Canadian Agronomist

DIGGING INTO RESEARCH

Glyphosate-resistant kochia control in spring wheat

CATEGORY **weeds** | ***May 11, 2021***

The most effective and consistent treatments for glyphosate-resistant (GR) kochia management included Authority (sulfentrazone) applied pre-emergence, post-emergent Enforcer D (fluroxypyr/bromoxynil/2,4-D) at the high label rate, and post-emergent Infinity (pyrasulfotole/bromoxynil).

Glyphosate-resistant (Group 9) kochia has rapidly spread across Alberta since it was first discovered in 2011 in chemical fallow fields located in Warner County. Previously, all populations were considered resistant to Group 2 herbicides. In a 2017 survey, GR kochia had grown to 50% of kochia populations in Alberta– and that resistance is spreading across the Prairies.

Field experiments were conducted near Lethbridge, Alberta in 2013 to 2015, and Coalhurst, Alberta in 2013 and 2014. Plots were split between GR kochia and glyphosate-susceptible (GS) kochia. The kochia populations did not have any Group 4 resistant biotypes, which an Alberta survey in 2017 found 18% of populations tested were dicamba-resistant, and 10% were triple-resistant to Group 2, 4 and 9 modes of action.

AC Lillian spring wheat was seeded 1.4 inches (3.5 cm) deep at a target rate of 30 seeds/ft^2 (300 seeds/m^2). Kochia was seeded simultaneously at 1/10th of an inch deep at the same target seeding rate. A pre-plant burndown was conducted prior to seeding.

The herbicide treatments included an untreated control and 19 herbicide treatments that were either registered for kochia management in spring wheat, or had potential for kochia control with minimal wheat injury. All herbicide treatments were applied post-emergent at the 4 to 5 leaf stage of wheat, except for Authority (sulfentrazone) which was applied pre-emergence 1 to 2 days before or after seeding.

Table 5. Visible control three weeks after post-emergence herbicide application, density, and aboveground biomass of glyphosate-resistant (GR) and glyphosate-susceptible (GS) kochia in wheat in one environment near Lethbridge, AB in 2015

		Lethbridge*†		
Herbicide treatment‡	Rate (g ae/ai ha^{-1})	Visible control (%)	Density (plants m^{-2})	Biomass (g m^{-2})
Untreated			246 a	208 a
Dicamba + 2,4-D	110 + 420	68 g	210 a	23 b-d
Bromoxynil/2,4-D	280/280	71 fg	235 a	29 bc
Fluroxypyr/2,4-D	40/160	79 d-f	210 a	33 ab
Florasulam/Fluroxypyr + MCPA	2.5/100 + 350	79 d-f	230 a	27 bc
Dicamba/Fluroxypyr	80/104	86 b-d	219 a	12 b-g
Fluroxypyr + Clopyralid/MCPA	100 + 75/420	79 d-f	217 a	42 ab
Fluroxypyr/Bromoxynil/2,4-D	48/114/144	73 e-g	188 a	18 b-e
Fluroxypyr/Bromoxynil/2,4-D	96/228/288	94 ab	212 a	3 e-g
MCPA/Dichlorprop-P/Mecoprop-P	395/765/320	89 bc	198 a	1 g
MCPA/Mecoprop-P/Dicamba	275/62.5/62.5	72 fg	227 a	15 b-f
Pyrasulfotole/Bromoxynil	30/170	92 ab	216 a	2 fg
Dicamba/2,4-D/Mecoprop-P	93/251/68	78 d-f	243 a	2 g
Dicamba/2,4-D/Mecoprop-P	124/331/90	89 bc	227 a	5 b-g
Dichlorprop-P/2,4-D	368/702	71 fg	177 a	11 b-g
Sulfentrazone	105	99 a	1 b	1 d-g
Fluroxypyr/Halauxifen + MCPA	77/5 + 350	71 fg	199 a	42 ab
Fluroxypyr/Halauxifen + MCPA	100/6.5 + 455	81 de	198 a	37 ab
Dicamba	300	83 cd	231 a	5 c-g
Dicamba	600	94 ab	221 a	2 d-g

* Values are LS means
† Within columns, different letters indicate significant differences based on Tukey's HSD ($\alpha = 0.05$)
‡ All herbicides were applied post-emergence at wheat 4-5 leaf stage except for sulfentrazone which was applied pre-emergence

Source: Geddes et al. 2021

Wheat injury and yield

Wheat visible injury was considered minor among the herbicide treatments at the majority of site-years. Injury ratings from 0 to 10% are considered acceptable. Wheat visible injury was not acceptable in Coalhurst in 2014 and Lethbridge 2015 for some treatments where dicamba was applied alone or in mixture with other Group 4 active ingredients.

Visible injury ranged from 11% to 21% in Coalhurst 2014 for dicamba + 2,4-D, Pulsar (dicamba/fluroxypyr), Target (MCPA/mecoprop-p/dicamba), and both high and low rates of Dyvel DSp (dicamba/2,4-D/mecoprop-p).

Treatments including higher rates of dicamba (2x and 4x label rate) applied alone were tested in 2015 only, and the 4x label rate was the only herbicide treatment in this environment that resulted in crop injury considered unacceptable (21% injury), while injury from dicamba applied at 2X label rate was considered just acceptable (10% injury).

Wheat yield remained the same among GR and GS kochia, herbicide treatments, and the untreated weedy control in each of the environments tested. The researchers thought that the lack of yield difference following herbicide treatments compared with that of the untreated weedy control could suggest that spring wheat yield loss occurs from kochia competition or interference prior to the 4 to 5 wheat leaf stage. It should be noted that a weed-free control was not included in the study, however.

Despite the lack of wheat yield response, the true benefit of herbicide application in wheat is the reduction in kochia growth inhibiting harvest operations, and reduced seed production and lower seed return to the soil seedbank.

Herbicide effectiveness

The most effective and consistent treatments for GR kochia management included Authority (sulfentrazone) applied pre-emergence, post-emergent Enforcer D (fluroxypyr/bromoxynil/2,4-D) at the high label rate, and post-emergent Infinity (pyrasulfotole/bromoxynil). All of these treatments resulted in ≥ 90% visible control in all environments and ≥ 90% kochia biomass reduction compared with the untreated control in Lethbridge 2014 and 2015.

Optica Trio (MCPA/dichlorprop-p/mecoprop-p), Dyvel DSp (dicamba/2,4-D/mecoprop-p) at the high label rate, and Pulsar (dicamba/fluroxypyr) resulted in acceptable control among environments resulting in ≥ 80% visible control in all environments and ≥ 80% kochia biomass reduction in

Lethbridge 2014 and 2015; however Dyvel DSp and Pulsar caused unacceptable (> 10%) wheat visible injury in Coalhurst 2014.

The majority of herbicides evaluated in the current study were mixtures of Group 4 synthetic auxins. Dicamba, fluroxypyr, 2,4-D, MCPA, clopyralid, dichlorprop-p, mecoprop-p, and halauxifen are examples of Group 4 herbicides. Not all of these would have acceptable activity on susceptible kochia when applied alone, which is why most auxins are mixed either together or with another mode of action.

While Group 4 herbicides continue to play an important role in control of GR kochia in spring wheat, including alternative modes of action in herbicide programs like Group 14 herbicides applied pre-emergence, or a Group 6 or 27 herbicide post-emergently will be important. The current research suggests that optimal control of glyphosate and ALS inhibitor-resistant kochia in spring wheat may be achieved in a layering approach with a combination of Authority applied pre-emergence with Enforcer D (Groups 4 + 6) or Infinity (Groups 6 + 27) applied post-emergence.

The sustainability of remaining herbicides for kochia control will depend on the successful implementation of integrated weed management including alternative crop life cycles (e.g., winter-annuals or perennials), competitive crop cultivars, cover crops, field scouting, resistance diagnostic testing, strategic and site-specific tillage, and potentially also harvest weed seed control.

Since this research was conducted, pre-plant Fierce herbicide (Group 14 flumioxazin and Group 15 pyroxasulfone) and Authority herbicide (Group 14 sulfentrazone) applied pre-plant or pre-emergent were registered for control of kochia before spring wheat.

This research was supported by the Alberta Barley Commission, Alberta Canola Producers Commission, Alberta Crop Industry Development Fund, Alberta Wheat Commission, BASF Canada, Dow AgroSciences, Nufarm Canada, Valent Canada, and Western Grains Research Foundation.

Ms. Alysha T Torbiak, Dr. Robert E Blackshaw, Mr. Randall N Brandt, Dr. Bill Hamman, and Dr. Charles M. Geddes. Herbicide strategies for managing glyphosate-resistant and susceptible kochia (*Bassia scoparia*) in spring wheat. *Canadian Journal of Plant Science*. **Just-IN**

Open Access https://doi.org/10.1139/CJPS-2020-0303

