Competition of Annual Weeds and Sugarbeets[1]

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Annual weeds are a major problem in sugarbeet production on the Texas High Plains. The most widespread and troublesome annual weeds are kochia (*Kochia scoparia* (L.) Schrad.), pigweed (mostly *Amaranthus Retroflexus* L. and *A. palmeri* S. Wats.), and barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.).

Broadleaf annual weeds have been shown to be more competitive with sugarbeets than grasses (1, 2, 4)[3]. Green foxtail (*Setaria viridis* (L.) Beauv.) densities of less than one foxtail per sugarbeet plant did not reduce sugarbeet root yield significantly in Wyoming (1). In the same study, one rough pigweed (*Amaranthus retroflexus* L.) per eight sugarbeets significantly reduced sugarbeet root yield. In New York, mustard (*Brassica* spp.) was more competitive than yellow foxtail (*Setaria glauca* L.) Beauv.) (4). The greater yield loss caused by broadleaf weeds appears to be due to their superior ability to compete for light.

In Washington, weeds that emerged soon after sugarbeet planting and competed until harvest reduced root yield the most (2). If weeds were removed within 9 weeks after sugarbeet emergence, yield was not reduced. When sugarbeets were hand-weeded for 7 to 9 weeks after sugarbeet emergence, full-season weed control resulted because crop competition controlled weeds that emerged later.

In most cases, yield reductions caused by annual weeds can be largely explained by the shading effect of weeds on the sugarbeets. There can also be competition for water or nutrients. Donald (3) gives an in-depth discussion of competition between plants. He explains how interactions compound advantages to the species able to dominate light interception. When a species falls behind on light interception, it has a reduced ability to effectively utilize its diminishing share of the water and nutrients. This in turn causes a further reduction in ability to compete for light.

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[3]Numbers in parentheses refer to literature cited.

Sucrose concentration of sugarbeet roots is affected much less by weed competition than is root yield. Dawson (2) found that sucrose concentration was reduced only where root yield was reduced by more than 63%.

Most sugarbeet growers in the Texas Panhandle use only a post-layby herbicide applied when the sugarbeets have 8 to 16 leaves. Hand labor and cultivation are used prior to that time. These studies were undertaken to determine when yield-reducing weeds emerge and how long weeds can remain in sugarbeets before yields are reduced. This information will help formulate more effective chemical and cultural weed control systems.

Materials and Methods

To determine how long weeds could compete with sugarbeets without depressing yield, plots were hand weeded at 2, 4, 6, and 8 weeks after sugarbeet emergence and then kept weed-free until harvest. Other plots were kept weed-free for 2, 4, 6, and 8 weeks after sugarbeet emergence and then allowed to become weedy to find out when emerging weeds were no longer competitive to the crop. Pigweed seed was broadcast on all plots just before emergence irrigation. Other weeds present were kochia and barnyardgrass. The two check treatments were weed-free and weedy for the entire growing season. Weeds were allowed to grow only in an eight-inch band centered on the sugarbeet row. Water furrows between rows were cultivated to facilitate furrow irrigation. A randomized complete block design with four replications was used both years.

In 1972, Holly HH10 sugarbeets were planted March 13 on 30-inch beds and irrigated on March 14 for emergence. Plots were two rows wide and 50 feet long. In October, weeds were harvested from both rows and sugarbeets from 45 ft. of one row.

Details of the experiment in 1973 were similar to 1972 except that plots were four rows wide and 30 ft. long. The center two rows were harvested for weed and sugarbeet yield in October. Wet, cold weather delayed planting until May 2, about 6 weeks later than normal. The study was irrigated on May 3 for emergence.

Results and Discussion

In 1972, about one weed emerged per foot of row in the weedy check (Table 1). Pigweed predominated but a few kochia and barnyardgrass plants were present. Sugarbeets that were kept weed-free for 6 weeks or longer after sugarbeet emergence on

March 23 yielded nearly as much as those kept weed-free for the entire growing season. Only a few pigweed emerged later than 6 weeks after sugarbeet emergence and at harvest were only about one-half as tall as those that emerged earlier. Kochia plants were almost eliminated when hoed 4 weeks after sugarbeet emergence. Barnyardgrass continued to emerge for 6 weeks and a few pigweed emerged after 8 weeks. Allowing weeds to grow and compete with sugarbeets for 8 weeks before weeding did not reduce yields.

Pigweed, at 2.4 plants per foot of row, was the only weed present in significant numbers in 1973. Removing weeds at 4 weeks or later after sugarbeet emergence on May 14 nearly eliminated pigweed for the year (Table 2). Contrary to 1972 results, pigweed allowed to grow for 8 weeks with sugarbeets competed significantly and reduced yield. The earlier onset of yield-reducing weed competition in 1973 can be attributed to a heavier weed stand and later planting which resulted in more rapid development of weeds. When weeds were removed at 8 weeks, sugarbeet plants were severely stunted compared to weed-free sugarbeets. After weed removal, sugarbeets appeared to recover, but yields were reduced in the fall.

This work demonstrates the overriding importance of early season weed control. The greatest number, most competitive, and potentially tallest weeds emerge early. A successful weed control system for the Texas Panhandle needs to be built around effective preplant and early postemergence herbicides.

Summary

For 2 years in areas infested predominantely with pigweed, and to a lesser extent with kochia and barnyardgrass, certain plots of sugarbeets were weeded for 2, 4, 6, or 8 weeks after sugarbeet emergence. Weeds were then allowed to emerge and grow until harvest. In other plots, weeds competed initially with sugarbeets for 2, 4, 6, or 8 weeks and then the plots were kept weed-free until harvest.

Late emerging weeds did not greatly influence the yield of sugarbeets when the sugarbeets were kept weed-free for 6 weeks after emergence. Weeds that were allowed to grow and compete with sugarbeets for 8 weeks after sugarbeet emergence reduced yield in one of two years. Control of early weeds within 6 weeks after sugarbeet emergence nearly eliminates weed competition for the season and is essential for maximum sugarbeet yield. Research effort should be concentrated on developing effective preplant and early postemergence herbicide systems.

Table 1. — Weed and sugarbeet yields in October after various periods of competition, 1972.

Treatment	Number of weeds in 100 ft of row			Dry weight of weeds, lb/A			Sucrose (%)	Root yield (tons/A)
	Pigweed	Kochia	Grass	Pigweed	Kochia	Grass		
Weed-free all year	0 c*	0.0 b	0.0 d	0 c	0 c	0 b	13.5 a	33.9 a
Weed-free 2 wks then weedy	98 a	2.8 a	6.3 a	4990 a	1300 b	180 a	14.1 a	20.4 c
Weed-free 4 wks then weedy	59 b	0.3 b	3.8 ab	3300 b	12 c	90 ab	13.3 a	26.0 b
Weed-free 6 wks then weedy	7 c	0.0 b	0.5 bd	360 c	0 c	8 b	13.1 a	31.5 a
Weed-free 8 wks then weedy	8 c	0.0 b	0.0 d	200 c	0 c	0 b	13.5 a	31.7 a
Weedy 2 wks then weed-free	0 c	0.0 b	0.0 d	0 c	0 c	0 b	13.5 a	33.7 a
Weedy 4 wks then weed-free	0 c	0.0 b	0.0 d	0 c	0 c	0 b	13.5 a	31.4 a
Weedy 6 wks then weed-free	0 c	0.0 b	0.0 d	0 c	0 c	0 b	13.3 a	34.8 a
Weedy 8 wks then weed-free	0 c	0.0 b	0.0 d	0 c	0 c	0 b	13.5 a	33.7 a
Weedy all year	75 ab	4.3 a	3.5 ac	4280 ab	2910 a	70 b	13.0 a	19.9 c

*Means followed by the same letter do not differ at the 5% level according to Duncan's New Multiple Range Test.

Table 2. — Pigweed and sugarbeet yield in October after various periods of competition, 1973.

Treatment	Number of pigweed in 100 ft row	Dry weight of pigweed (lb/A)	Sucrose (%)	Root yield (tons/acre)
Weed-free all year	0 b*	0 b	16.3 a	25.2 a
Weed-free 4 wks then weedy	4 b	39 b	16.6 a	25.2 a
Weed-free 6 wks then weedy	3 b	26 b	16.2 a	24.7 ab
Weed-free 8 wks then weedy	1 b	2 b	15.7 a	25.4 a
Weedy 4 wks then weed-free	0 b	0 b	16.6 a	24.8 ab
Weedy 6 wks then weed-free	0 b	0 b	15.8 a	23.4 ab
Weedy 8 wks then weed-free	0 b	0 b	16.3 a	21.3 b
Weedy all year	241 a	4450 a	16.1 a	12.5 c

*Means followed by the same letter do not differ at the 5% level according to Duncan's New Multiple Range Test.

Literature Cited

(1) BRIMHALL, PHIL B., EARL W. CHAMBERLAIN, and H. P. ALLEY. 1965. Competition of annual weeds and sugarbeets. Weeds 13:33-35.

(2) DAWSON, J. H. 1965. Competition between irrigated sugarbeets and annual weeds. Weeds 13:245-249.

(3) DONALD, C. M. 1963. Competition among crop and pasture plants. *In* A. G. Norman (ed.) Advances in Agronomy. 15:1-118. Academic Press, New York, New York.

(4) ZIMDAHL, ROBERT L. and STANFORD N. FERTIG. 1967. Influence of weed competition on sugarbeets. Weeds 15:336-339.