TERMINATING FALL-SEEDED COVER CROPS

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SUMMARY

1. Seed cereal rye at no more than 25 pounds per acre.
2. Winter wheat is easier to kill than cereal rye in the spring.
3. Use full herbicides rates. Apply SelectMax at 12 to 16 fl oz/A or PowerMax at 32 to 64 fl oz/A.
4. Apply herbicides as early as possible following cover crop green-up with consideration to the weather forecast 5 to 7 days after application.
5. Herbicides work much slower in early spring and may require 2 to 3-weeks to reach 85% burndown control.
6. Cereal rye stubble may suppress emergence and development of broadleaf weeds including nightshade, lambsquarters, and pigweed.

INTRODUCTION

Sugarbeet farmers have adopted the practice of seeding nurse crops as a companion crop with sugarbeet to reduce stand losses from wind and blowing soils. Spring-seed nurse crops are seeded at sugarbeet planting and are terminated when sugarbeet is at the 4-leaf stage or when small grains are 4 to 5 leaves (tillering). Many farmers have stated they desire to implement cover crops for a longer length of time. That is, seeding cover crops after wheat harvest and prior to sugarbeet planting or after sugarbeet harvest to reduce the chances and amount of blowing soil during the winter and early spring.

Soil health is currently a popular topic in agriculture. The topic is complicated, but the goal essentially is to protect our land resource. Cover crops in sugarbeet production is often discussed since fields are very smooth and contain very little surface crop residue after sugarbeet harvest. In addition, primary and secondary fall tillage is done on fields to be planted to sugarbeet to lessen spring tillage and to conserve moisture in advance of planting next year's sugarbeet crop. Once again, tillage often creates smooth fields that are susceptible to soil erosion, especially in dry and windy conditions.

A probe experiment was initiated in September 2016 with multiple objectives including: a) how effective is spring-applied Roundup PowerMax (glyphosate) or Select Max (clethodim) for killing fall-seeded cover crops; b) when should herbicides be applied to optimize cover crop control and sugarbeet stand establishment; and c) do cover crops provide additional benefits, for example, weed suppression? The goal was to better understand how and when fall-seeded cover crops must be terminated so that sugarbeet can be planted in mid- to late April.

MATERIALS AND METHODS

Prosper, ND. Stubble was chisel plowed following wheat harvest at the Prosper Experiment Station, near Prosper, ND. Secondary tillage was done using a Kongskilde 's-tine' field cultivator with rolling baskets on September 6, 2017. Experiment was a split plot design with 4 replications. The main (whole) plot was fall seeded cover crop; the subplot was herbicide, herbicide rate, and timing of herbicide application.

Winter wheat at 60 lb/A, cereal rye at 50 lb/A, and a mixture of oat at 40 lb/A and tillage radish at 5 lb/A were spread by hand across respective whole plots in each replication and shallow tilled to incorporate seeds into soil on September 6, 2017. One main plot was left with no cover crop.

Select Max at 6 fl oz/A + 1.5 pt/A methylated seed oil (MSO) and Roundup PowerMax at 28 fl oz/A + Prefer 90 non-ionic surfactant (NIS) at 0.25% v/v with ammonium sulfate (N-Pak-AMS) at 2.5% v/v were applied as treatments on April 17, April 21, and April 29, 2017 when winter wheat was 5, 5, and 7-inches, respectfully, and

cereal rye was 8, 9, and 10 inches, respectfully (Table 1). All herbicide treatments were applied with a bicycle sprayer (without the customary hood) in 17 gpa spray solution through 110002 Turbo TeeJet nozzles pressurized with CO_2 at 40 psi across plots. Percent visual control or burndown of winter wheat and cereal rye was evaluated on October 27, 2016 and April 13, April 29, May 5, May 12, and May 23, 2017.

Table 1. Application Information – Prosper, ND 2017

Date	April 17	April 21	April 29
Time of Day	3:00 PM	3:00 PM	4:00 PM
Air Temperature (F)	49	62	58
Relative Humidity (%)	33	38	16
Wind Velocity (mph)	4	2	6
Wind Direction	NW	W	NE
Soil Temp. (F at 6”)	54	56	46
Soil Moisture	Good	Good	Good
Cloud Cover (%)	80	10	30
Winter Wheat	5 inch	5 inch	7 inch
Cereal Rye	8 inch	9 inch	10 inch

‘SV36272RR’ sugarbeet, treated with NipsIt Suite, Tachigaren at 45g per unit, and Kabina at 7g per unit, was seeded in 22-inch rows at 60,560 seeds per acre on May 26, 2017. Roundup PowerMax at 32 fl oz per acre + ClassAct NG at 2.5% v/v was applied on June 19 and July 10, 2017 to control weed escapes in the trial.

Renville, MN. Cereal rye at 100 lb/A was seeded into a preharvest sugarbeet field on September 12, 2016. Rye was harrowed into the soil following seeding using a field cultivator. Roundup PowerMax at 22, 32, and 64 fl oz/A plus Class Act NG at 2.5% v/v or SelectMax at 6 fl oz/A plus Class Act NG at 2.5% v/v was applied to the center 7.3 ft of an 11 ft plot by 30 feet long on April 7, 2017. Herbicide was applied with a bicycle sprayer at 17 GPA through TeeJet 8002XR nozzles at 40 psi.

Evaluations were a visual assessment of cereal rye control (visual reduction in ground cover) on April 17, April 21 and April 28, 2017.

Data were analyzed with the ANOVA procedure of ARM, version 2017.4 software package.

RESULTS AND DISCUSSION

Cover Crop Establishment and Overwintering at Prosper. A visual assessment of cover crop establishment was collected on October 27, 2016. In general, cover crop emergence and percent visual ground cover was very good, perhaps exceeding expectations (Table 2). Favorable moisture conditions and warm temperatures in the fall of 2016 promoted cover crop growth. Cereal rye growth was most uniform while winter wheat was the least uniform. Tillage radish emerged but were small, ranging from 0.5 to 1 inch in diameter and 2 to 4 inches long. Ground cover in the no-cover crop main plot was a uniform cover of volunteer spring wheat.

Table 2. Percent visual ground cover and range of observations across replications, October 27, 2016 at Prosper, ND

	Visual Ground Cover	Range of Visual Ground Cover Observations
Cover Crop	%	%
Winter Wheat	60	40-70
Cereal Rye	85	80-90
Oat and Tillage Radish	68	50-80
No Cover Crop[1]	38	30-40

[1]Block contained volunteer wheat from previous crop

Cover crop establishment was evaluated April 6 and April 13, 2017 following snow melt. On April 6, the cereal rye whole plots were greening up, but there was very little visual evidence of living winter wheat. Spring green-up and early season growth changed quickly in one week. On April 13 the number of green cereal rye or winter wheat plants per meter square were counted and a visual assessment of green-up was taken in $1m^2$ quadrats at three evenly spaced points within the cover crop whole plot. Cereal rye ground cover and uniformity were greater than winter wheat which may have suffered some winter-kill damage (Table 3). However, the number of rye or winter wheat plants per m^2 were similar. This may be attributed to the aggressive behavior of cereal rye which was well tillered on April 13 and was in general, much more robust than winter wheat.

Seeding rates were determined from the literature and through personal communication. In both cases, there was a wide range of opinions regarding seeding rates. Cereal rye seeding rate of 50 lb/A was much too great as the rye whole plots resembled sod.

Table 3. Percent visual ground cover, number of plants per square meter and range of observations across replications, April 13, 2017 at Prosper, ND

	Visual Ground Cover	Range of Visual Ground Cover Observations	Number of Plants per Square Meter	Range of count Observations per Square Meter
Cover Crop	%	%	Number	Number
Winter Wheat	46	0-80	16	0-44
Cereal Rye	73	40-100	17	6-32

Cereal Rye and Winter Wheat Control at Prosper. Percent visual control or burndown was collected April 29 (data not presented), May 5, May 12, and May 23, 2017. In general, winter wheat burndown was faster than cereal rye. Roundup PowerMax at 28 fl oz/A applied on April 17 or April 21 controlled 70% or 75% winter wheat on May 5 or 18 or 14 DAT (days after treatment), respectfully. PowerMax gave only 45% and 25% cereal rye control (Table 4). Winter wheat control from PowerMax ranged from 83 to 98% control by May 12 or 17 to 25 DAT. A minimum of 90% burndown control of cereal rye did not occur until May 23 or 32 to 28 DAT and following PowerMax application on April 21 or April 25. Roundup PowerMax provided greater overall cereal rye and winter wheat control and speed of kill than SelectMax. However, herbicide rate for both Roundup PowerMax and SelectMax probably were not sufficient, especially for early spring application. These results support the recommendation of full herbicide rates, including PowerMax at 32 to 43 fl oz/A and SelectMax at 12 to 16 fl oz/A. The use of appropriate adjuvants will also accentuate herbicide efficacy.

Cereal rye early-season growth and development was very rapid. Herbicide burndown application should be timed as early as possible or immediately after green-up in early spring. However, application timing is a compromise between growth and development of target species and environmental conditions. For example, the April 17 application was followed by wintry weather including 2 to 3 inches of snow and low temperatures. The cereal rye and winter wheat control data suggests herbicides and cover crop efficacy including speed of kill were influenced by environmental conditions.

Table 4. Percent visual cereal rye and winter wheat control, across herbicide, application timing, and evaluation date, Prosper, ND

		May 5		May 12		May 23	
		c rye	w wheat	c rye	w wheat	c rye	w wheat
Herbicide[1]	Appl Date	%	%	%	%	%	%
PowerMax	April 17	55 cd	70 ab	65 c	83 b	75 c	85 b
Select Max	April 17	20 ef	45 d	5 f	60 c	0 g	20 f
PowerMax	April 21	60 bc	75 a	83 b	98 a	100 a	99 a
Select Max	April 21	5 g	25 e	25 e	50 d	0 g	55 d
PowerMax	April 25	20 ef	30 e	70 c	88 b	98 a	100 a
Select Max	April 25	0 g	10 fg	20 e	25 e	20 f	45 e
LSD (0.05)		**10**		**7**		**7**	

[1]Roundup PowerMax at 28 fl oz/A + Prefer 90 NIS at 0.25% v/v + N-Pak AMS at 2.5% v/v; Select Max at 6 fl oz/A + Noble MSO at 1.5 pt/A

Cereal Rye Control at Renville. Cereal rye control (burndown) was dependent on Roundup PowerMax rate and number of days between application and evaluation. Roundup PowerMax at 64 fl oz/A gave 95% cereal rye control 21 DAT (Table 5). Cereal rye control from PowerMax at 32 fl oz/A was similar to control from PowerMax at 64 fl oz/A on April 21 and April 28 or 14 and 21 DAT. However, numbers of days to achieve similar numeric control from PowerMax at 64 fl oz/A was approximately 7 days faster than from PowerMax at 32 fl oz/A. PowerMax at 64 fl oz/A provided greater rye burndown control than PowerMax at 22 fl oz/A. Cereal rye control from SelectMax at 6 fl oz/A was less than control from PowerMax, regardless of rate.

Table 5. Percent visual cereal rye control, across herbicide, herbicide rate, and evaluation date, Renville, MN

Herbicide[1]	Herbicide Rate	April 17	April 21	April 28
	fl oz/A	----------% control----------		
PowerMax	22	41 b	61 b	76 b
PowerMax	32	41 b	73 a	85 ab
PowerMax	64	69 a	86 a	95 a
SelectMax	6	10 c	17 c	31 c
LSD (0.05)		**16**	**12**	**10**

[1]Roundup PowerMax at 28 fl oz/A + Class Act NG at 2.5% v/v; SelectMax at 6 fl oz/A + Class Act NG at 2.5% v/v

Weed Suppression at Prosper. There is some evidence suggesting cover crop stubble suppresses germination and emergence of broadleaf weeds. Percent weed suppression across cover crop and burndown herbicide combination was collected visually on June 6 and June 12 and was collected using stand counts per unit area on June 12. Cereal rye stubble suppressed emergence and growth of hairy nightshade, lambsquarters, and pigweed better than winter wheat stubble or the no stubble blocks, but weed suppression was confounded by incomplete cover crop burndown control in some treatments (Table 6). Cover crop termination date did not affect weed suppression from cereal rye but delaying winter wheat termination to April 25 improved weed suppression. Winter wheat did not suppress hairy nightshade, lambsquarters, and pigweed. However, there were numeric differences in suppression when wheat cover crop termination date was delayed from April 21 to April 25 and from April 17 to April 21. Both visual and stand count data (data not presented) collected June 6 and 12 suggest that cereal rye stubble suppresses broadleaf weeds even after rye was killed with April applications of Roundup PowerMax.

Table 6. Visual weed suppression from cereal rye and winter wheat stubble, by cover crop termination date

	Cereal rye	Winter wheat
Cover Crop	%	%
April 17	91 a	39 c
April 21	96 a	51 c
April 25	93 a	71 b
No Cover Crop	55 b	54 b
LSD (0.05)	**18**	