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Responses of black and cranberry beans (*Phaseolus vulgaris*) to post-emergence herbicides

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Abstract

There is a limited number of post-emergence (POST) herbicides available for weed management in black and cranberry beans in Ontario. The tolerance of two cultivars of black beans (AC Harblack and Midnight Black Turtle) and two cultivars of cranberry beans (Hooter and SVM Taylor) to POST applications of bentazon, bentazon plus fomesafen and imazamox plus fomesafen was evaluated at the maximum-use dose (1 ×) and twice the maximum-use dose for soybeans (2 ×) at two Ontario locations in 2001 and 2002. There were no differences between AC Harblack and Midnight Black Turtle or Hooter and SVM Taylor cultivars in their responses to the POST herbicides tested. The POST application of bentazon, bentazon plus fomesafen and imazamox plus fomesafen at 7 DAT caused only minor crop effects in dry beans. At 14 DAT visual injury ratings were higher in black beans (1.4–3.0%) compared to cranberry beans (0.4–1.6%). Visual injury was minimal at 28 DAT and was below 1% for all cultivars and market classes. The POST application of bentazon, bentazon plus fomesafen and imazamox plus fomesafen at the single or double-use rate caused no significant effect on plant height, shoot dry weight, seed moisture content and yield of black or cranberry beans compared to the untreated. Black and cranberry beans were more sensitive to bentazon and bentazon plus fomesafen than imazamox plus fomesafen. Based on these results, there is sufficient tolerance for use of these herbicides post-emergence in black bean and cranberry bean production in Ontario.

Keywords: Bentazon; Fomesafen; Imazamox; Field trials; Dry beans; *Phaseolus vulgaris* L

1. Introduction

Coloured dry beans (*Phaseolus vulgaris* L.) are an important cash crop for bean growers in south western Ontario. In 2002, Ontario coloured dry bean growers produced approximately 8,400 tonnes of black beans and 11,200 tonnes of cranberry beans which represented 17% and 44% of total Canadian black and cranberry bean production, respectively (MacKenzie, 2002). Weeds can cause major yield reductions in coloured dry beans. There is currently a limited number of herbicides registered for weed control in coloured dry bean production. More research is needed to identify post-emergence (POST) herbicides that have an adequate margin of crop safety in black and cranberry beans and provide consistent control of broadleaved weeds in these crops.

Bentazon is a selective benzothiadiazole POST herbicide that can provide effective control of broadleaved weeds including *Chenopodium album* L. (common lambsquarter), *Amaranthus retroflexus* L. (redroot pigweed), *Portulaca oleracea* (purslane), *Ambrosia artemesiifolia* L. (common ragweed), *Raphanus raphanistrum* (wild radish), *Galinsoga ciliata* (hairy galinsoga), *Senecio vulgaris* (common groundsel), *Datura stramonium* L. (jimsonweed), *Ambrosia trifida* L. (giant ragweed), *Abutilon theophrasti* Medic. (velvetleaf), *Polygonum*

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persicaria L. (ladysthumb), *Sinapis arvensis* L. (wild mustard), *Xanthium strumarium* L. (cocklebur), *Capsella bursa-pastoris* (shepherdspurse) and *Stellaria media* (common chickweed) including group II and V resistant biotypes (Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) 2004; Vencill, 1990).

Bentazon in tank mix combination with fomesafen (a diphenyl ether herbicide) can provide improved control of broadleaf weeds such as *Amaranthus* spp., *Ambrosia* spp., *Solanum* spp. and *Polygonum convolvulus* (OMAFRA, 2004).

Imazamox plus fomesafen is an imidazolinone plus diphenyl ether herbicide that is only available as a premixed formulation in Ontario that can effectively control a broad spectrum of weeds such as *Setaria faberii* Herrm. (giant foxtail), *Setaria viridis* (L.) Beauv. (green foxtail) *Setaria glauca* (L.) Beauv. (yellow foxtail), *Echinochloa crusgalli* (L.) Beauv. (barnyardgrass), *Xanthium strumarium* L., *Polygonum persicaria* L., *Chenopodium album* L., *Amaranthus retroflexus* L., *Ambrosia artemesiifolia* L., *Abutilon theophrasti* Medic., *Sinapis arvensis* L. and *Solanum ptycanthum* Dun. *ex* DC. pp. (eastern black nightshade) including group V resistant biotypes (OMAFRA, 2004; Vencill, 1990).

There is little information on the tolerance of black and cranberry beans to bentazon, bentazon plus fomesafen, and imazamox plus fomesafen under Ontario growing condition. Bentazon with the adjuvant in the formulation, bentazon plus fomesafen and imazamox plus fomesafen are not currently registered for use in black or cranberry bean production in Ontario. Registering these POST herbicides will provide Ontario growers with additional options to manage broadleaved weed species. The objective of this research was to determine the tolerance of black beans and cranberry beans to POST applications of bentazon, bentazon plus fomesafen, and imazamox plus fomesafen for possible registration in Ontario.

2. Materials and methods

Field studies were conducted at the Huron Research Station, Exeter, Ontario and at Ridgetown College, Ridgetown, Ontario in 2001 and 2002. The soil at Exeter was a Orthic Humic Gleysol Brookston clay loam with 43% sand, 33% silt, 24% clay, 5.0% organic matter and pH of 8.1 in 2001, and 47% sand, 34% silt, 19% clay, 3.4% organic matter and pH of 8.0 in 2002. The soil at Ridgetown was a Grey–Brown Podzolic Watford/Brady sandy–clay loam with 61% sand, 27% silt, 12% clay, 3.2% organic matter and pH of 6.9 in 2001, and 48% sand, 34% silt, 18% clay, 5.3% organic matter and pH of 7.0 in 2002. Seedbed preparation consisted of fall moldboard plowing followed by two passes with a field cultivator in the spring.

The experiment were arranged in split–split plot design with four replications. The main plots were herbicide treatments, the sub-plots were market class of dry beans and the sub–sub plots were dry bean cultivars. Selection of herbicide doses and spray additives was based on the current maximum-use rate in soybeans in Ontario. The treatments consisted of an untreated check and two doses, the maximum labelled use rate (1 ×) and twice the maximum labelled use rate (2 ×) in soybeans, for each of the treatments listed in Tables 2–8. Imazamox alone is not currently available in Canada and can only be purchased as a prepackaged mixture with fomesafen or bentazon. Adjuvant rates were doubled when going from the 1 × to the 2 × rate, to simulate spray overlaps in the field where plants receive twice the adjuvant doses. Two widely grown cultivars with different genetic backgrounds of black beans (AC Harblack and Midnight Black Turtle) and cranberry beans (Hooter and SVM Taylor), were planted at both sites. Plots were 3 m wide (four rows) by 10 m long at Exeter and 3 m wide by 8 m long at Ridgetown. Each plot consisted of one row each of AC Harblack, Midnight Black Turtle, Hooter and SVM Taylor beans spaced 0.75 m apart. Black beans were planted at a rate of 400,000 seeds/ha and cranberry beans were planted at a rate of 175,000 seeds/ha on dates listed in Table 1.

Herbicide treatments were applied POST at the 1–2 trifoliolate leaf stage using a CO_2-pressurized backpack sprayer delivering 200 l/ha at 200 kPa using 8002 flat-fan nozzles (Teejet 8002 flat-fan nozzle tip, Spraying Systems Co., PO. Box 7900. Wheaton, IL 60188). The boom was 2.5 m long with six nozzles spaced 50 cm

Table 1
Planting and harvest dates for black and cranberry beans treated with post-emergence herbicides at Exeter and Ridgetown, Ont. in 2001 and 2002

Location	Year	Cultivar	Planting date	Harvest date
Exeter	2001	AC Harblack	June 9	September 13
		Midnight Black Turtle	June 9	September 14
		Hooter	June 9	September 6
		SVM Taylor	June 9	August 29
	2002	AC Harblack	June 10	September 12
		Midnight Black Turtle	June 10	September 18
		Hooter	June 10	September 17
		SVM Taylor	June 10	September 6
Ridgetown	2001	AC Harblack	June 16	October 10
		Midnight Black Turtle	June 16	October 9
		Hooter	June 16	October 30
		SVM Taylor	June 16	September 20
	2002	AC Harblack	June 11	September 12
		Midnight Black Turtle	June 11	September 12
		Hooter	June 11	September 11
		SVM Taylor	June 11	September 3