Post-Emergent Herbicide Selection for Okra Oilseed Production

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Abstract

Okra (*Abelmoschus esculentus*) seed has garnered attention for its potential as a livestock feed, particularly in light of possible threats to soybean (*Glycine max*) productivity. While established weed control systems exist for okra vegetable production in the Southern USA, information is lacking on management tools for oilseed production in the North Central region. A number of promising post-emergent herbicides were evaluated for crop injury and effects on oilseed and biomass yield. Fomesafen, imazaquin, mesotrione, nicosulfuron, and pyridate were compared at single application rates. In a separate study, mesotrione and pyrithiobac-Na were each evaluated at three different application rates. Mesotrione and pyrithiobac-Na were the only herbicides not shown to reduce okra yields, and further research is warranted.

Figure 1: 2007 okra herbicide experiment

Introduction

Okra may be a complement to soybean as an oilseed component of North Central USA livestock rations. Okra and soybean have similar seed oil and protein content, and okra seed yields have regularly exceeded 2000 kg ha^{-1} in variety trials (Phippen, 2006), while okra is unsusceptible to pathogens like soybean cyst nematode (*Heterodera glycines*) and Asian soybean rust (*Phakopsora pachyrhizi*). However, weed management practices developed for okra horticultural production do not include post-emergent herbicides suitable for broadcast use against dicot weeds (Mossler and Lamberts, 2005; Stall, 2006). Identification of active ingredients for that role would address a constraint to agronomic production of okra seed.

Direct information on okra tolerance to post-emergence herbicide is scant. In a volunteer okra control experiment, Prostko et al. (1998) found that pyrithiobac-Na reduced okra biomass at 140 g a.i. ha^{-1} , but not 70 or 30 g a.i. ha^{-1} application rates. Several herbicides were identified from regional extension literature (e.g. Bissonnette, 2007; Owen and Hartzler, 2006) as being relatively ineffective when applied post-emergence to weed species that, like okra, are in the Malvaceae; these active ingredients include fomesafen, imazaquin, nicosulfuron, and pyridate. Preliminary experiences with mesotrione have indicated the possibility of okra tolerance to that material (M.L. Vincent, personal communication, 2006).

Figure 2: Top: mature okra pods. Bottom: okra seeds (r) with soybean seeds (l) for comparison.

2006 Experiment

Introduction & Methods

'Clemson Spineless' okra (Figure 8) was planted 18 May 2006 at a rate of 8 kg ha^{-1} pure live seed in an Osco silt loam (Fine-silty, mixed, superactive, mesic Typic Argiudolls). Plots were 3 m wide (four 77 cm rows) and 6.1 m long. Treatments included five post-emergent and one pre-emergent herbicides (Table 1), one hand-weeded check, and one check with no weed control. The pre-emergent treatment was applied on 19 May 2006 and shallowly incorporated, and the post-emergent treatments were applied on 23 June 2006. Visual crop injury ratings were performed on 6 July 2006 on a scale from 1 (no injury) to 5 (injury equivalent to that of to most injured plot present). With the exception of one mechanical row cultivation, no additional whole-field weed control was performed. Weed pressure was heavy in July, suppressing okra growth and development, and resulting in the decision to harvest the trial for biomass rather than seed. Above ground okra biomass was collected from 1.2 m of the center two rows of each plot on 28 July 2006 for air-dried biomass yield determination.

Table 1: 2006 herbicide treatment levels.

Active Ingredient	Form Applied	Application Rate g a.i. ha^{-1}
Fomesafen	Reflex 2EC †	210
Imazaquin	Scepter 70DG †	100
Mesotrione	Callisto 4SC †	110
Nicosulfuron	Accent 75WDG †	50
Pyridate	Tough 3.75EC	530
Trifluralin	Treflan 4EC	1100

† Includes 0.25% v/v non-ionic surfactant

Analysis of variance was performed with treatment as a fixed effect and block as a random effect, and Fisher's protected least significant difference was calculated among treatment levels. The alpha-level for hypothesis testing and mean separation was 0.05.

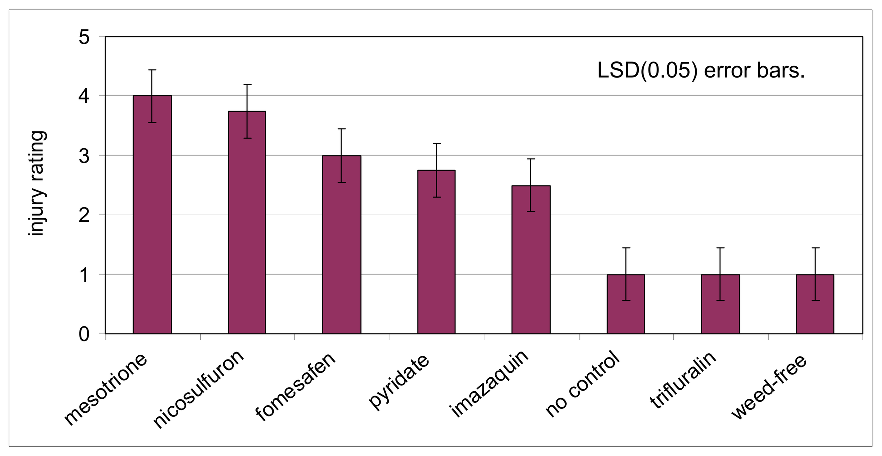

Figure 3: Okra crop injury ratings (1 = no injury, 5 = worst injury).

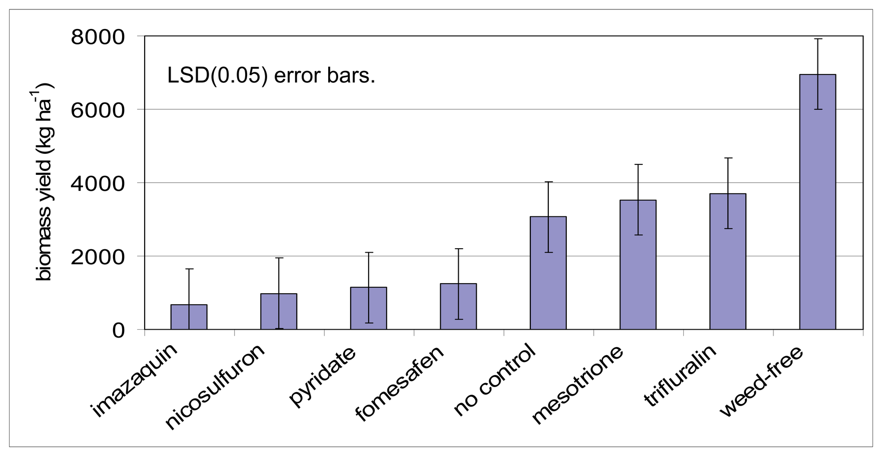

Figure 4: Okra biomass yields.

Results & Discussion

Mesotrione and nicosulfuron produced moderate to severe visible injury on treated okra plants (Figure 3). Plots treated with imazaquin, pyridate, and fomesafen exhibited slight to moderate injury, lesser than that caused by mesotrione but distinguishable from the unsprayed checks (Figure 7). Despite the crop injury it produced following application, mesotrione was the only post-emergent active ingredient not to reduce late July okra biomass yields relative to the no-weed-control check (Figure 4). Yields from the other four post-emergent active ingredients were less than half of those achieved by the check. Pre-emergent trifluralin did not produce crop injury or yield reduction.

2007 Experiment

Introduction & Methods

'Clemson Spineless' okra was planted 12 May 2007 at a rate of 13 kg ha^{-1} pure, live seed in an Ipava silt loam (Fine, smectitic, mesic Aquic Argiudolls). Plots were 3 m wide (four 77 cm rows) and 4.5 m long (Figure 1), and were kept weed-free by hand-weeding throughout the experiment. Post-emergent herbicide treatments were applied 9 July 2007. The treatment structure was a factorial of two active ingredients and three application rates (Table 2), plus an unsprayed check. Treatments were replicated three times in a randomized complete block design. Visual crop injury ratings were performed on 24 July 2007 on a scale from 1 (no injury) to 10 (complete necrosis). Three m of the center two rows of each plot was hand-harvested on 11 October 2007, and threshed for seed yield.

Table 2: 2007 herbicide treatment levels.

Active Ingredient	Form Applied
Mesotrione	Callisto 4SC †
Pyrithiobac-Na	Staple 85SP †

† Includes 0.25% v/v non-ionic surfactant

Application Rate	g a.i. ha^{-1}
1	70
2	105
3	140

Analysis of variance was performed with active ingredient as a fixed effect and block and application rate as random effects, and the Fisher's protected least significant difference was calculated among simple effects. The α-level for hypothesis testing and mean separation was 0.05.

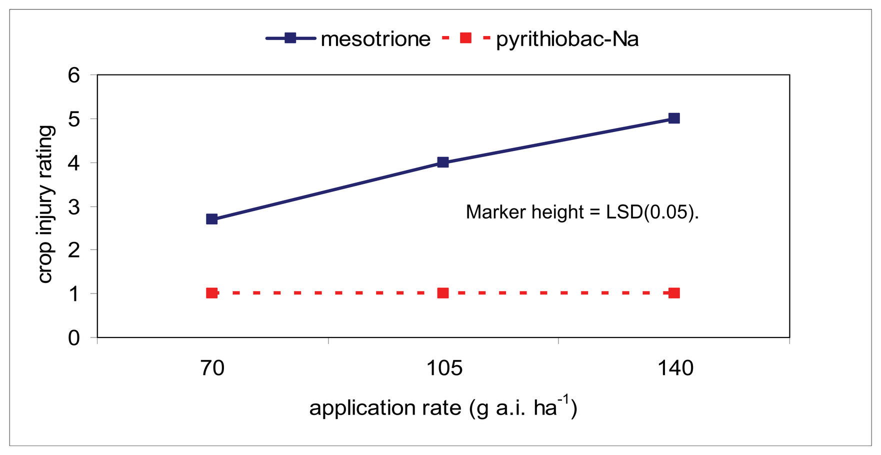

Figure 5: Okra crop injury ratings (1 = no injury, 10 = death).

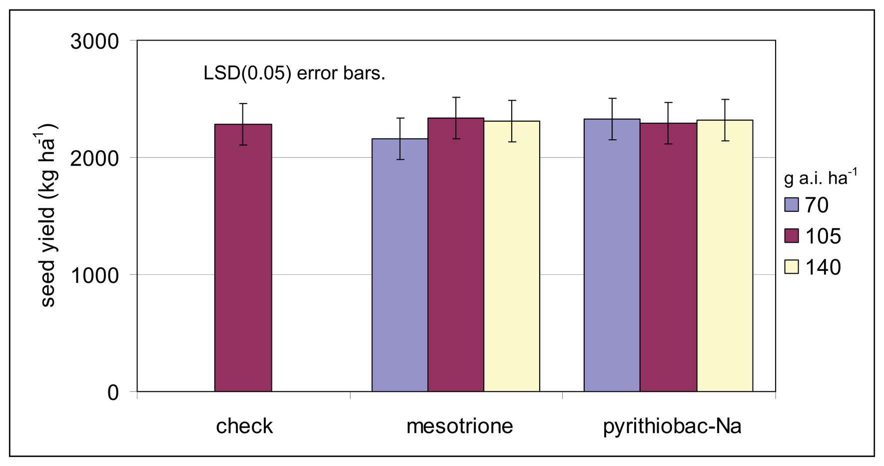

Figure 6: Okra seed yields.

Results & Discussion

No visible crop injury was caused by pyrithiobac-Na at any application rate. Mesotrione produced slight to moderate levels of chlorosis on treated okra plants, and the effect increased with application rate. Neither active ingredient reduced okra seed yield at any application rate, relative to the unsprayed check.

No evidence was found for okra seed yield reduction from application of moderate to high rates of mesotrione or pyrithiobac-Na. Chlorotic leaf tissue resulting from mesotrione application did not reduce subsequent seed yields.

Figure 7: 2006 okra herbicide experiment following post-emergent treatments. Fomesafen injury is visible in the foreground.

Figure 8: 'Clemson Spineless' okra (rule in inches).

Conclusions

In two separate, one-year trials, no evidence was apparent for suppression of okra seed yields by applications of mesotrione and pyrithiobac-Na at application rates currently labeled for other dicot crops. The visible crop injury caused by mesotrione application was not associated with any reduction in yield. Weed control research efforts in okra should include further site-years of evaluation of these promising materials. Future mesotrione trials in okra should include the use of crop oil concentrate (the primary labeled adjuvant for mesotrione), now that crop safety with non-ionic surfactant has received preliminary validation. Fomesafen, imazaquin, nicosulfuron, and pyridate displayed limited potential for post-emergent use in okra in one year of experimentation. Single-pass post-emergent weed control may be problematic in okra oilseed production, even when accompanied by row cultivation. Future research is needed on two-pass post-emergent systems, as well as pre- plus post- systems.

References

Bissonnette, S. (ed.) 2007. 2007 Illinois agricultural pest management handbook. Univ. Illinois Extension, Urbana, IL.

Mossler, M.A. and M.L. Lamberts. 2005. Okra pest management strategic plan. Univ. Florida, Gainesville, FL.

Owen, M.D.K. and R.G. Hartzler 2006. 2007 Herbicide guide for Iowa corn and soybean production. Pub. WC-94. Iowa State Univ. Extension, Ames, IA.

Phippen, W.B. 2006. Okra evaluation trial for seed production. p. 17-18. *In* E.T. Maynard and C.C. Gunter (eds.) Midwest vegetable variety trial report for 2006. Bull. B18048. Purdue Univ., West Lafayette, IN.

Prostko, E.P., E. Rosales-Robles, and J.M. Chandler. 1998. Wild okra control with bromoxynil and pyrithiobac. J. Cotton Sci. 2:100-103.

Stall, W.M. 2006. Weed control in okra. Doc. HS192. Florida Cooperative Extension Ser. Gainesville, FL.

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