Factors Contributing to Cotton Injury from Soil-Applied Residual Herbicides

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RESEARCH PROBLEM

There is narrow selectivity in cotton with regards to soil-applied herbicides, meaning that rates needed for effective weed control can likewise cause cotton injury, especially when environmental conditions are less than optimal for cotton emergence and growth. The objective of this research was to determine the influence of seed size, vigor, and planting depth on cotton injury from soil-applied residual herbicides.

BACKGROUND INFORMATION

Extensive use of glyphosate has led to the evolution of glyphosate-resistant weed species, of which glyphosate-resistant Palmer amaranth is the most notable (Heap, 2012). Glyphosate-resistant Palmer amaranth is the most problematic weed cotton producers throughout the Midsouth are facing, with 87% of the cotton acreage in Arkansas infested with this resistant biotype (Norsworthy et al., 2012). Glyphosate resistance has prompted a return to the use of soil-applied residual herbicides. Most often, early-season cotton injury from soil-applied herbicides occurs under cool, moist conditions (Askew et al., 2002; Hayes et al., 1981). Conversely, other researchers have reported no or slight cotton injury with residual herbicides in other environments (Faircloth et al., 2001; Riar et al., 2011). For the soil types and production practices common to the Midsouth, little research has been conducted to determine the reasons for inconsistent cotton tolerance under different microenvironments. Therefore, an assessment of factors responsible for cotton injury caused by preemergence-applied residual herbicides is important.

RESEARCH DESCRIPTION

Field studies were conducted at the Arkansas Agricultural Research and Extension Center, Fayetteville, Ark. and at the Rohwer Research Station, Rohwer,

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Ark. in 2012 evaluating the influence of cotton seed size, planting depth, and seed vigor on cotton injury from various soil-applied herbicides (diuron, fomesafen, and fluometuron). In Fayetteville, seed sizes, ranging from 0.33 to 0.46 oz/100 seed were planted into Taloka silt loam soil. Treatments were applied immediately after planting and included a nontreated control, and diuron applied at 1 and 2 lb ai/acre. In Rohwer, low- and high-vigor cotton seed were planted at shallow and normal planting depths in early-April. Herbicide treatments were made immediately after planting and included diuron, fomesafen, and fluometuron at 1 and 2× rates. Experiments were irrigated regularly, and estimates of injury to cotton were visually rated at 1, 2, 3, and 4 weeks after treatment (WAT). All above-ground cotton biomass was collected, oven-dried, and weighed. In both experiments, data was subjected to analysis of variance (ANOVA) and means were separated using Fisher’s protected least significant difference test (LSD).

RESULTS AND DISCUSSION

Injury was significantly reduced when soil-applied herbicides were applied to high-vigor cotton plots. The ability of the high-vigor seeds to rapidly germinate, freeing the seedling from the herbicide zone and shortening the window of contact, enabled high-vigor seed to tolerate application more effectively than low-vigor seed (Fig. 1). Results from the planting depth study suggest variation among herbicide chemistries. Planting depth (either at 0.25 in or 1.0 in) did not affect injury in plots treated with fluometuron, although injury from diuron was 11% less when cotton was planted deeper. In contrast, fomesfen injury increased 15% in deep planting (Fig. 2). Seed sizes, ranging from 0.33 to 0.46 oz/100 seed, did affect cotton injury from diuron. The four larger seed sizes exhibited no statistical difference though there was a trend for decreased injury with increased seed size in both the 1× and 2× rates. Statistical differences were observed between the smallest seed size (0.33 oz/100 seed) and the largest (0.46 oz/100 seed). At 1× rates, injury was reduced by 13% by using larger seed. At 2× rates, injury was reduced 37% by using larger seed (Fig. 3). Larger seed possess a greater endosperm and can therefore better survive uptake of herbicides from the preemergence zone. In summary, cotton seed size, seed vigor, and planting depth influenced injury from soil-applied herbicides.

PRACTICAL APPLICATION

The objective of this research was to evaluate genetic and agronomic factors that potentially influence cotton tolerance to soil-applied residual herbicides. By selecting larger seed with high vigor and planting at depths best suited to individual herbicide chemistry, these soil-applied herbicides can be implemented to control problem weeds in cotton while minimizing potential injury.
ACKNOWLEDGMENTS

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LITERATURE CITED


Fig. 1. Injury at 6 weeks after treatment (WAT) of low- and high-vigor cotton when applied with different soil-applied herbicides.

Fig. 2. Injury at 6 weeks after treatment (WAT) from soil-applied herbicides to cotton at different planting depths.
Fig. 3. Injury at 30 days after treatment (DAT) from 1 and 2× rates of diuron applied to cotton of different seed sizes.