Employing Fall vs. Spring Herbicides to Combat Glyphosate-resistant Kochia in Soybeans

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Glyphosate-resistant (GR) kochia has risen to the forefront of growing issues facing soybean producers in central North Dakota. There are several factors that contribute towards kochia problems in soybeans: 1) post-emergence broadleaf weed control options in soybeans are limited, 2) kochia has many strengths that align with soybean weaknesses (salinity and drought tolerance, for example), 3) lack of residue after soybean harvest leads to more kochia seed dispersal via wind. The easiest way to control kochia in soybeans is to use an effective pre-emergence herbicide program. However, in central and western North Dakota, the soybean planting season may not align with sufficient rainfall patterns to activate pre-emergence herbicides. Plus, in years like 2014, kochia emergence occurred in the spring before any field activity began, leaving no-till producers with few options if glyphosate-resistant kochia was present. A fall application could theoretically solve both issues provided the weed control was sufficient.

In the fall of 2013 a study was initiated to evaluate the effectiveness of fall-applied herbicides when compared to spring-applied herbicide programs. The main objective was to identify any fall applications that would provide kochia control similar to a typical spring application. Fall applications were made on October 30, 2013, while spring applications were made on May 7, 2014. It should be noted that kochia had already emerged on May 1, so the weed control ratings for the spring treatments are considered post-emergence, whereas the fall treatments would be pre-emergence control of kochia. Herbicide efficacy evaluations were taken on two dates, as well as a late-season assessment of kochia regrowth (and hence a snapshot of the duration of herbicide residual activity). During the first evaluation on May 28, two ratings were taken based on the size of kochia plants, one for kochia with four leaves or less, and one for larger kochia. Glyphosate was applied after the June 19 evaluation to better elicit the regrowth of new kochia (no GR kochia was present in this study). Soybean seed yield and test weight were also taken to determine if herbicide injury occurred to the crop.

Overview of Kochia control after pre-emergent herbicide applications.

At the first rating, most of the products used as spring treatments provided excellent control of small kochia, meaning less than four leaf or 0.5" (Table 1). With the larger kochia plants, most of the other products (fall and spring) would be considered poor to good control. At the second evaluation, the small dead kochia were not considered and only ratings of the remaining kochia were taken. This control was generally the same or slightly greater than the earlier evaluation. Across herbicide treatments, there was no significant effect of fall vs. spring treatments. Some herbicides, however, were better as a fall-applied product, and some were better spring-applied. Anthem, Spartan, Valor, and Fierce were equal or better when fall-applied, although it should be noted that the fall rate of Spartan was 8 oz/ac vs. the spring application which was 5 oz/ac. Metribuzin and BroadAxe were better as a spring treatment. The big difference between the fall and spring applications was the length of residual. Fall-applied products (in general) did not suppress kochia through canopy closure as well as spring treatments. There were some soybean yield differences based on the applied herbicide. However, this was not due to herbicide injury but due to poor weed control. The plots with poor weed control (i.e. the non-treated plots and fall metribuzin) had the lowest yields. Products that have been known to cause soybean injury in some cases were generally among the yield leaders, simply due to better weed suppression.

Table 1. Comparison of fall and spring herbicide applications prior to soybean planting for the control of kochia.

App Time[1]	Product	Rate	5/28 Kochia > 4 leaf	5/28 Kochia ≤ 4 leaf	6/19 Kochia Control	8/6 Regrowth[2]	Test Weight	Yield
		oz/a	0-99	0-99	0-99	% of plots	lb/bu	bu/a
	non treated		0		0	100	55.4	31.3
fall	Anthem	12	28		45	100	56.4	50
fall	Broadax	25	59		56	75	56.3	44.4
fall	Fierce	3	55		68	50	56.4	45.5
fall	metribuzin	0.5 lb/a	24		18	25	55.8	36.7
fall	Spartan	8	89		85	100	56.5	46.3
fall	Valor	3	40		60	100	56.2	47.8
spring	Anthem	12	45	99	42	50	56.4	42.2
spring	Broadax	25	86	97	83	25	56.3	47.4
spring	Fierce	3	41	95	54	25	56.3	49.8
spring	metribuzin	0.5 lb/a	75	99	84	75	56.6	45.2
spring	metribuzin + Sharpen	0.5 lb/a + 1.5	77	97	68	0	56.6	50.9
spring	[3]Sharpen	1.5	24	99	23	50	56.5	42.9
spring	Spartan	5	68	99	71	100	56.7	48.7
spring	Valor	3	51	90	60	70	56.4	44.4
spring	[3]Verdict	7.5	53	83	83	100	56.5	42.4
spring	Verdict + Zidua	6 + 3	77	75	68	25	56.2	44.3
LSD (α=0.05)			13	3	14	50	0.6	7.7

[1]Fall applications made on October 30, spring applications on May 7.

[2]Soybeans were at 80% canopy closure.

[3]MSO + AMS would enhance the post-emergent activity of Sharpen and Verdict.

Trial was planted on June 3; glyphosate sprayed after the June 19 evaluations.

Both BroadAxe and metribuzin were pleasant surprises in this study. BroadAxe is a mixture of Spartan + Dual II. Dual II is not known for kochia control but did seem to provide a boost to the Spartan

component of the mix, plus it will also provide grass control. Metribuzin (Group 5) is one of the few products in the list that doesn't contain a PPO inhibitor (Group 14). Group 14 herbicide resistance is likely the next thing that will emerge in kochia populations as this mode-of-action is currently the most effective (and in soybean, one of the only effective) chemistries that will still control all kochia populations, and therefore should see heavy use. Metribuzin is also inexpensive, more closely compared to application costs of glyphosate than many other pre-emergence herbicides available. With this in mind, it should be easy to incorporate two to three modes-of-action in a pre-emergence herbicide program to combat kochia populations.

Effective fall-applied herbicides are available. Once the soil temperatures in the fall limit the amount of microbial degradation, using Spartan, Valor, or Fierce in the fall could be an attractive option for those who have had issues with product activation or who would rather spend time on weed control in the fall than during spring planting.

From a weed resistance stand point, a combination of three modes-of-action could be achieved with several product combinations. At this time, the most effective such combination appears to be Spartan (Group 14) + metribuzin (Group 5) + Zidua (Group 15) (these weren't applied together in this study). This could be followed up with bentazon (Group 6) as an early post-emergence treatment, if needed.