REDUCING AT-PLANTING COSTS IN COTTON PRODUCTION THROUGH HILL-DROPPED SEED PLACEMENT AND PRECISION APPLICATION OF IN-FURROW INSECTICIDES

Guy Collins
Keith Edmisten
Jack Bacheler
Dan Mott
Seth Levkoff
Wesley Hancock
James Lanier
Ranjit Riar
Seth Holt
Bill Foote
James Atkins
Luke O'Neal
North Carolina State University
Raleigh, NC

Abstract

Seed costs have drastically increased due to the release of modern gene technologies, causing some growers to become more interested in hill-dropped planting systems. As opposed to planting cottonseed in an equidistant fashion, hill-dropping involves planting multiple seed in a single location, or hill, with a defined space between hills. Hill-dropping techniques were originally implemented to improve seedling emergence in surface-compacted soils, however preliminary data in North Carolina has also shown that lint yield can be maintained while reducing plant populations through hill-dropped systems. Temik 15G is a common granular in-furrow insecticide commonly used at planting to control thrips. If used in hill-dropped systems, it is reasonable to assume that Temik applied in-furrow between seed hills may not be necessary. Lohmeyer et al. (2002) and Van Duyn et al. (2002) found that neither thrips control nor yield was compromised by precision application of in-furrow insecticides. Therefore, the application of Temik directly and exclusively to seed hills could present additional at-planting cost savings and could potentially have positive environmental impacts, however the optimal length of the insecticide band surrounding seed hills, and cost/efficacy comparisons with modern seed treatments, has yet to be determined. These questions warrant the investigation of these parameters through field experiments.

Experiments were conducted at an on-farm location in Duplin County, NC, during 2007 and 2008, and at Central Crops Research Station near Clayton, NC, during 2008. Deltapine 455 BG/RR cottonseed was planted on 38-inch rows in a hill-dropped system consisting of 3 seeds per hill, and hills spaced 16 inches apart. Five pounds of seed was selected from the same bag and was treated with Avicta Complete Pac seed treatment. Treatments, were evaluated using a randomized complete block design, and included a factorial arrangement of two Temik rates (3.3 and 6.6 lbs/A) and three band lengths (solid band, 3-inch band, and 6-inch band). The two Temik rates are common field-use rates in solid bands, and these rates were adjusted for the 3- and 6-inch bands to match these application rates on an equivalent per-unit-area basis. The 3-inch band involved the application of Temik exclusively to the average area occupied by a seed hill, and the 6-inch band to twice the average area of a seed hill. Welding rods, shortened to the appropriate band lengths (3 or 6 inches), were used as guides so that the lengths of Temik bands were implemented consistently. Additional treatments included Avicta Complete Pac seed treatment, with and without a subsequent foliar application of Orthene 97 at 0.25 lbs/A at three weeks after planting (WAP), a single application of Orthene 97 at 0.25 lbs/A 3WAP with no prior insecticide, and a non-treated control. Band application of Temik was conducted using small plastic spoons, modified by flame melting, to consistently deliver the appropriate rate to the designated band length or area. Furrows of all treatments were left open until all band treatments were applied, to avoid confounding effects of immediate seed burial of some treatments, therefore furrows of all treatments were subsequently and simultaneously covered with the press wheel of a push planter upon completion. Foliar treatments of Orthene 97 were applied using a CO_2-propelled backpack sprayer, equipped with a single hollow-cone nozzle, calibrated to deliver 10 GPA. Collection of live thrips at 3, 4, and 5 WAP, was conducted by cutting five randomly-selected plants per plot at the soil surface, which were immediately placed into jars containing a liquid soap and water solution. These plants were subsequently washed thoroughly through a 270-mesh sieve with 53µm/0.0021-inch openings, and thrips were then washed into small vials containing 70% alcohol solution. Plants were air-dried and weighed one week later. A microscope and a clear plastic tray, marked with

0.25-inch squares, were used to count thrips in each treatment sample. Data were subjected to ANOVA and means were separated using Fisher's Protected LSD at $p \leq 0.05$. The treatments included in the factorial arrangement were analyzed separately from the additional treatments, and means are reported as a percent of the non-treated control, to account for relativity to a "no insecticide" control. Parameters that did not exhibit a Temik rate x band length interaction in the factorial analysis, are reported using regular mean separation procedures comparing both Temik rates applied in a solid band (standard grower methods) and the additional treatments.

Thrips numbers of both Temik rates increased similarly from 3 to 5 WAP. Band length had no effect on thrips numbers at 3 or 5 WAP; however the 3-inch band of Temik had 61% more thrips than the solid band at 4 WAP. Band length also had no effect on plant dry weight at 3 and 4 WAP, however at 5 WAP; plants grown in a 3-inch band weighed 22% less than those grown in the solid band of Temik. Temik rate had no effect on plant dry weight at 3 or 4 WAP; however the 3.3 lbs/A rate resulted in 18% less dry weight compared to solid band at 5 WAP in Duplin County, 2007. Unexpectedly, the 6.6 lbs/A resulted in 13% more nematodes; however band length had no effect on nematode numbers. Neither band length nor Temik rate had any effect on lint yield, nodes above white flower; percent open bolls, plant height, total nodes, and total bolls. There was no Temik rate x band length interaction for any parameter, therefore comparisons between the two standard methods (3.3 and 6.6 lbs/A Temik applied in solid bands) and the additional treatments could be observed. Plant dry weight at 3 WAP was least for the Orthene alone treatment and the non-treated control compared to either Temik rate and seed treatments at all locations, however at Duplin County and Clayton in 2008, Temik applied at 3.3 lbs/A resulted in 10% less dry weight when compared to Avicta + Orthene. At Duplin County and Clayton in 2008, thrips numbers at 5 WAP were greatest for Avicta alone and the non-treated control. At these same locations, thrips numbers at 5 WAP for Orthene alone was 41% greater than when Temik was applied at 6.6 lbs/A. At Duplin County in 2007, thrips numbers at 5 WAP were greatest for the non-treated control, followed by Avicta alone. Temik applied at 6.6 lbs/A had 50% less thrips than Orthene alone, but was no different than the 3.3 lbs/A rate or Avicta + Orthene. At Duplin County in both years, plant dry weight at 5 WAP was greatest for the 6.6 lbs/A rate of Temik and Avicta + Orthene, followed by Avicta alone, then Orthene alone, and lastly, the non-treated control. Dry weight at these locations was no different between the 3.3 lbs/A of Temik and Avicta alone. At Clayton in 2008, plant dry weight was greatest for Temik applied at 6.6 lbs/A but was no different than the 3.3 lbs/A rate, Avicta alone, or Avicta + Orthene, but was 37% greater than the dry weight of Orthene alone. Dry weight was significantly least for the non-treated control at this location as well. No treatment had any effect on plant height at Duplin County or Clayton in 2008, however at Duplin County in 2007, plant height was greatest for Temik applied at 6.6 lbs/A and Avicta + Orthene, followed by Avicta alone and Orthene alone, and lastly the non-treated control. At this location, plant height of Avicta alone and Orthene alone was similar to 3.3 lbs/A of Temik, as was the 6.6 lbs/A rate and Avicta + Orthene, however plant height of Avicta alone and Orthene alone was less than that of 6.6 lbs/A of Temik and Avicta + Orthene. Total nodes, total bolls, and nematode numbers were similar among all treatments at all locations. Nodes above white flower was greatest for the non-treated control, followed by Orthene alone, and lastly the 6.6 lbs/A rate of Temik and Avicta + Orthene, at all locations. Nodes above white flower values for Temik applied at 3.3 lbs/A and Avicta alone were not different from any treatment except for the non-treated control. All treatments resulted in significantly greater percent open bolls than the non-treated control across locations. Lint yield of the non-treated control was significantly less than all other treatments across locations. Both Temik rates, Avicta alone, and Avicta + Orthene yielded similarly, however the Orthene alone treatment only yielded significantly less than Avicta alone and Avicta + Orthene.

Analysis of the additional treatments suggests that Avicta seed treatment is similarly effective in controlling thrips when compared to the standard rates of Temik. however some data suggests that a subsequent application of Orthene may be appropriate in some instances. Results from the analysis of the factorial treatments show that optimal lint yield and maturity characteristics can be maintained with precision application of Temik in hill-dropped planting systems, thus significantly reducing at-planting costs and improving profitability. Some data, regarding early-season growth parameters and thrips numbers, suggests that the higher rate of Temik and/or the 6-inch band should be used in some circumstances; however these effects were not necessarily realized in the end-season growth parameters or lint yield. Implications of significant costs savings from this experiment warrant the development of affordable technology, capable of precision application of in-furrow insecticides. Future research efforts should focus on favorable environmental impacts and validation of these results by conducting similar experiments involving earlier planting dates or in more environments, to further encourage the development of such technology.

References

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