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WEED POPULATION DYNAMICS UNDER GLYPHOSATE-RESISTANT COTTON CROPPING SYSTEMS

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Abstract

Concerns about the effect of intense glyphosate applications on continuous cotton cropping systems have increased with acreage of glyphosate-resistant cotton varieties exceeding 90% in the state of Alabama. In particular, the potential for this intense usage to shift weed populations toward more tolerant species and ultimately resistance. Field studies were implemented in 2000 at the Tennessee Valley Research and Education Center, Belle Mina, and at the E.V. Smith Research Center, Field Crops Unit, Shorter, to study the effect of intense glyphosate usage on sicklepod (*Senna obtusifolia*) and pitted morningglory (*Ipomoea lacunosa*) populations. Experimental units consisted of glyphosate-resistant cotton varieties (Suregrow® 125 BR, Belle Mina; Suregrow® 501 BR, Shorter) planted in four 40 in. rows, 25 ft. long at each location. Cotton was planted and maintained with conventional tillage practices and Alabama Cooperative Extension Systems recommendations for fertility and non-weed pests. Treatments consisted of three applications of glyphosate at either ½x or 1x (1x = 1.0 lb ai/A) rates applied at various times including postemergence over-the-top one leaf (POT-1), POT-4, postemergence directed spray eight leaf (PDS-8), and PDS-12. Variations on this basic pattern included pyrithiobac (0.04 lb ai/A) added to the POT-1 or POT-4 applications, prometryn (0.75 lb ai/A) plus MSMA (1.5 lb ai/A) substituted for the PDS-12 application, and fluometuron applied as a preemergence (PRE) treatment. A hand-weeded check plot was also maintained. The aforementioned treatments were applied with and without pendimethalin (0.8 lb ai/A), preplant incorporated (PPI), yielding a total of 16 treatments per site. Experimental design was a randomized complete block with four replications. Plot integrity was maintained over years at each location. The glyphosate product used was Roundup Ultra®, 4 lb ai/gal (3 lb ae/gal). Response variables measured included: weed density early- (June), mid- (July), and late-season (August); visual control and crop injury ratings (not presented); and crop yield. Baseline weed densities in a measurement plot (250 sq. ft.) were recorded at the onset of the studies: Belle Mina, pitted morningglory, 97 plants/plot; Shorter, sicklepod, 138 plants/plot.

Pendimethalin showed no interaction for the plant density counts in the sicklepod study at Shorter; therefore, treatments were combined in analysis (α=0.05). Treatments utilizing glyphosate alone at both the ½x and 1x rates had more sicklepod plants per plot than those where other herbicides were used in combination with glyphosate at the end of the 2000 growing season. The treatment that exhibited the fewest number of plants at the end of year one (5 plants/plot) included both pyrithiobac and fluometuron. At the beginning of year two, all plots showed a greater number of emerged sicklepod seedlings (76-267 plants/plot), with no significant differences between treatments. This increase in density is likely due to a relatively wet spring as compared to 2000, which stimulated the large seedbank. At the conclusion of the 2001 growing season, sicklepod densities ranged from 3-8 plants/plot with no significant differences between treatments. Seed cotton yield data exhibited a pendimethalin by year interaction, therefore, data were pooled accordingly due to absence of treatment effects. Pendimethalin resulted in higher yields in both 2000 and 2001, likely due to early-season annual grass suppression. Seed cotton yields ranged from 1423-3274 lb/A.

The effect of pendimethalin was significant in the pitted morningglory study at Belle Mina. Early season plant counts in 2000 revealed an increase in density when no pendimethalin was applied; being significantly higher for the glyphosate ½x rate treatments and one treatment that included pyrithiobac in the POT (4 leaf) application. When pendimethalin was not applied, those treatments utilizing the 1x rate of glyphosate and/or the ½x rate plus pyrithiobac and/or fluometuron PRE showed a decrease in plant densities. Mid-season evaluations for 2000 continued to exhibit the trend of glyphosate alone at the ½x rate without pendimethalin having significantly higher numbers of plants/plot. At the end of 2000, pitted morningglory counts ranged from 0-6 plants/plot, with pendimethalin plots having significantly fewer plants/plot, however, these low numbers may be of no practical significance. No differences were detected between plots at the beginning of 2001. However, early evaluations again showed an increase in plant populations where pendimethalin was not applied, excepting the fluometuron treatments, which showed no difference. When pendimethalin was not applied, the addition of fluometuron to the treatment reduced the number of plants/plot significantly compared to other treatments. At the conclusion of the 2001 growing season, those treatments with glyphosate alone at the ½x rate without pendimenthalin showed the highest numbers of plants/plot, with all other plots equal. Seed cotton yields at Belle Mina showed only a year main effect with 2001 yielding 61% higher than 2000,due to the much more favorable moisture conditions.

In summary, at the conclusion of two years of repeated glyphosate and glyphosate-mixed treatments, no differences in sicklepod plant numbers were detected. Pitted morningglory occurrence in glyphosate-only systems was higher, especially if the ½x rate was utilized. Long-term management strategies for pitted morningglory in glyphosate-resistant cotton might include the use of pendimethalin. Further studies into the effectiveness of pendimethalin applied PRE for pitted morningglory management would be critical for conservation tillage systems.