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Integrated crop-livestock systems may be effective tool for managing herbicide-resistant kochia

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For livestock producers, kochia is relatively high in crude protein and can be used as an alternative forage for alfalfa, or ensiled and used as an alfalfa silage replacement. Integrated crop-livestock systems may offer alternative weed control methods that are effective for managing herbicide-resistant kochia biotypes and provide alternative livestock feed.

Kochia is a problematic herbicide-resistant annual broadleaf weed in cropping systems in arid and semi-arid regions in western Canada and the US. The rapid spread of herbicide-resistant kochia biotypes, some resistant to three different herbicides, and indeterminate growth habit has resulted in harvesting issues, yield losses and poor weed control in annual crops. Crop harvest can be aided with pre-harvest herbicides, or as an alternative, dense kochia patches can be cut and harvested for forage. For livestock producers, kochia is relatively high in crude protein and can be used as an alternative forge for alfalfa in beef and dairy diets, or ensiled and used as an alfalfa silage replacement. Integrated crop-livestock systems may offer alternative weed control methods that are effective for managing herbicide-resistant kochia biotypes and provide alternative livestock feed.

The objectives of this study conducted at the Agriculture and Agri-Food Canada (AAFC) Lethbridge Research and Development Centre were to evaluate nutrient composition and *in vitro* degradability of glyphosate (Group 9)-resistant (GR) and glyphosate-susceptible (GS) kochia with or without pre-harvest herbicide application, at six harvest dates. Both kochia populations seeded in the experiments were acetolactate synthase (ALS) inhibitor (Group 2)-resistant, which allowed for the control of other weeds using Refine SG (tribenuron-methyl + thifensulfuron-methyl; Group 2). ALS-inhibiting herbicides and/or synthetic auxins (Group 4), such as dicamba or fluroxypyr, are commonly used to control kochia, however kochia was one of the first weed species that evolved ALS inhibitor-resistance, while glyphosate and synthetic auxin resistance is also present across the Canadian prairies.

Pre-harvest herbicide treatments consisting of glyphosate (Group 9) + Heat (saflufenacil) were made before each harvest date and compared to control plots with no pre-harvest herbicide application. Kochia was harvested at six different times, every two weeks between August 3 (pre-bloom) and October 12 (fully mature seeds). Agronomic and chemical composition data including plant density, dry matter (DM) yield and several nutrient composition factors were collected for characterization and evaluation.

Harvest date had greatest impact on feed value

Overall, the study indicated that harvest date had a greater impact on kochia feed value, chemical composition and *in vitro* degradability than pre-harvest herbicide treatment or herbicide resistance traits. Harvest date was positively correlated to DM yield, acid (ADF) and neutral detergent fiber (NDF) concentrations and total digestible nutrient (TDN) content. The study found that DM yields increased with harvest dates up to kochia seed set and mid-maturity at the end of September, and then declined, largely due to a killing frost. Maturity had no impact on plant density. The results also showed no significant difference in above-ground vegetative biomass of GR and GS with no pre-harvest herbicide application, but DM yield was higher in GR kochia compared to GS kochia under pre-harvest herbicide treatments.

Harvest date was negatively associated with dry matter degradability (DMD) and crude protein (CP) concentrations. However, overall, CP levels found in kochia were fairly high, although CP levels decreased from 23 per cent in early August to 14 percent at the last harvest date in October. Even at full maturity, CP concentrations of about 14 per cent were sustained, and the inclusion of kochia in ruminant diets could reduce protein supplementation costs of growing and finishing beef cattle fed corn-based diets.

The results also showed that kochia harvested at the vegetative stage had an *in vitro* DMD comparable to that of alfalfa at the same maturity. The DMD decreased from 72 per cent to 59 per cent with advancing harvest dates, while NDF decreased from 62 per cent to 48 per cent. The results also showed a slight decline in degradability and an increase in *in vitro* methane (CH_4) production with pre-harvest application of glyphosate, which also tended to increase structural carbohydrates in the plant cell wall, while decreasing non-fibrous carbohydrate fractions.

Overall, this research shows that crop-livestock systems may offer alternative weed control methods that are effective for managing herbicide-resistant kochia biotypes and provide alternative livestock feed. Additional studies using kochia harvested at optimal maturity to investigate intake, in *in vivo* digestibility and growth performance studies would further define the value of kochia as forage in ruminant production systems. This could potentially revert what is now seen as a problematic weed into a valuable forage source for beef and dairy cattle.

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J. Nair, P.M.T. Lima, A.L. Abdalla, L.J. Molnar, Y. Wang, T.A. McAllister, C.M. Geddes (2021). Kochia (*Bassia scoparia*) harvest date impacts nutrient composition, in vitro degradability, and feed value more than pre-harvest herbicide treatment or herbicide resistance traits. Animal Feed Science and Technology.

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