Timing of Winter Rye Removal for Weed Control in Soybeans

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Soybean production in North Dakota is currently threatened by numerous factors including glyphosate resistant weeds, root and foliar diseases, soil erosion, and creeping salinity. Winter rye is growing in popularity due to a number of different niches it can fill in a crop rotation. Besides being harvested for grain, rye can also be used as a forage or cover crop. One of the main benefits it provides as a cover crop is weed control through a combination of allelopathy and heavy competition. The strengths of rye can also be used to supplement the weaknesses of soybeans. Rye can be used to break up disease cycles, provide weed suppression, provide winter cover, use excess spring moisture, or be used for fall or spring grazing; all while still utilizing the growing season for a cash crop.

A study was conducted at the Carrington Research Extension Center in 2014 to evaluate weed control and soybean yields under different scenarios of removing rye. The treatments consisted of a no-rye check, plots with rye tilled into the soil or sprayed prior to planting soybeans, treatments where rye was either mowed, harvested for forage or sprayed at anthesis, and a treatment where rye was left for the duration of the soybean growing season. The rye was planted on September 26, 2013. Soybeans were planted on June 3, 2014, into rye that was just entering the boot stage. A supplemental glyphosate application was made to all soybeans (except in treatments 6 and 7) on June 16.

Kochia control varied by replicate, based on plant stand, and ranged from 30 to 70 percent. When averaged across treatments, there was no pre-existing treatment differences in kochia stand prior to implementing the rye removal strategies. The weed suppression was largely in the form of reduced kochia growth and vigor, but not necessarily reduced plant numbers. Soybean growth and development did not appear to be influenced by the presence of rye, nor the removal strategies (other than mechanical damage) through the June 16 rye removal treatments, when rye was at anthesis and the soybeans were developing their first true leaves. The weed suppression of the Hancock rye disappeared once the rye began the senescence process and the canopy opened up. At that point, the stunted kochia within the canopy began more vigorous growth. By the middle of August, this rye variety on its own lost most of its effectiveness on kochia. The other treatments, aided by the application of glyphosate continued to maintain a high level of suppression, even though the rye had been removed quite some time ago. The most impressive treatment was the application of glyphosate at anthesis, in which the rye carcasses remained intact (retaining some canopy coverage) until soybean harvest, although there was not statistically more weed control than treatments 3 through 5. This data suggests that the longer the rye remains in the field, up until anthesis, the better the weed control. There is also preliminary data to suggest that different rye varieties have different levels of allelopathy (data not shown). Hancock is a variety that appears to provide more weed suppression through competition, whereas other rye varieties seem to maintain weed suppression through leaf drop.

Table 1. Weed control and yield of soybeans based on different winter rye removal strategies.

	Treatment	Time of Removal	Kochia Control			Test Weight	Yield		Rye Biomass	
			28-May	15-Jul	18-Aug		Soybean	Rye	Fresh	Dry
			%	%		lb/bu	bu/a	bu/a	lb/a	lb/a
1	no rye		0	-	62.5	56.3	29.0	-	-	-
2	rye tilled	27-May	46.3	-	66.3	57.2	37.4	-	-	-
3	rye sprayed - prior to soybean planting[1]	27-May	50	-	76.3	57.3	48.0	-	-	-
4	rye mowed	16-Jun[2]	53.7	-	77.5	56.9	37.1	-	-	-
5	rye forage harvested	16-Jun	60	-	77.5	56.8	36.2	-	5258.5	2155.1
6	rye left standing	na	55	38.8	16.3	57.3	9.7	7.8	-	-
7	rye harvested for grain	6-Aug	53.8	45	16.3	57.3	12.1	27.6	-	-
8	rye sprayed - anthesis	16-Jun	46.3	-	88.8	56.6	32.7	-	-	-
	LSD (0.05)		NS	9.1	12.9	0.3	8.4	--	--	--

Planting Date = June 3; Harvest Date = October 8; Rye Planted = September 26, 2013

[1] Spray application was glyphosate

[2] Soybeans first true leaves, rye @ anthesis

In the treatments where rye remained past anthesis, soybean yields were heavily influenced (~75% reduction compared to other treatments). Meanwhile, in the plot where rye was harvested as grain, the rye yielded 27 bu/ac. Letting the rye remain until soybean harvest reduced those yields to roughly 8 bu/ac. When rye was harvested as grain, the total yield for the soybeans and rye was roughly the same as the soybean yield for most other treatments. If soybeans were $10/bu and rye was $6/bu (based on recent pricing) that would put the total revenue from producing the two crops at roughly the same level as producing only the soybeans. Rye harvested as a forage resulted in over one ton of dry matter per acre, plus over 35 bu/ac soybeans. However, in field scale operations, the soybean yield would likely be lower due to the mechanical damage from the baling operation and bale removal, although the soybeans may still be small enough to recover from some of the damage. The highest soybean yield was achieved with the pre-plant burndown of the rye. This likely resulted in lower early season competition with the soybeans. It was different from the tilled treatment for two possible reasons; 1) due to the dry conditions at the end of the growing season, the no-till nature of the burndown treatment provided a moisture bonus to those plots, or 2) incorporating rye residue into the soil caused some allelopathic damage to the soybeans. The no-rye check plot had a fairly low yield as well. Much of that is attributed to lack of weed control early in the season, as all other plots retained an average of approximately 50 percent kochia suppression.

Overall, the rye and soybeans grew well together. The rye recovered remarkable well from the soybean planting operation, and the soybeans grew through the rye canopy with ease for the first month or so (through rye anthesis). The soybeans didn't seem heavily influenced by any direct rye allelopathic effects. This could be due to the soybean planting operation clearing a path around the soybean root zone. The soybean yields could have been higher in the treatments involving rye that was harvested as grain if more moisture was received during the latter portion of the growing season, making the income from harvesting both crops potentially similar to harvesting a single soybean crop, but with the added benefits of low input costs and more winter cover. Treatments that had rye growing until anthesis or beyond would also provide more ground cover for the winter. This means that a single winter rye crop could provide cover for the winters prior to and after soybean production. Ultimately, the rye was a benefit to the soybean production system in most scenarios. The decision about a specific method and

time of removal could be left to an individual producer to fit within an existing production framework and objectives.

Comparison of kochia growing within and alongside winter rye plots.