BELTWIDE EVALUATION OF THE EFFECT OF 2,4-D DRIFT ON COTTON

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Abstract

The upcoming release of Enlist™ (Dow AgroSciences, Indianapolis, IN) and Xtend™ (Monsanto Company, St. Louis, MO) cotton has increased concerns over the effect of off-target movement and misapplication of 2,4-D and dicamba, respectively on cotton without resistance to these herbicides. Adoption of these new technologies won't immediately be 100%, creating an interface between Enlist™ and Xtend™ cotton cultivars and cultivars without

auxinic herbicide resistance. Cotton is known to be one of the most sensitive crops to 2,4-D (Farwell et al., 1976), and previous research has documented that exposure to 2,4-D results in detrimental effects on the growth, fruiting development, and yield of cotton (McIlrath et al., 1951; Everitt and Keeling, 2009; Johnson et al., 2012). However, past studies have shown that the growth stage of cotton at the time of exposure has an effect on the magnitude of yield loss, with cotton exposed prior to bloom resulting in the most severe yield loss compared to exposure during later growth stages (Egan et al., 2014). In the current study, evaluations of cotton exposed to 2,4-D at various growth stages were conducted at 12 locations across the cotton belt during 2013 and 2014. Locations included Lewiston, NC (2014), Moultire, GA (2013), New Deal, TX (2013 & 2014), Portageville, MO (2014), Quincy, FL (2014), Snook, TX (2013 & 2014), Starkville, MS (2013 & 2014), and Tifton, GA (2013 & 2014). Two sub-lethal rates of 2,4-D, representing a physical drift scenario (1/421 of the full rate) and a tank contamination scenario (1/21 of the full rate), were applied to PhytoGen 499 WRF, the cultivar utilized at all study locations. Applications were made at six different growth stages; four leaf (4-lf), 9 leaf (9-lf), first bloom (FB) and FB+2wk, FB+4wk, and FB+6wk. Visual injury evaluations of epinatsy, on a scale of 0 (no injury) to 100% (plant death), were conducted at eight of the locations. Plant mapping was performed at 11 locations to determine the total number of bolls (a measure of reproductive development) and percent open bolls (a measure of crop maturity) on a per plant basis at the end of the season. Seedcotton yield at all locations was quantified at harvest. Means for visual injury ratings, plant mapping, and seedcotton yield results were separated by Fisher's Protected LSD at $p \leq 0.05$ using SAS 9.4 software (SAS Institute Inc., Cary, NC).

Locations were grouped according to the severity of yield loss compared to non-treated cotton, resulting in three groups each containing four locations. Group I consisted of locations in which mild yield loss ($\leq$ 15%) occurred and included the New Deal, TX 2013 & 2014, Snook, TX 2013, and Starkville, MS 2014 locations. Group II consisted of locations which experienced a moderate yield loss (16 to 25%) and included the Quincy, FL, Snook, TX (2014), and Tifton, GA 2013 & 2014 locations. Group III consisted of locations that experienced the most severe yield loss (26 to 40%) and included the Lewiston, NC, Moultrie, GA, Portageville, MO, and Starkville, MS 2013 locations.

Visual injury ratings showed a similar pattern across all three groups, with maximum injury levels across both 2,4-D rates being greater in treatments that applied 2,4-D in the 4-lf and 9-lf growth stages (45 – 83% injury) than those observed when 2,4-D was applied at the FB stage and later (0 to 45% injury). Plant mapping results showed the drift rate of 2,4-D reduced the total number of bolls per plant, compared to non-treated cotton, when applied at the FB stage in Group III only. The contamination rate resulted in a reduction in total bolls per plant at the 9-lf, FB, and FB+2wk stages across all three groups. The effect of 2,4-D on percent open bolls was observed in early growth stages (4-lf and 9-lf) across all three groups, with only the FB stage in Group II showing any effect later than the 9-lf stage. The contamination rate of 2,4-D resulted in significant yield loss when applied at the 4-lf, 9-lf, FB, and FB+2wk growth stages across all three groups. Additionally, the contamination rate resulted in yield loss at the FB+4wk growth stage in Groups II and III, while the drift rate resulted in yield loss at the FB stage in Group II and at the 4-lf, 9-lf, FB, and FB+2wk stages in Group III.

Across all three groups, the tank contamination rate was responsible for the majority (75%) of instances in which significant yield loss occurred. When significant, the drift rate of 2,4-D resulted in a yield loss ranging from 19 – 40% compared to non-treated yield. The contamination rate resulted in a yield loss ranging from 16 – 81% compared to non-treated yield. The greatest magnitude of yield loss occurred when 2,4-D was applied at FB, followed by applications at FB+2 wk and 9-lf. Visual injury symptoms did not reflect the severity of yield loss resulting from 2,4-D applications near FB due to the lack of vegetative injury symptoms present. However, cavitation of bolls resulting from 2,4-D applications beginning at FB was a symptom present across all three groups, and likely led to the reduction in the number of bolls that was quantified by plant mapping, particularly when a significant yield loss occurred. In conclusion, this study suggests that 2,4-D would have the most severe effect on yield when cotton is exposed during growth stages near FB, primarily due to a reduction in the amount of bolls produced by plants exposed to 2,4-D during these stages.

References

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