Italian Ryegrass Control in Spring Canola Using Multiple Herbicide Modes of Action

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Italian ryegrass resistance to glyphosate is a potentially serious issue for spring canola growers in the region. Herbicide resistance can develop when a single mode of action is used repeatedly over time, as was the case with Group 1 herbicides like Hoelon for grass weed control in pulse crops. Strategies that incorporate other modes of action can reduce dependence on glyphosate and potentially delay the development of Italian ryegrass resistance to glyphosate. Italian ryegrass in this region has already developed resistance to Group 1 and Group 2 herbicides, but glyphosate (Group 9) resistance, if present, is not yet widespread; therefore, Roundup Ready® canola is still an effective tool for Italian ryegrass control. Non-glyphosate options are limited but soil-active Group 3 herbicides, such as trifluralin (Treflan®) and ethalfluralin (Sonalan®), can be effective if adequately incorporated and activated in the soil by tillage and/or rainfall before ryegrass emergence. Also, glufosinate (Liberty® SC), a Group 10 herbicide, can be applied in LibertyLink® canola but is less effective on grass weeds compared with glyphosate, particularly if the grass weeds are tillered and well developed (Figure 1). Glufosinate is primarily a contact herbicide with only limited translocation in the plant. Finally, Group 13 clomazone (Clomate 3ME) is labeled for canola and may give some control of Italian ryegrass. No other herbicide options, other than the ones mentioned above, are available for selective Italian ryegrass in spring canola.

Figure 1. Effect of delayed seeding on Italian ryegrass density in spring canola. Early seeding on the left with no herbicide control, delayed seeding on the right with no herbicide control.

We compared multiple and single mode-of-action herbicide treatments for control of Italian ryegrass in spring canola at a field site on the WSU Cook Agronomy Farm. The field was in chickpeas in 2022 and the residue was left in place. On April 6, 2023, liquid fertilizer, 100-10-0-20 N-P-K-S lb/A, was drop-spread over the plot area. On April 24, 2023, the plot area was cultivated twice at 90° at a depth of 2-3 inches with a field cultivator with an attached tine harrow. Treflan HFP treatments were then applied at 24 fl oz/A and incorporated twice in opposite directions with a field cultivator/harrow. Spring canola, 'InVigor LibertyLink/TruFlex® LR345PC'is resistant to glyphosate and glufosinate and was initially seeded on April 25 with a Great Plains drill with double-disc openers on 10-inch spacing; however, 1.05 inches of rain fell on May 9 and washed out or buried the emerged canola. The trial site was recultivated and reseeded on May 15. The seeding rate was 15 seeds per ft^2 and placed 0.75 to 1.25 inches deep. By May 25, 10 days after seeding, the canola had emerged; however, very little precipitation occurred after emergence resulting in drought conditions and reduced secondary Italian ryegrass emergence. Early postemergence (EPOST) applications of Roundup PowerMax® at 22 and 44 fl oz/A and Liberty SC at 29 oz/A were applied on June 6 when the canola had 3-4 leaves and the Italian ryegrass had 2-4 leaves. Late postemergence (LPOST) treatments of PowerMax at 22 fl oz/A and Liberty at 29 oz/A, were applied on June 15 when the canola had 6 leaves and was beginning to bolt, and the Italian ryegrass plants ranged from 2 leaves to several tillers. All herbicides were applied with a 10-ft hand-held spray boom with six TeeJet® AIXR110015 nozzles on 20-inch spacing and pressurized with a CO_2 backpack. Spray output was 15 gpa at 40 psi with a ground speed of 3 mph. All PowerMax and Liberty applications included NH_4SO_4 at 17 lb/100 gallons of spray mix.

Italian ryegrass control was rated visually as a percent of the nontreated checks on June 15 and 30 in the growing crop, and on September 2, 2023, at harvest. Crop injury from herbicides was visually assessed on June 30 and July 14 compared with the nontreated checks. Canola was harvested on September 2 with a Wintersteiger plot harvester and samples were bagged, cleaned, and weighed to calculate plot yield.

The overall Italian ryegrass density was low this year because the plot area was cultivated and reseeded after the flood event on May 9, which controlled 90% of the Italian ryegrass when comparing the nontreated check plots to an adjacent trial that did not get flooded (Figure 1). However, the flooding did not appear to reduce the efficacy of the PPI Treflan applications as control ratings 44 DAT (days after treatment) were greater than 90% of the nontreated check in all plots (Table 1). Italian ryegrass control with treatments of Treflan followed by PowerMax or Liberty was 100% 9 DAT for the EPOST applications. The EPOST Liberty alone treatment averaged 71% control of the nontreated check on June 15 and 90% by June 30 but was still less effective than all other treatments, which were at or near 100%.

By harvest, Italian ryegrass control was 99-100% with all treatments except the single-mode Liberty treatment, which averaged 80% control. The reduced Italian ryegrass density from the delayed seeding combined with the lack of secondary flushes resulted in good control from all treatments; however, only relying on a single application of Liberty was less effective. All PowerMax applications were so effective in controlling Italian ryegrass that it was difficult to determine if Treflan added control in the multiple-mode treatments; however, Treflan resulted in

fewer plants for the postemergence applications to control and thus reduced the likelihood of selecting for resistance.

Table 1. Italian ryegrass control in 2023 spring canola with multiple modes of action.

	Apr 24	June 6	June 15	June 6	June 15	June 30	Sept 2
	---------- Canola stages* ----------			-------Italian ryegrass control ratings**-------			
Trt	PPI	3-4 leaves EPOST	6 leaves-bolting LPOST	44 DAT PPI	9 DAT EPOST	15 DAT LPOST	Harvest
	------- Herbicides applied (oz/A) -------			--------- % of nontreated check---------			
1	-	PM (44)	-	-	92 cd	100 a	100 a
2	Treflan	PM (44)	-	97 abc	100 a	100 a	100 a
3	Treflan	-	-	94 c	89 d	99 ab	99 a
4		-	PM (22)	-	0 f	98 b	99 a
5	Treflan	-	PM (22)	99 ab	97 bc	100 a	100 a
6	-	PM (22)	PM (22)	-	87 d	100 a	100 a
7	Treflan	PM (22)	PM (22)	96 bc	100 a	100 a	100 a
8	-	Liberty	-	-	71 e	90 c	80 b
9	Treflan	Liberty	-	99 a	100 ab	100 a	100 a
10		PM (44)	Liberty	-	97 bc	100 a	100 a
11	Treflan	Liberty	Liberty	99 a	100 ab	100 a	100 a
12	Nontreated check			-	-	-	-

*PPI = preplant incorporated, EPOST = early postemergence, LPOST = late postemergence;
Treflan (trifluralin) was applied at 24 fl oz/A PPI and incorporated twice with a cultivator at 180°;
EPOST PowerMax was applied at 44 and 22 fl oz/A, and Liberty was applied at 29 fl oz/A;
LPOST PowerMax was applied at 22 oz/A; LPOST Liberty was applied at 29 oz/A.
All PowerMax and Liberty applications included NH_4 SO_4 at 17 lb/100 gal
**DAT = days after treatment. Numbers followed by the same letter in each column are not statistically different ($P \leq 0.05$).

The negative outcome of the delayed planting was that flowering occurred later during hotter temperatures, which potentially resulted in greater plant stress and lower yields. This was especially evident for EPOST PowerMax applications at 44 oz/A and the split PowerMax EPOST plus LPOST applications. These PowerMax applications resulted in reduced growth and some yellowing that was observable when the plots were rated on June 30 and July 14 (Table 2). The PowerMax treatments also had lower yields compared with the nontreated check or the single or multiple-mode Liberty treatments. Delayed planting is one tool for controlling Italian ryegrass; however, any physiological stress from glyphosate that delays canola development will be particularly problematic for late-planted canola.

Table 2. Spring canola injury and yield.

	Apr 25	June 2	June 15	June 30	July 14	Sept 2
			Canola stages*			
Trt	PPI	3-4 leaves EPOST	6 leaves-bolting LPOST	Plants initiating flowering	Plants flowering	Harvest
	Herbicides applied (oz/A)			Percent crop injury**		lb/A
1	-	PM (44)	-	23 ab	13 a	1365 cde
2	Treflan	PM (44)	-	17 bc	10 ab	1508 bcd
3	Treflan	-	-	0 d	0 d	1594 abc
4		-	PM (22)	1 d	2 cd	1332 de
5	Treflan	-	PM (22)	0 d	4 bc	1369 cde
6	-	PM (22)	PM (22)	13 c	9 ab	1289 de
7	Treflan	PM (22)	PM (22)	15 bc	10 ab	1211 e
8	-	Liberty	-	0 d	1 cd	1794 a
9	Treflan	Liberty	-	0 d	1 cd	1770 a
10		PM (44)	Liberty	27 a	8 ab	1347 de
11	Treflan	Liberty	Liberty	1 d	0 d	1734 ab
12	Nontreated check			0	0	1793 a

*See Table 1 for application details. PM=Roundup PowerMax herbicide. Numbers followed by the same letter in each column are not statistically different ($P \leq 0.05$).
**Canola injury included stunting and/or yellowing following postemergence applications.