weed per 1.5 m of sugarbeet row. Weeds other than common sunflower and common cocklebur were removed by hand during the first week of May and as needed the reminder of the season.

The 12 weed control treatments consisted of an untreated control, handweeded check, clopyralid at 0.1 or 0.2 kg/ha, desmedipham plus phenmedipham at 0.27 plus 0.27 kg/ha, and desmedipham plus phenmedipham plus clopyralid at 0.27 plus 0.27 plus 0.1 kg/ha or 0.27 plus 0.27 plus 0.2 kg/ha, respectively. Each herbicide treatment was applied either to 7 or 15 cm tall common sunflower or to 5 or 10 cm tall common cocklebur. Herbicide treatments were applied once, as a broadcast application in water at 200 L of water per hectare with a tractor mounted sprayer.

Visual estimates of sugarbeet injury and weed control where 0 = no injury or control and 100 = completely killed were recorded 20 days after herbicide treatment. Sugarbeet stand and weed density were also recorded 20 days after herbicide treatment. Sugarbeet were cultivated three times beginning in mid- May and were irrigated and fertilized to ensure optimum sugar production.

During the first week of October common sunflower and common cocklebur plants that were not killed by herbicide treatments and plants in the untreated control were handcut from each plot. Sugarbeet were topped and harvested during early October with a mechanical two-row harvester. As mentioned earlier, half of each sugarbeet plot was interseeded to common sunflower and half to common cocklebur; during the sugarbeet harvest two rows of sugarbeet were harvested from the common sunflower half and two

rows from the common cocklebur half of each plot. A 9 kg subsample from each plot was washed, weighed, and analyzed for sucrose content by the method outlined by the Association of Official Chemists (1955).

RESULTS AND DISCUSSION

Common sunflower and common cocklebur densities of 5 plants/9 m of sugarbeet row were uniform within the plot area each year (Table 1). Weed densities recorded 20 days after herbicide treatment in 1991 and 1992 underestimated weed control because many of the common sunflower and common cocklebur were still alive even though they showed signs of herbicide injury (Table 1). Weed control ratings taken 20 days after treatment, although subjective, more accurately reflected the effect of herbicide treatments on weeds.

Desmedipham plus phenmedipham applied to either stage of weed growth controlled less than 25% of the common sunflower (Table 1). Clopyralid at 0.1 or 0.2 kg/ha applied to common sunflower that were 5 or 10 cm tall provided common sunflower control which ranged from 81 to 98% across years.

Combining desmedipham plus phenmedipham with clopyralid at 0.1 or 0.2 kg/ha did not reduce or enhance common sunflower control.

Desmedipham plus phenmedipham applied at either stage of common cocklebur growth controlled less than 30% of the weed (Table 1). Clopyralid at 0.1 or 0.2 kg/ha applied to common cocklebur that were 5 or 10 cm tall provided control that ranged from 95 to 98%. Combining desmedipham plus phenmedipham with clopyralid did not reduce or enhance common cocklebur control.

Sugarbeet stand was not affected by postemergence herbicide application (Table 2). In 1991 sugarbeet injury was greatest in areas treated with desmedipham plus phenmedipham plus clopyralid at 0.27 plus 0.27 plus 0.2 kg/ha when sugarbeet were in the cotyledon to 2-true leaf stage of growth. In 1992 sugarbeet injury from desmedipham plus phenmedipham plus clopyralid at 0.27 plus 0.27 plus 0.2 kg/ha applied when sugarbeet were in the 2-true-leaf stage of growth produced more sugarbeet injury than clopyralid or desmedipham plus phenmedipham applied alone at the same stage of crop growth.

Schweizer and Bridge (1983) have shown that 18 common sunflower plants per 30 m of sugarbeet row have the potential to reduce sugarbeet root yield 55 to 79% depending upon the year. In this experiment, a common sunflower density of 5 plants/9 m of sugarbeet row reduced sugarbeet root yield 41, 24, and 29% in 1991, 1992, and 1993, respectively (Table 3). Even though weed densities were similar between the two experiments, common sunflower did not exhibit the crop

Table 2. Response of sugarbeet to herbicide treatments and interference from common sunflower or common cocklebur.

		At the time of herbicide treatment					Sugarbeet					
		Weed size		Sugarbeet stage of growth			Stand 20 DAT†			Injury 20 DAT†		
Treatment	Rate	Common sunflower	Common cocklebur	1991	1992	1993	1991	1992	1993	1991	1992	1993
	(kg/ha)	(cm)		(true leaves)			(plants/15 cm row)			%		
untreated control	-	-	-	-	-	-	55	69	88	5	0	0
handweeded	-	-	-	-	-	-	75	69	86	5	0	0
desmedipham + phenmedipham	0.27 + 0.27	7	5	0-2	2	4	69	61	89	5	3	9
desmedipham + phenmedipham	0.27 + 0.27	15	10	2-4	6-8	6	48	56	86	8	4	10
clopyralid	0.1	7	5	0-2	2	4	71	69	99	13	2	5
clopyralid	0.1	15	10	2-4	6-8	6	67	73	98	12	0	3
clopyralid	0.2	7	5	0-2	2	4	61	69	95	15	2	1
clopyralid	0.2	15	10	2-4	6-8	6	56	73	98	10	0	1
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.1	7	5	0-2	2	4	67	58	99	7	5	6
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.1	15	10	2-4	6-8	6	53	68	81	13	1	8
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.2	7	5	0-2	2	4	48	58	95	33	8	9
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.2	15	10	2-4	6-8	6	57	72	86	5	1	6
LSD (0.05)	-	-	-	-	-	-	NS	NS	NS	18	4	4

† Abbreviation: DAT = days after herbicide treatment.

Table 3. Response of sugarbeet to herbicide treatments and interference from common sunflower or common cocklebur.

		At the time of herbicide treatment					Sugarbeet					
							Common sunflower interference			Common cocklebur interference		
		Weed size		Sugarbeet stage of growth			Root yield			Root yield		
Treatment	Rate	Common sunflower	Common cocklebur	1991	1992	1993	1991	1992	1993	1991	1992	1993
	(kg/ha)	(cm)		(true leaves)			(t/ha)			(t/ha)		
untreated control	-	-	-	-	-	-	34.3	65.4	60.0	24.4	77.8	58.7
handweeded	-	-	-	-	-	-	58.4	85.5	85.1	42.0	86.3	85.5
desmedipham + phenmedipham	0.27 + 0.27	7	5	0-2	2	4	41.8	60.2	54.3	33.1	70.7	59.5
desmedipham + phenmedipham	0.27 + 0.27	15	10	2-4	6-8	6	38.4	65.4	57.3	26.4	70.9	59.1
clopyralid	0.1	7	5	0-2	2	4	50.8	94.3	80.2	40.2	83.5	77.0
clopyralid	0.1	15	10	2-4	6-8	6	55.0	78.1	87.2	44.0	83.0	86.6
clopyralid	0.2	7	5	0-2	2	4	40.0	82.0	77.2	29.8	83.9	77.5
clopyralid	0.2	15	10	2-4	6-8	6	50.5	91.9	79.4	40.5	95.7	78.0
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.1	7	5	0-2	2	4	35.0	73.7	75.6	25.2	80.6	77.0
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.1	15	10	2-4	6-8	6	39.3	82.5	72.5	30.7	82.6	72.6
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.2	7	5	0-2	2	4	33.7	65.2	70.9	26.3	74.5	69.5
desmedipham + phenmedipham + clopyralid	0.27 + 0.27 + 0.2	15	10	2-4	6-8	6	35.5	84.0	81.8	22.4	85.0	75.3
LSD (0.05)	-	-	-	-	-	-	19.0	16.2	8.2	21.0	15.1	8.7

interference at Scottsbluff that was observed in Colorado by Schweizer and Bridge (1983).

Desmedipham plus phenmedipham applied at either stage of weed growth provided poor control of common sunflower which was reflected in sugarbeet root yields that were similar to the untreated control (Tables 1 and 3). In 1992 and 1993 sugarbeet root yields averaged over desmedipham plus phenmedipham treated areas were 22.7 to 29.3 t/ha lower than those observed in the handweeded treatment and indicate the inability of this herbicide treatment to reduce the influence of this weed with sugarbeet. Clopyralid provided common sunflower control which ranged from 81 to 91%. This excellent weed control was reflected in sugarbeet root yields that were similar to the handweeded treatment (Tables 1 and 3). Sugarbeet root yields were similar between different rates and timings of clopyralid. The combination of desmedipham plus phenmedipham plus clopyralid at 0.27 plus 0.27 plus 0.2 kg/ha applied when sugarbeet were in the cotyledon to 4 true-leaf stage of growth provided excellent common sunflower control but resulted in crop injury and a reduction in sugarbeet root yield as compared to the handweeded treatment. In 1993 desmedipham plus phenmedipham plus clopyralid at 0.27 plus 0.27 kg/ha plus 0.1 kg/ha applied at either stage of weed growth resulted in a reduction in sugarbeet root yield. Percent sugar was not influenced by herbicide treatments in 1991 through 1993 (data not shown).

Common cocklebur densities of 5 plants/9 m of sugarbeet row reduced crop root yields 42, 10, and 31% in 1991, 1992, and 1993, respectively (Table 3). Sugarbeet crop interference from common cocklebur averaged across three years resulted in a 28% crop root yield reduction while that observed from common sunflower was 31%.

Desmedipham plus phenmedipham applied at either stage of weed growth provided poor control of common cocklebur which was reflected in sugarbeet root yields that were similar to the untreated control (Tables 1 and 3). Sugarbeet root yields in clopyralid treated areas in 1992 and 1993 were similar to the handweeded treatment and reflect the excellent common cocklebur control achieved with clopyralid. Combining clopyralid with desmedipham plus phenmedipham did not enhance or reduce common cocklebur control but did result in a reduction of sugarbeet root yield in 1993 when the 0.2 kg/ha rate of clopyralid was utilized in the treatment combination. Percent sugar was not influenced by herbicide treatments in 1991 through 1993 (data not shown).

Postemergence applications of clopyralid can be successfully

utilized to control common sunflower and common cocklebur selectively in sugarbeet. Clopyralid's ability to control common sunflower and common cocklebur was reflected in sugarbeet root yields similar to those observed in a handweeded control. Combining clopyralid with desmedipham plus phenmedipham did not enhance common sunflower or common cocklebur control. Combinations of clopyralid plus desmedipham plus phenmedipham at 0.2 plus 0.27 plus 0.27 kg/ha did increase sugarbeet injury and in some years resulted in a reduction of sugarbeet root yield.

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