



Control kochia when small

CATEGORY [weeds](#) | February 20, 2025

Fine-tune carfentrazone-ethyl application to kochia at a weed growth stage of up to 5 cm with no branches to help avoid nonlethal herbicide dosing, which can help to reduce the risk of non-target site herbicide resistance evolution.

Kochia is one of the most troublesome weed on the Prairies. With herbicide resistance to Groups 2, 4, and 9. Weed staging is an important consideration in weed control, because sub-lethal herbicide application due to improper weed staging can increase the risk of nontarget site herbicide resistance evolution.

Group 14 active ingredients are an important mode of action for kochia control. This mode of action can be used for pre-seeding burndown (pyraflufen, carfentrazone-ethyl, saflufenacil), pre-emergence control in wheat and some pulses (flumioxazin, sulfentrazone), desiccation (carfentrazone-ethyl, saflufenacil, flumioxazin), and postharvest (pyraflufen) applications. Pre-seed and pre-emerge applications of non-residual herbicides like carfentrazone-ethyl or pyraflufen are especially important for controlling multiple-resistant kochia.

With the recent confirmation of Group 14 kochia resistance to saflufenacil in 2021, this discovery reinforces the importance of providing lethal herbicide doses to kochia to help delay the further development of herbicide resistant kochia. The objectives of this research project were to evaluate kochia response to carfentrazone-ethyl when applied at different growth stages, and to form a predictive model for sublethal dosing exposure risk of carfentrazone-ethyl based on kochia initial height, branch number, and leaf number.

The greenhouse pot experiment was conducted at Agriculture and Agri-Food Canada's Saskatoon Research and Development Centre. Kochia was seeded into the pots at three (2019 and 2020) or four (2022) different dates to provide different growth stages for herbicide application. The pots were thinned to one plant per pot upon emergence.

The herbicide treatment was an application of carfentrazone-ethyl (Aim; Group 14) at the label rate of 17.5 g ai/ha and a control without application.

Initial plant height, branch number, and leaf number were recorded at the time of herbicide application.

Herbicide damage ratings were taken at 1, 2, and 4 weeks after herbicide treatment (WAT). At 4 WAT, final plant height, final branch number, the presence of reproductive organs and surviving aboveground biomass were measured.

Kochia sublethal dosing exposure risk (SLDER) was estimated as a function of plant size at application based on final plant height, final plant branch number, overall herbicide tolerance, final biomass, and immediate reproductive potential.

Risk of escapes increases with larger plants

Final plant height was impacted by initial height and leaf number. Final treated kochia maximum plant height at 4 WAT was estimated at 21 cm based on initial branch number and leaf number.

At 4 WAT, maximum final branches for treated kochia was 18 branches/plant, and predicted maximum branches of nontreated kochia was 27 to 28/plant.

Final untreated kochia biomass was strongly correlated with initial plant height, initial branch number, and initial leaf number. Accumulated biomass was 2.6 to 5.1 g/plant.

At 4 WAT, these largest kochia escapes in the study would be associated with 100% SLDER risk. For the SLDER risk scale, 100% indicates complete escape and loss of control either from uninjured plants, flowering, or a larger amount of vegetative growth in terms of either biomass, plant height, or branch development, while 0% risk would be essentially no plant growth present.

Carfentrazone-ethyl damage to kochia decreased as initial plant height, initial branch number, and initial leaf number increased. One hundred per cent injury was only consistent when kochia was treated at 5 cm or less in height and had no branches.

After kochia was 5 cm tall, before it had developed branches, and after it had developed approximately 12 leaves, kochia injury fell below 100 per cent. However, there were survivors at early growth stages even when kochia did not have any branches.

The researchers expected this would be the case, as carfentrazone-ethyl is a contact herbicide, and bigger plants with more leaves and branches require good coverage for control.

An estimated 5% SLDER risk was herbicide application at 4 cm in height, 0 branches, and 11 leaves. A 25% risk was application at 7 cm initial plant height, 3 initial branches/plant, and 52 initial leaves/plant.

Research provides further guidance on herbicide staging

Typically, after pesticide registration, weed tolerance to a contact-based herbicide based on weed staging is not investigated. This study on the effects of nonlethal herbicide applications on kochia provides insight into consequences of sublethal dosing exposure. Kochia escapes from nonlethal dosing of pesticides means the potential reproduction and spread of plants that pose an increased risk of the development of herbicide resistance.

The current label for carfentrazone-ethyl is to treat kochia up to 10 cm in height. This study found that the best control was herbicide application when kochia was up to 5 cm tall, before it had developed branches, and before it had developed approximately 12 leaves. The observation that the development of plant branches means a reduction in carfentrazone-ethyl control of kochia could provide an additional scouting target. This may help preserve herbicide longevity.

Furthermore, kochia's environmental plasticity, history for resistance evolution, and tumble weed dispersal method means kochia may be present in a field in various growth stages. As a result, fine-tuning kochia staging and carfentrazone-ethyl application timing to weed staging of 5 cm and no

branches may help to avoid nonlethal herbicide dosing, improve kochia control, and reduce weed competition.

The first run of this experiment was presented in Teanna Novek's fourth year undergraduate thesis. The authors gratefully acknowledge the technical support of Taylor Kaye. The authors also gratefully thank the greenhouse staff at the Saskatoon Research and Development Centre for preparing soil, watering, and pest monitoring activities. FMC Canada donated herbicide.

Shaun M. Sharpe and Teanna Novak. 2024. Sublethal dosing exposure risk of kochia (*Bassia scoparia* (L.) A.J. Scott) to carfentrazone-ethyl. *Canadian Journal of Plant Science*. **104**(6): 555-562.

OPEN ACCESS: <https://doi.org/10.1139/cjps-2023-0168>