2003 Sugarbeet Research and Extension Reports. Volume 34, Page 139-142

EFFECT OF SMALL GRAIN STUBBLE LENGTH ON SUGARBEET PRODUCTION – A 2 YEAR SUMMARY

Joseph F. Giles, and Norman R. Cattanach

Associate Professor and Research Specialist
Department of Soil Science, North Dakota State University

Introduction

Small grain residue incorporated into the surface of the soil profile is beneficial in preventing soil erosion in the Red River Valley of the North located in Minnesota and North Dakota. This residue has been found to cause plugging problems during primary tillage operations and reduce the establishment of adequate sugarbeet plants when left following harvest in long lengths in large amounts. Previous work conducted on the performance of present sugarbeet seeding equipment with increased surface residue has shown a decline in sugarbeet stand establishment. With the development of crop residue shredders, evaluation of the benefits of reducing the length of stubble and its effects on sugarbeet establishment and production is needed.

Materials and Methods

Field experiments were initiated on Bearden silty clay loam (Fine-silty, mixed, super active, frigid, Aeric Calciaquoll) on the Kirk Watt farm at Glyndon, MN in August 2001 and 2002. Treatments were stubble left at harvest length and shredded to three-fourths, half, and one quarter of harvest length prior to primary tillage with a chisel plow. Each experiment was arranged in a randomized complete block design with six replications. Individual residue treatment plots measured 22 feet wide and 35 feet long. Soil nitrogen levels were adjusted with fertilizer to approximately 130 lbs/acre of available residual soil test (0-4 ft) plus added fertilizer N.

Following secondary spring tillage sugarbeet, Beta 6447, was planted on May 15 and April 29 in 2002 and 2003, respectively, with a John Deere MaxEmerge 2 planter at 4 and 5 mph ground speed in each residue treatment. Sugarbeet was placed 1.25 inches deep at 3.5 and 5.5-ir in-row spacing at both ground speeds. A 22-inch row spacing was used. Counter was surfaced band applied at 11.9 lbs/a and incorporated with chain at planting. Post emergence herbicides, cultivation and hand labor was used as needed for weed control. Two applications each oi Eminent and Super Tin were applied for Cercospora leafspot control.

Sugarbeet population of the 3.5-inch in-row seeding was hand thinned to 150 plants per 100 feet of row at the four-leaf stage.

Sugarbeet were harvested September 26 and 23 in 2002 and 2003, respectively. The middle two rows of each 6 row plot were harvested. Yield determinations were made and quality analysis performed at American Crystal Sugar Quality Tare Lab, East Grand Forks, MN.

Results and Discussion

Surface residue measurements, taken at seeding time, decreased with decreased length of stubble resulting from the shredding operation in 2002 but not in 2003 (Tables 1 and 2). The 2002 observation was not expected, as the shredding operation had increased the number of residue pieces. The primary and secondary tillage operations had incorporated these smaller pieces into the soil profile to a larger degree than the longer uncut residue. Stubble height was not as high in 2003, therefore the difference in length of stubble pieces was not as great, resulting in lower overall surface residue percentages. Soil nitrate nitrogen levels in the surface 12 inches were higher on the shortest stubble treatment on July 30, 2002. This was perhaps the result of the quicker release of nitrogen through decomposition from the small grain residue during this part of the growing season because of the increased soil incorporation of the smaller stubble pieces. No differences between stubble treatments were observed in either the early or late sampling in 2003 (Tables 2 and 3). The soil moisture conditions in the early part of the growing season in the two years were different, with 2002 being drier.

Root and recoverable sugar yields decreased with reduction in grain stubble length in both years (Tables 4, 5, 6). Increased rate of decomposition of the smaller stubble pieces may have impacted availability of nitrogen during early season growth resulting in significant decreased root production. Harvest sugarbeet populations were similar for all treatments each year.

The reduction in stubble length had affect on the amount of surface residue measured at planting time, but not on sugarbeet stand establishment. The number of harvested beets was similar between the 5.5-inch and the hand-thinned 3.5 inch seeded population of 150 beets per 100 ft of row in 2002, as was the root yield and sugar production (Table 7). The effect of imposed tillage treatments can occasionally be lost by hand thinning an overseeded sugarbeet population. The decreased population in the hand-thinned treatment in 2003 (Table 8) resulted from misunderstanding of the distance between plants by the labor crew. The reduction in population resulted in a decrease in quality as shown by the recoverable sugar parameters (Table 9). Planter ground speeds less than 5 mph had no significant effects on measured parameters, although the two-year means show a trend for decreasing recoverability of sugar with increased speed.

With the improved design and heavy nature of the majority of the planters units being used to plant sugarbeet currently, the penetration of small grain residue is much cleaner and with less hair-pinning than experienced with the lighter weight planters of the past. The results of this two-year study show it is not necessary to reduce the length of the stubble to maintain optimum sugar production. Maintaining the longer stubble length will help to reduce soil erosion during open winters and increase the soil moisture by trapping snow. Use of a head-stripper rather than a sickle bar, may necessitate the use of a shredder.

Table 1. Effect of small grain residue height on surface residue percentage after planting and soil nitrate nitrogen levels in soil profile (July 30), Glyndon, MN, 2002.

TREATMENT Stubble Height	Surface Residue Percent	0-6 inch	Soil Nitrate, ppm 6-12 inch	Total
One-fourth original	32	9	14	23
Half original	42	5	4	9
Three-fourth original	41	5	4	9
Full	46	5	4	9

Table 2. Effect of small grain residue height on surface residue percentage after planting and soil nitrate nitrogen levels in soil profile (May 20), Glyndon, MN, 2003.

TREATMENT Stubble Height	Surface Residue Percent	0-6 inch	Soil Nitrate, ppm 6-12 inch	Total
One-fourth original	31	13	16	29
Half original	35	11	18	29
Three-fourth original	25	14	19	33
Full	30	14	17	31

Table 3. Effect of small grain residue height on soil nitrate nitrogen levels in soil profile (July 27), Glyndon, MN, 2003.

TREATMENT Stubble Height	0-6 inch	Soil Nitrate, ppm 6-12 inch	Total
One-fourth original	4	3	7
Half original	3	4	7
Three-fourth original	3	4	7
Full	3	2	5

Table 4. Effect of small grain residue height on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population (September 26), Glyndon, MN, 2002.

TREATMENT Stubble Height	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
One-fourth original	17.7	17.15	2.20	5317	298.6	140
Half original	18.1	17.11	2.13	5434	299.6	138
Three-fourth original	18.4	16.71	2.36	5309	286.9	135
Full	19.1	17.03	2.14	5707	297.8	141
LSD (.05)	1.2	NS	NS	NS	NS	NS

Table 5. Effect of small grain residue height on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population (September 23), Glyndon, MN, 2003.

			LOSS TO	RECOVERABLE	REC	HARVEST

TREATMENT Stubble Height	ROOT YIELD Tons/A	SUCROSE Percent	MOLASSES Percent	SUGAR Lbs/Acre	SUGAR Lbs/T	BEETS /100 FT
One-fourth original	21.9	17.57	1.38	7077	324	135
Half original	22.5	17.45	1.34	7244	322	134
Three-fourth original	23.9	17.66	1.35	7822	326	146
Full	21.8	17.33	1.35	6954	320	130
LSD (.05)	2.0	NS	NS	717	NS	NS

Table 6. Effect of small grain residue height on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002-2003.

TREATMENT Stubble Height	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
One-fourth original	19.8	17.38	1.79	6197	311	137
Half original	20.3	17.27	1.74	6345	311	137
Three-fourth original	21.2	17.18	1.86	6559	306	140
Full	20.5	17.19	1.75	6331	309	135
LSD (.05)	1.0	NS	NS	NS	NS	NS

Table 7. Effect of plant population and planter ground speed over small grain residue height treatments on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population (September 26), Glyndon, MN, 2002.

TREATMENT	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
Seed spacing						
3 inch (thinned)	18.4	17.01	2.20	5469	296.0	137
5.5 inch	18.3	16.99	2.21	5415	295.6	139
LSD (.05)	NS	NS	NS	NS	NS	NS
Planter Speed						
4 mph	18.5	17.09	2.20	5514	297.9	143
5 mph	18.2	16.91	2.22	5370	293.8	133
LSD (.05)	NS	NS	NS	NS	NS	NS

Table 8. Effect of plant population and planter ground speed over small grain residue height treatments on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population (September 23), Glyndon, MN, 2003.

TREATMENT	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
Seed spacing						
3 inch (thinned)	22.5	17.40	2.20	7197	320	119
5.5 inch	22.6	17.60	2.21	7351	326	154
LSD (.05)	NS	NS	NS	NS	NS	8
Planter Speed						
4 mph	22.3	17.50	2.20	7201	323	135
5 mph	22.7	17.51	2.22	7347	323	137
LSD (.05)	NS	NS	NS	NS	NS	NS

Table 9. Effect of plant population and planter ground speed over small grain residue height treatments on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002-2003.

TREATMENT	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
Seed spacing						
3 inch (thinned)	20.4	17.20	2.20	6333	308	128
5.5 inch	20.4	17.29	2.21	6383	310	147
LSD (.05)	NS	NS	NS	NS	NS	8
Planter Speed						
4 mph	20.4	17.29	2.20	6360	310	140
5 mph	20.5	17.21	2.22	6356	308	135
LSD (.05)	NS	NS	NS	NS	NS	NS