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Cover Crops for Wind Erosion Protection of Sugar Beets

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Introduction

Wind erosion is a major problem that influences the establishment of sugar beets on lighter textured soils in Wyoming and other parts of the Great Plains. Sugar beets are most susceptible during the establishment period when potential wind damage is the highest. Cultural practices that leave residue on the surface appear to have the greatest potential for minimizing this erosion problem. However, with preceding crops of sugar beets, beans, or corn for silage, there is not enough residue remaining to provide erosion protection.

The objective of this research was to develop a sugar beet production system that uses a living mulch for wind erosion protection during establishment. The system employs conventional tillage followed by planting of a living mulch crop between the future sugar beet rows. The beets are planted later. The living mulch crop provides protection for the beets when they are emerging and then is eliminated with a herbicide.

A major question with this system was whether sugar beet yields could be maintained when grown with the competing cover crop that provides erosion protection. Research conducted from 1989 to 1995 investigated type of cover crop, timing of planting of cover crop and beets to provide erosion protection, and the timing and method of cover crop removal to limit competition with sugar beets.

Experimental Procedure

Research studies were conducted at the Torrington Research and Extension Center on a light-textured, sandy loam soil susceptible to wind erosion. Cover crops included fall-planted winter wheat and rye or spring-planted barley, oats, and winter wheat. Preceding crops included dry beans and corn grown for silage. Conventional seedbed preparation (plowing, roller harrowing, and leveling) was done

Photo 1. Herbicide application, herbicide incorporation and sugar beet planting operation in a cover crop.

in September after harvest of the preceding crop. Plots were four rows wide with rows spaced 30 inches. Two rows of grain were planted for each row of sugar beets. The grain rows were 6 inches on either side of the future sugar beets (alternate spacings of 12 and 18 inches). Fall-seeded cover crops were planted about October 1 and spring-seeded crops about March 20.

Sugar beets were planted to stand at a seeding rate of 68,000 seeds per acre, generally in mid-April. Preplant herbicides (Nortron and/or Ro-Neet) were applied in a 7-inch band and rotary incorporated during the planting operation (Photo 1). Betamix and/or Stinger were applied post-emergence as needed. Fall-seeded cover crops were sprayed with Roundup just prior to beet planting and spring-seeded cover crops were sprayed with Poast two to three weeks after sugar beet emergence. Cultivation included disks with knives about the end of May (Photo 2), S-tine cultivation about the middle of June, and ditching about the first week of July. Sugar beets were generally harvested the first week of October.

Photo 2. First cultivation of sugar beets.

Studies conducted from 1989 to 1994 were conducted under sprinkler irrigation, while the 1995 study was conducted using furrow irrigation. Beds were formed for the furrow irrigated study prior to cover crop planting, which allowed fall irrigation of the cover crops. The system with cover crops planted in rows beside the sugar beet row works very well for either irrigation method.

Results

The key to success with the cover crop system is to remove the cover crops before competition has occurred but after adequate wind erosion protection from cover crops has been established. Monitoring cover crop dry matter, cover crop height, soil moisture, and temperatures with different spray dates has established reliable criteria. The fall-seeded cover crops should be sprayed with Roundup just prior to sugar beet planting. Rye provides more dry matter than winter wheat and can be sprayed earlier. For adequate wind erosion protection, spring-seeded cover crops should not be removed before

Table 1. Cover crop dry matter as a function of cover crop height for barley (BAR), oats (OAT), spring seeded winter wheat (SWW), winter wheat (WW) and rye, Torrington Research and Extension Center.

Height (inches)	Dry Matter (lb/A)				
	BAR	OAT	SWW	WW	RYE
2	90	--	170	240	370
3	140	70	420	490	660
4	230	160	620	730	950
5	350	260	780	960	1230
6	500	360	880	1190	1500
7	680	460	930	1400	1760
8	890	570	940	1610	2011

sugar beet emergence; therefore, a selective herbicide (Poast) must be applied.

Due to the variance in spring temperatures, spraying with Poast cannot be done by the calendar. It is necessary for the cover crop to attain 400 to 600 pounds of dry matter per acre to provide wind erosion protection. This occurs when about 300 to 400 heat units (40 degrees Fahrenheit base temperature) have been accumulated. Each of the cover crops has slightly different criteria which are related to heat units. Accumulation of heat units is an awkward criteria to implement, but it was found that cover crop dry matter was related to cover crop height (see Table 1). Spraying before dry matter accumulation reaches 400 to 500 pounds per acre limits competition for soil water and adequate sugar beet emergence can be maintained. Using this criteria, barley should be sprayed when 4 to 6 inches high, oats when 5 to 7 inches high and spring seeded winter wheat sprayed when 3 to 4 inches high. Similarly, winter wheat can be sprayed at about 3 inches height and rye when 2 to 3 inches high. Sugar beets growing with sprayed winter wheat cover crop are shown in Photo 3.

Photo 3. Sugar beets growing in a sprayed winter wheat cover crop.

Sugar beet populations and yields with and without cover crops for all years of study are shown in Table 2. Sugar beet populations were generally lower when cover crops were grown. Overall mean populations were only significantly different when barley was used as a cover crop and this was not carried over to a significant difference in sugar beet yields. The only significant increase in sugar beet yields was when rye was used as a cover crop. For the four years when rye was used as a cover crop, sugar beet yields averaged 27.7 tons per acre compared to 24.4 tons per acre when no cover crop was used.

Cover crop costs include those for establishment and for herbicide application. Benefits of the cover crop include reduced cultivation required to control wind erosion and yield increases in years when sugar beets must be replanted because of wind damage. In 1994 and 1995, delayed planting dates were included in the no cover crop treatments. As shown in Table 3, sugar beet yields were reduced 20 to 25 percent with delayed planting in these studies. The yield losses were directly related to amount of heat lost as measured by growing degree days rather than to calendar date of planting. When the losses incurred with replanting are included the advantages of using cover crops for sugar beet establishment on light soils is evident.

Detailed economic analyses of sugar beets grown with cover crops have not been conducted, as sugar beets are grown on such a wide range of soils with varying wind erosion potential and because Wyoming winds are so variable. However, direct costs are on the order of one ton of beets per acre and so benefits exceed costs if one sugar beet replanting is avoided every four to five years. Thus, if sugar beets are grown on wind erosion prone soils, with sprinkler or furrow irrigation, cover crops appear to be a viable option to prevent sugar beet losses.

Table 2. Sugarbeet harvest populations and yields with and without a cover crop, Torrington Research and Extension Center, 1989-1995.

Cover crop	Year	Harvest Population		Sugarbeet Yield	
		With CC	No CC	With CC	No CC
Barley	1989	19.2	19.6	24.1	29.4
	1990	27.0	30.9	19.6	19.3
	1991	27.2	31.2	26.4	23.3
	1992	15.7	29.2	27.3	25.2
	1993	26.1	32.7	20.7	25.1
	1994	22.1	15.1	27.1	24.9
	1995	35.1	37.9	22.7	24.2
	Mean	24.6*	28.1*	24.0	24.5
Oats	1990	29.2	30.9	16.0	19.3
	1992	17.0	29.2	26.8	25.2
	1993	33.1	32.7	24.0	25.1
	1994	19.7	15.1	25.5	24.9
	1995	39.4	37.9	24.0	24.2
	Mean	27.7	29.1	23.3	23.7
Spring seeded winter wheat	1989	19.2	19.6	30.1	29.4
	1993	34.9	32.7	23.8	25.1
	1994	26.1	15.1	28.0	24.9
	1995	40.3	37.9	25.9	24.2
	Mean	30.1	26.3	26.9	25.9
Winter wheat	1990	18.3	30.9	17.4	19.3
	1991	27.9	30.7	24.7	23.1
	1992	15.7	29.2	25.3	25.2
	1993	31.1	32.7	25.2	25.1
	1994	34.9	15.1	25.6	24.9
	1995	37.9	37.9	28.7	24.2
	Mean	27.6	29.4	24.5	23.6
Rye	1991	20.1	31.2	24.7	23.3
	1993	26.1	32.7	24.2	25.1
	1994	29.2	15.1	32.1	24.9
	1995	41.6	37.9	29.7	24.2
	Mean	29.2	29.2	27.7*	24.4*

**Means are significantly different at the 0.05 level of significance.*

Table 3. Sugarbeet response to delayed planting dates and growing degree days lost (GDD--40°F base temperature) after the initial planting date, Torrington Research and Extension Center.

Year	Planting Date	GDD lost (F-day)	Sugarbeet	
			Yield (T/A)	Sucrose (%)
1994	Apr 14	0	30.3	16.7
	Apr 20	89	29.3	15.8
	May 2	219	25.2	15.2
	May 9	326	23.7	14.9
1995	Apr 13	0	24.2	14.6
	May 15	176	22.1	14.8
	May 31	361	18.1	15.4

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