Factors Contributing to Cotton Injury from Soil-Applied Residual Herbicides

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RESEARCH PROBLEM

There is narrow selectivity in cotton with regard 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 mid-South 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 on under cool, moist conditions (Askew et al., 2002). 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 mid-South, 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 pre-emergence-applied residual herbicides is important.

RESEARCH DESCRIPTION

Field studies were conducted in Fayetteville and Rohwer, Ark. in 2012 and 2013 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 obtained from a red-germplasm variety provided by Fred Bourland of the Northeast Research and Extension Center in Keiser, Arkansas and planted 0.75 in 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 and Fayetteville, low- and high-vigor cotton seed was planted at 0.25 and 1.0 in depths in early-April. Low-vigor cotton seed was obtained by subjecting high-vigor seed to an accelerated seed coat aging test. 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 (LSD) method.

RESULTS AND DISCUSSION

Injury was significantly reduced when soil-applied herbicides were applied to high-vigor cotton plots. The ability of the high-vigor seed to rapidly germinate, freeing itself from the herbicide zone and shortening the window of contact, enabled high-vigor seed to tolerate application more effectively than low-vigor seed. Results from the planting depth study suggest variation among herbicide chemistries. In Fayetteville in 2012 and 2013, low-vigor seed planted deeper than 0.25 inch resulted in greater injury to cotton from fomesafen, diuron, and cotoran. In Rohwer in 2012, greater injury was observed on cotton planted at 1 inch depths that was treated with fomesafen (Fig. 1). In contrast, there was no statistical separation on injury observed from diuron and fluometuron though numeric trends suggest an opposite effect. In 2013, a statistically significant increase in injury was observed when low-vigor cotton planted at 1.0 inch depths was treated with 2× rates compared to normal labeled rates. Additionally, low-vigor seed applied with a 2× rate of diuron exhibited greater injury when planted at deeper depths (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). An exponential decrease in injury was observed as seed size increased (Fig. 3). Larger seed possesses 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.

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LITERATURE CITED


Fig. 1. Cotton injury at 22 days after treatment from soil-applied herbicides at different planting depths in Rohwer, Ark. in 2012.

Note: Cotoran = fluometuron; Direx = diuron; Reflex = fomesafen.
Fig. 2. Injury at 22 days after treatment (DAT) caused by two rates of pre-emergence herbicides applied to cotton planted at 0.25 and 1.0 inch depths at Rohwer, Ark. in 2013.

Note: Cotoran = fluometuron; Direx = diuron; Reflex = fomesafen.
Fig. 3. Injury at 18 days after treatment for various seed sizes within a seed lot in Fayetteville, Ark.