Using row spacing to increase crop competition with weeds

Craig M. Alford[1], Stephen D. Miller[1] and Jack T. Cecil[1]

[1] Associate Research Scientist, Professor and Assistant Research Scientist, University of Wyoming, Dept. of Plant Sciences.
Laramie, Wyoming, USA, 82071, Email cmalford@uwyo.edu, sdmiller@uwyo.edu , jtcecil@uwyo.edu

Abstract

Maize, sugarbeet, and dry bean are the primary row crops grown in Wyoming, usually in 76 cm rows. A substantial amount of research has been conducted in the mid-west; showing yields of crops can be increased when they are grown in narrow rows (< 76 cm). In addition to improving yields narrow rows may also allow crops to be more competitive with weeds. Row spacing trials were established in maize, sugarbeet and dry bean at Torrington Wyoming under sprinkler irrigated conditions. Crops were grown in 38, 56 and 76 cm rows. Light interception readings were taken throughout the growing season and end of season weed biomass and crop yield were determined. Growing crops in narrow rows reduced weed biomass, and light interception by the crop was increased, especially early in the season. Sugarbeet yields were increased when grown in narrow rows, while row spacing had no impact on maize or dry bean yields.

Media summary

Growing sugarbeet in narrow rows (38 or 56 cm) can reduce weed biomass and increase crop yields compared to production in 76 cm rows.

Key Words

Row spacing, weed biomass, light interception, maize, sugarbeet, dry bean.

Introduction

The three primary row crops grown in Wyoming are maize (*Zea mays*), sugarbeet (*Beta vulgaris*) and dry bean (*Phaseolus vulgaris*). There are 32,000 ha of maize, 16,000 ha of sugarbeet, and 12,000 ha of dry bean production in the state. All of these crops are grown under irrigated conditions typically in 76 cm rows. Producers growing these crops are looking for ways to improve crop yield and on-farm income. A considerable amount of research has been conducted showing that crop yield can increase if crop row spacing is reduced. Most research on crop row spacing done since the early 1980's has focused on reducing row spacing narrower than 76 cm. In Wyoming this research has been very limited. Fornstrom and Jackson (1983) showed that reducing sugarbeet row spacing from 76 to 56 cm resulted in a yield increase of 3.4 t/ha. Research in many other northern areas of the United States has shown yield increases of up to 9.9% by growing maize in rows narrower than 76 cm (Paszkiewicz, 1998; and Roth, 1997).

In addition to improving crop yields, reduced row spacing can also provide the crop with a competitive advantage over weeds. In Wyoming ALS herbicide resistant kochia (*Kochia scoparia*) has become a problem in some production areas. Reducing the row spacing may provide a cultural control measure to help manage this herbicide resistant weed. Studies investigating the effect of maize row spacing on weed growth in Michigan and Ontario found that weed biomass was reduced 28% by reducing row spacing to 56 cm and by 16 to 29% in 38 cm rows (Begna et al, 2001, Stewart, 2001 and Tharp and Kells, 2001). However, research in Minnesota found that reducing row spacing had no significant impact on weed biomass (Johnson *et al*, 1998). One theory for the reduced weed growth in narrow rows is quicker row closure which reduces the light penetration to the weeds emerging below the crop canopy. Several studies have shown that narrow rows are more efficient (0 to 11%) at intercepting light than wide rows

(Begna *et al*, 2001, Stewart, 2001, Teasdale, 1995, and Tharp and Kells, 2001). Differences between row spacings tend to diminish as the season progresses because of row closure in wide rows.

The potential yield benefit and reduction in weed growth has stimulated interest among Wyoming producers for research on narrow rows under our growing conditions where low night temperatures can slow crop growth in the spring and give weeds an advantage. A series of studies were conducted from 2001 to 2003 to determine how maize, sugarbeet, and dry bean responded to production in narrow rows. An additional objective of this research was to determine how weed growth was affected when these crops were grown in narrow rows.

Methods

Studies were established at the Research and Extension Center, Torrington, Wyoming under sprinkler irrigated conditions from 2001 to 2003. Maize and sugarbeet were tested in 2001 and 2002, while dry bean was tested in 2002 and 2003. All three crops were seeded in 38, 56, and 76 cm rows with the maize and sugarbeet each receiving five different herbicide treatments and the dry bean receiving a single treatment. For this report results for herbicide treatment will be pooled and the main effects of row spacing presented. All plots were replicated four times for maize and sugarbeet and six times for dry bean each year. Plot size in all studies was 3.1 m by 8.5 m.

Light readings were collected through the growing season, in weed free plots, using a LI-COR Linear Quantum sensor to determine how row spacing influenced light penetration through the crop canopy. Light readings were collected at solar noon when each row spacing for a given crop was closing the row. Readings were collected above the crop canopy and at the soil surface by placing the light sensor diagonally across the centre two rows of each plot. The data were converted to the percentage of the full sunlight reaching the soil surface. Weed biomass samples were collected prior to harvest using four 0.25 m^2 quadrants. All samples were dried for 96 hours at 60?C and dry weight determined. Yield data were collected for all crops. Data were analysed using analysis of variance and means separated using Fisher's protected LSD (P = 0.05).

Results

Weed biomass was highest in sugarbeet and least in dry bean (Table 1). Sugarbeet was the only crop where weed biomass was significantly reduced when grown in narrow rows, however, there were definite trends for reduced weed biomass in both narrow row maize and dry bean (Table 1). Row spacings of 38 and 56 cm significantly reduced weed biomass in sugarbeet compared to 76 cm rows, but the narrower rows were not different from each other. Sugarbeet and dry bean are low growing plants and will tend to cover the row quicker than maize, however, if a weed gets above the crop canopy it will be much more competitive in these crops compared to maize. Weed pressure was less in dry bean than the other crops due to a blanket herbicide application over the entire experimental area. Row spacing had a significant impact on light interception, particularly early in the season. In both maize and sugarbeet the 38 and 56 cm rows intercepted more light than 76 cm rows early in the season; however, by row closure of the 56 cm rows the differences had disappeared (Figure 1).

Sugarbeet produced 13% more sucrose in 38 cm compared to 76 cm rows (Table 2). Differences between 38 and 56 cm rows were not significant even though yields were 9% higher in 38 cm rows. Row spacing had no effect on maize or dry bean yield.

Table 1. Effect of row spacing on weed biomass production in sugarbeet, maize and dry bean at Torrington, Wyoming from 2001 to 2003.

Row Spacing	Sugarbeet	Maize	Dry bean

(cm)		(g/m^2)	
38	354	274	6
56	444	289	14
76	755	372	24
LSD (P=0.05)	271	NS	NS

Table 2. Effect of row spacing on crop yield in sugarbeet, maize and dry bean at Torrington, Wyoming from 2001 to 2003.

Row Spacing	Sugarbeet (sucrose)	Maize (grain)	Dry bean (grain)
(cm)		(t/ha)	
38	9.73	8.34	2.84
56	8.93	9.00	2.86
76	8.63	8.74	3.02
LSD (P=0.05)	0.93	NS	NS

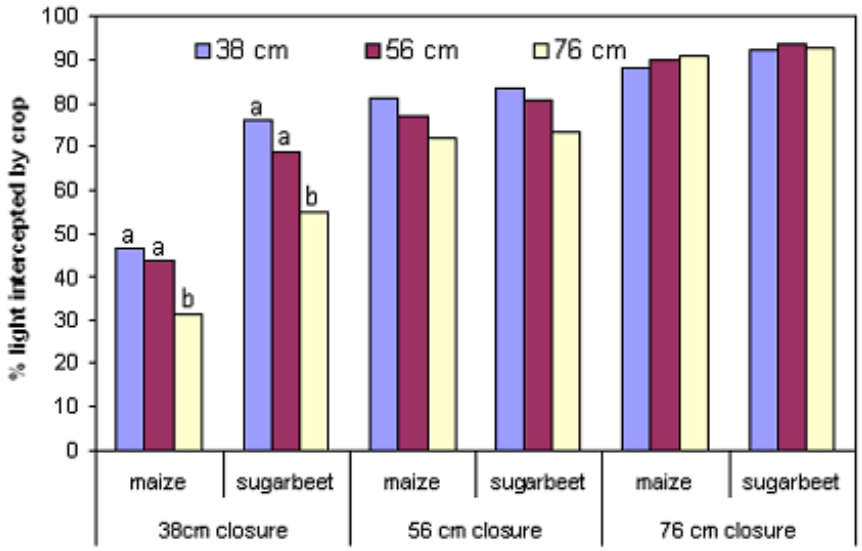

Figure 1. Effect of row spacing on light interception by sugarbeet, and maize at row closure at Torrington, Wyoming from 2001 to 2002. [Significant differences observed only at 38 cm closure; means with different letters within a crop are significantly different from each other (P=0.05)].

Conclusion

Growing crops in narrower row spacings can reduce weed growth although the degree of reduction will depend on the crop. Weed growth is most likely reduced because of increased light interception by the crop canopy in narrow rows early in the growing season. While reducing weed growth, yields may be increased (i.e. sugarbeet) or not affected (i.e. maize and dry bean). Producers interested in integrated weed management may be able to improve crop competition without adversely affecting yields by going to a narrow row production system.

References

Begna, SH, Hamilton RI, Dwyer LM, Stewart DW, Cloutier D, Assemat L, Fortoutan-Pour K, and Smith DL. (2001). Weed biomass production response to plant spacing and corn (*Zea mays*) hybrids differing in canopy architecture. Weed Technology 15: 647-653.

Fornstrom KJ and Jackson G (1983). Sugarbeets planted to stand in 56 and 76-centimeter rows. Journal of the American Society of Sugarbeet Technologists 20, 6:535-543.

Johnson GA, Hoverstad TR, and Greenwald RE. (1998). Integrated weed management using narrow corn row spacing, herbicides, and cultivation. Agron. J. 90: 40-46.

Paszkiewicz S. (1998). Narrow row width influence on corn yield. Pioneer Hi-Bred International (www.pioneer.com/usa/crop_management/national/narrowrow.htm).

Roth GW (1997). Potential of narrow row corn production in Pennsylvania. Pennsylvania State University. Agronomy Fact 52.

Stewart G (2001) Weed control in corn: Helping the crop compete. www.gocorn.net/Weed2.html

Teasdale JR (1995). Influence of narrow row/high population corn (*Zea mays*) on weed control and light transmittance. Weed Technology. 9:113-118.

Tharp BE, and Kells, JJ. (2001). Effect of glufosinate-resistant corn (*Zea mays*) population and row spacing on light interception, corn yield, and common lambsquarters (*Chenopodium album*) Growth. Weed Technology 15: 413-418.