# PRODUCTION OF SUGARBEET IN LIVING COVER CROPS

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## INTRODUCTION:

Traditional tillage practices in sugarbeet production in North Dakota and Minnesota reduce or eliminate surface plant residue which increases the potential for wind erosion. In addition, frequent strong winds often cause death of sugarbeet seedlings resulting in less than optimum plant populations or costly replanting. Seeding sugarbeet into living cover crops will reduce soil erosion and may prevent stand loss due to strong spring winds. Therefore, the objective of this study is to evaluate easily adapted cover cropping systems in sugarbeet production in North Dakota and Minnesota.

## MATERIALS AND METHODS:

Two field experiments were conducted at Casselton ND on a Bearden silt loam soil. The soil pH, exchangeable P, and exchangeable K were approximately 7.9, 55 lbs/A, and 475 lbs/A, respectively. Nitrogen was added to increase residual soil nitrogen levels to 120 lbs/A in September of 1989.

In Experiment I, fall treatments were established on September 7, 1989. Azure barley, Musketeer winter rye and Roughrider winter wheat were established at a seeding rate of 30 lb/A. The winter rye and winter wheat were established in 6 and 18 inch rows, while the barley was established in six inch rows. The experimental design was a randomized complete block with a split-block restriction. Crop species comprised the main plot, while tillage (tillage or no tillage) comprised the sub-blocks with four replications. One half of the plots were lightly tilled prior to any spring planting of sugarbeets.

In Experiment II, seeding rate comprised the main plot, while three levels of tillage comprised the sub-blocks with four replications. Musketeer winter rye was established in September, 1989 at seeding rates of 15, 30, 45, and 60 lb/A. Tillage levels were no tillage (NT), light tillage (LT), and moderate tillage (MT).

Beta 1745 sugarbeet was planted at 1.25 inches deep in 22 inch rows and later thinned back to a population of 125 plants per 100 feet of row. A tank mixture of Roundup at 0.5 lb/A + Antor at 5 lb/A and surfactant at 0.5% v/v was applied in a 10 inch band directly over the sugarbeet row at planting to all treatments. Poast at 0.3 lb/A was applied to all treatments on May 25 when the spring planted treatments were in the fifth leaf stage, and while surviving winter wheat and winter rye were in early boot stage of development. Two rows from each plot were machine harvested on September 25, 1990. Root quality was determined at the American Crystal Sugar Quality Lab, East Grand Forks, MN.

RESULTS AND DISCUSSION:

Experiment I results of sugarbeet root yield and quality parameters are listed in Table 1. In 1990, sugarbeet population and sugar concentration was not affected by cover crop treatments. Loss to molasses tended to increase in the spring treatments, with the exception of spring barley. Sugarbeet root yield and extractable sugar were significantly reduced in the winter rye treatments. Tillage had no significant effect, except in winter rye seeded at 6 inch row spacing. However, this effect may be confounded by an unintentional Roundup by tillage interaction (see paper titled "Control of Living Cover Crops In Sugarbeets" in this proceedings).

Table 1. The effect of cover crop on sugarbeet population, sugar concentration, loss to molasses, root yield, and extractable sugar at Casselton in 1990.

| TREATMENT | ROW WIDTH | TILLAGE | PLANT POP | SUGAR | LOSS TO MOLASSES | ROOT YIELD | EXTRACT SUGAR |
|---|---|---|---|---|---|---|---|
| | inches | | plts/A | % | % | T/A | lb/A |
| No cover | 6 | Till | 28398 a | 17.4 a[1] | 1.7 a | 21.1 a | 6610 a |
| | | No till | 28805 a | 17.3 a | 1.8 a | 20.6 a | 6361 a |
| Spring barley | 6 | Till | 27666 a | 17.9 a | 1.6 bc | 20.4 a | 6654 a |
| | | No till | 27829 a | 18.0 a | 1.6 bc | 20.1 a | 6588 a |
| Spring Rye | 6 | Till | 28642 a | 17.8 a | 1.7 ab | 20.5 a | 6627 a |
| | | No till | 26690 a | 17.1 a | 1.8 ab | 21.7 a | 6619 a |
| Fall barley | 6 | Till | 26934 a | 17.3 a | 1.8 ab | 20.8 a | 6418 a |
| | | No till | 25388 a | 18.1 a | 1.6 ab | 20.1 a | 6643 a |
| Winter wheat | 6 | Till | 26933 a | 18.0 a | 1.5 bc | 21.1 a | 6955 a |
| | | No till | 26608 a | 17.7 a | 1.6 bc | 21.8 a | 6998 a |
| Winter wheat | 18 | Till | 26771 a | 18.2 a | 1.6 bc | 21.1 a | 7008 a |
| | | No till | 27096 a | 18.0 a | 1.6 bc | 20.8 a | 6831 a |
| Winter rye | 6 | Till | 23027 a | 18.0 a | 1.6 bc | 15.7 c | 5081 c |
| | | No till | 27666 a | 17.4 a | 1.5 bc | 17.2 b | 5651 b |
| Winter rye | 18 | Till | 26771 a | 17.5 a | 1.6 c | 18.2 b | 5792 b |
| | | No till | 24004 a | 18.1 a | 1.5 c | 17.2 b | 5721 b |

[1]Values within columns not followed by the same letter are significantly different at the 5% level of probability by Duncan's New Multiple Range

Use of soil water by living cover crops was monitored at two week intervals starting two weeks after sugarbeet planting and continuing until harvest. A neutron probe was used to determine soil water content at one foot increments to a depth of 48 inches. Use of soil water by a fall seeded crop, a spring seeded crop, and no cover crop was not significantly different at the one foot depth at any time during the growing season (Figure 1). AT no time during the growing season did soil water content differ by more than 3% between treatments. Near normal rainfall during May and June may have reduced the magnitude of differences.

Table 2. The effect of cover crop treatment on nitrate nitrogen use from the 0-24" soil profile by May 28, 1990.

| Spring Tillage Prior to Planting | Cover Crop Type | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | None | Fall Barley | W.Wht 6" Rows | W.Wht 18" Rows | W.Rye 6" Rows | W.Rye 18" Rows | Spr Rye | Spr Barley |
| | lbs N Removed/Acre 2 ft. | | | | | | | |
| Tilled 2" Deep | -- | 26 | 28 | 46 | 93 | 86 | 31 | 41 |
| No Till | -- | 36 | 5 | 2 | 58 | 29 | 24 | 1 |

Experiment II results of sugarbeet root yield and quality parameters are listed in Table 3. In 1990, sugarbeet population and loss to molasses were not affected by seeding rate or tillage. The seeding rate by tillage interaction was significant for sugar concentration, with 15 and 30 lb/A seeding rate having the greatest sugar concentration with light or no tillage. Conversely, sugarbeet root and extractable sugar yields were greatest with 15 lb/A seeding rate and with moderate or no tillage. As in experiment I, this phenomenon may be explained by an unintentional Roundup x tillage interaction.

Table 3. The effect of seeding rate of winter rye cover crop and level of tillage on sugarbeet population, sugar concentration, loss to molasses, root yield, and extractable sugar at Casselton in 1990.

| SEEDING RATE | TILLAGE[1] | PLANT POP | SUGAR | LOSS TO MOLASSES | ROOT YIELD | EXTRACT. SUGAR |
|---|---|---|---|---|---|---|
| lb/A | | plt/A | % | % | T/A | lb/A |
| 15 | NT | 24192 | 17.5 | 1.6 | 15.1 | 4820 |
| | LT | 22788 | 17.4 | 1.6 | 14.6 | 4630 |
| | MT | 23004 | 17.6 | 1.6 | 17.2 | 5516 |
| 30 | NT | 21492 | 17.6 | 1.5 | 13.0 | 4159 |
| | LT | 20412 | 17.7 | 1.5 | 12.4 | 4000 |
| | MT | 19440 | 17.2 | 1.5 | 14.2 | 4439 |
| 45 | NT | 20952 | 17.2 | 1.5 | 12.9 | 4030 |
| | LT | 21384 | 16.9 | 1.5 | 12.0 | 3670 |
| | MT | 19764 | 16.4 | 1.6 | 12.4 | 3674 |
| 60 | NT | 20844 | 17.4 | 1.5 | 12.8 | 4071 |
| | LT | 18144 | 17.1 | 1.5 | 10.7 | 3339 |
| | MT | 19980 | 15.9 | 1.6 | 12.4 | 3540 |
| SEEDING RATE LSD | | NS | 0.4 | NS | 1.5 | 465 |
| TILLAGE LSD | | NS | 0.3 | NS | 1.1 | 344 |

[1]NT = no tillage, LT = light tillage, MT = moderate tillage

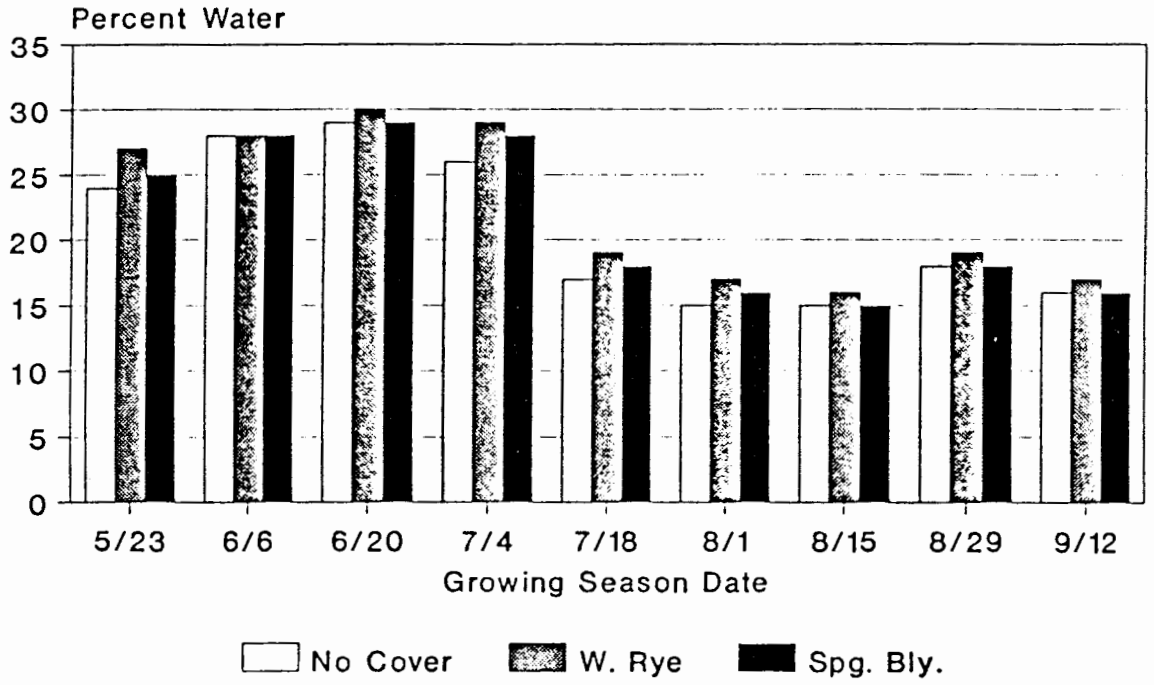


Figure 1. Effect of cover crop on soil water content in the 0-12" depth soil profile during the growing season.

Both fall and spring seeded living cover crops significantly reduced residual avilable soil nitrate nitrogen by May 28, 1990 (Table 2). Fall seeded barley utilized 26 lb/A nitrogen. The winter wheat treatments lowered available residual nitrate nitrogen by 28 and 46 pounds per acre respectively. Winter wheat stands were reduced 80 to 90% by winterkilling, resulting in N use levels comparable to the fall seeded barley cover crop. Fall seeded rye suffered no winter kill consequently nitrogen use was about 65 lbs/A greater than for the fall seeded barley. Fall rye treatments reduced available soil nitrate nitrogen levels by about 90 pounds compared to the no cover cropping treatment. Spring seeded rye and barley utilized 31 and 41 lbs/A of nitrogen by May 28. When no tillage was done prior to planting sugarbeets in the spring nitrogen use by the fall barley and spring rye treatments remained nearly the same. However N use by the winter wheat and winter rye was reduced by 25 to 50 lbs/A. This is probably a result of more effective control of winter rye and winter wheat by Roundup herbicide applied at planting time under notill conditions thus reducing nitrogen uptake.

CONCLUSION:

Sugarbeets were successfully produced utilizing living cover crops with or without spring tillage in 1990. However, sugarbeet yield was disappointing in winter rye treatments for both experiments. This may be due to failure to control the cover crop early enough, higher winter rye seeding rates than were necessary, or the observed Roundup x tillage interaction. Early control of the cover crop was imperative, however, further research is needed to quantify the critical growth stage at which the cover crops induce excessive competition to sugarbeet.