AN INTERSEEDING SYSTEM FOR COTTON PRODUCTION TO REDUCE PEST OCCURRENCE AND ENERGY CONSUMPTION

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Abstract

Cotton growers in the southern USA are facing new and existing production problems that are reducing farm profits and sustainability: 1) herbicide-resistant weeds are spreading throughout the Southeast, 2) thrips are consistently ranked as an important insect pest group Beltwide, 3) the most effective tool for managing nematodes and thrips (Temik 15G) is no longer available, and 4) fuel costs have increased significantly over the last ten years. An interseeding system developed at Clemson University allows planting of cotton into standing wheat, about 2-3 weeks before wheat harvest. This system, which combines benefits of crop residue and minimum tillage operations, has the potential to alleviate many of the production problems cited above, while enhancing farm profits and soil properties. Crop residue associated with the interseeding production system reduced weed populations and required significantly less herbicide inputs compared with the conventional system. Columbia lance nematodes populations were reduced in the interseeding system by 83% without an application of nematicide. Populations of thrips were reduced by 74% in the interseeding production system. Interseeded cotton yields were similar to those from the conventional full-season crop. In addition, interseeded systems required 35% less fuel than conventional production systems.

Introduction

Cotton is currently a profitable crop for southern farmers. Growers in this region are facing new and existing production problems that are either reducing farm profits and sustainability or threatening soil conservation practices: a) herbicide-resistant weeds are spreading throughout the Southeast, therefore, soil-applied residual herbicides have become the most adopted method to manage herbicide-resistant weeds (such as Palmer amaranth). An aggressive soil and foliar herbicide program can cost up to $50/acre; however, hand-weeding, cultivation, and crop abandonment will cost growers over $900/acre in lost revenue and increased production costs; b) thrips are consistently ranked as an important insect pest group Beltwide. During 2008-2010, cotton producers across the USA lost over $100 million to thrips (Williams, 2011). With at-plant preventative treatments and foliar applications combined, control costs during the same period were in the tens of millions of dollars as well; c) the most effective tool for managing nematodes and thrips (aldicarb -- Temik 15G) is no longer available. In addition, currently there is a shortage of Telone II nematicide in the USA; d) the cost of fuel represents over 30% of the total costs of owning and operating farm tractors. This portion has increased significantly over the last ten years and will increase further as the price of fuel rises in the future. It is important that every effort be made to reduce energy use in agricultural production from both standpoints of economics and availability.

An interseeding or relay intercropping system developed at Clemson University (Khalilian et al, 1991; Hood et al, 1992) allows planting of cotton into standing wheat, about 2-3 weeks before wheat harvest. This conservation technology, which combines cover crops and minimum tillage operations, has the potential to address most, if not all, of the production problems cited above, while enhancing soil chemical, physical, and/or biological properties. The interseeding system uses control-traffic production schemes, a deep-tillage operation prior to planting wheat in the fall, and a planter unit that covers a typical combine head width. All field operations, including planting, fertilizing, and applying pesticides, utilize the same wheel-traffic lanes to prevent compaction in the plant-growth zones. This eliminates the need for a second deep-tillage operation before planting cotton, a requirement in Coastal Plain soils for optimizing crop yields. The objectives of this study were to determine the effects of the interseeding system on pest management, soil properties, fuel consumption, and crop responses in cotton production.

Materials and Methods

Tests were conducted as a randomized complete block design during 2013 and 2014 at the Edisto Research and

Education Center, near Blackville, SC, on a Varina loamy sand soil, a typical productive soil in the Southeastern Coastal Plain. Interseeding involves planting skip-row wheat. This was done by blocking every fifth seed tube on a grain drill which resulted in 15-inch skips (38 inches apart) for interseeding cotton (Figure 1-A). The drill was adjusted to maintain the same seeding rate (lb/acre) as conventional solid wheat. Wheat was planted in the fall following a deep tillage operation with a Worksaver Terra-Max subsoiler. Cotton was interseeded into standing wheat around mid-May using a 4-row modified John Deere (JD) 1700 vacuum planter. The conventional wide planting units on this planter were replaced with four units of JD narrow row planters (Figure 1-B). This system perfectly fit in narrow skips between wheat rows. Conventional full season cotton was also planted in mid-May with a strip-till system following a deep tillage operation. Wheat was harvested during the first week in June (about 3 weeks after cotton was interseeded) using a conventional grain combine (Figure 1- C & D).

Figure 1. Skip-row wheat (A), interseeding cotton (B), emerged cotton shortly before wheat harvest (C), and following wheat harvest (D).

The cotton cultivar Delta-Pine 1050 was planted at approximately 3-4 seeds/ft in the conventional and interseeded plots. Fertilizer was applied at recommended rates based on soil analyses. Interseeded and conventional plots were divided into two 8-row subplots with one 8-row untreated (no herbicides) and the other treated (herbicide program). Postemergence herbicides were applied to the treated plots as needed according to the weed spectrum observed in the field. Weed biomass was collected using a 0.45 m^2 quadrat during and at the end of the season in both untreated and treated plots to quantify effect of residue on weed populations. Cotton was harvested in October using a spindle picker equipped with an AgLeader yield monitor and a GPS unit to map changes in lint yield within and among treatments.

Results and Discussion

The John Deere narrow-row planting units worked well between the rows of wheat for planting cotton. Small beds generated during wheat planting provided an excellent non-compacted zone for the subsequent interseeding operation. Soil compaction (cone index) values from the interseeded cotton rows eight months after tillage (in the fall) were not significantly higher than those obtained two months after strip-tillage operation from conventional full-season cotton rows. This indicated that one tillage operation in the fall, deep enough to disrupt root inhabiting hardpans, in conjunction with controlled traffic could eliminate the need for an additional deep tillage in the spring for cotton in

Coastal Plain soils. This could result in a savings of $8-10 per acre. The residual effect of deep tillage operations will extend for one additional year when interseeding is practiced. The interseeded systems required 35% less fuel than conventional production systems.

In both years, wheat yields were not affected by row spacing or interseeding. The seeding rate per acre was equivalent for conventional and skip-row wheat. There was no significant difference in yield between cotton interseeded into standing wheat three weeks before harvest (Figure 2) and conventional full-season cotton. However, revenues from the interseeding systems were higher due to harvest of the wheat crop (60 Bu/acre). Therefore, interseeding will allow growers to capitalize on the economic advantages of two crops per year on the same land.

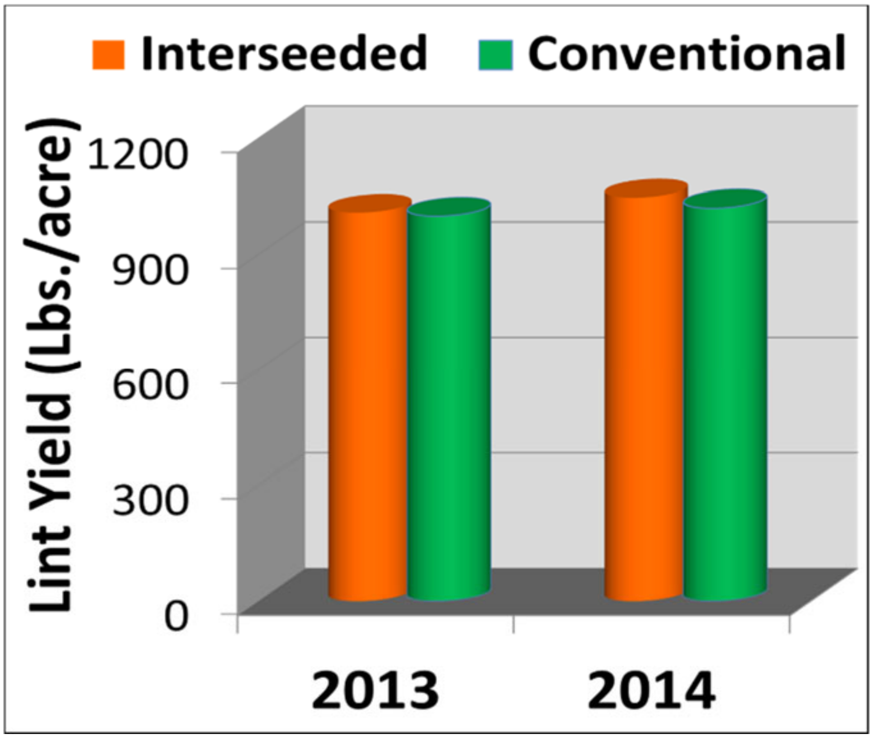

Figure 2. Cotton lint yields (2013 - 2014).

Crop residue associated with the interseeding production system reduced weed biomass (Fig. 3) and required significantly less herbicide inputs compared with the conventional system. *Palmer amaranth*, yellow nutsedge, and annual grass biomass was reduced 91, 41, and 98%, respectively, in the interseeding untreated plots compared to the untreated conventional plots. In the interseeded herbicide treated plots, reductions in *Palmer amaranth* and annual grass biomass were 100 and 93%, respectively. There was no yellow nutsedge observed in the interseeded or full season cotton in treated plots.

Table 1. Effects of cropping method on soil OM, available K, Columbia lance, and thrips (2014).
** Values in a row with the same letter are not significantly different.

	Interseeded	**Conventional**	**% Change**
%Organic Matter (OM)	1.25 **	0.80 b	56%
Available K (lbs./acre)	108 a	81 b	33%
Nematode /100 cc soil	14 b	80 a	-83%
Thrips / 10 plants	3.8 b	14.6 a	-74%
Fuel requirements (gallon/acre)	6.0 b	9.2 a	-35%

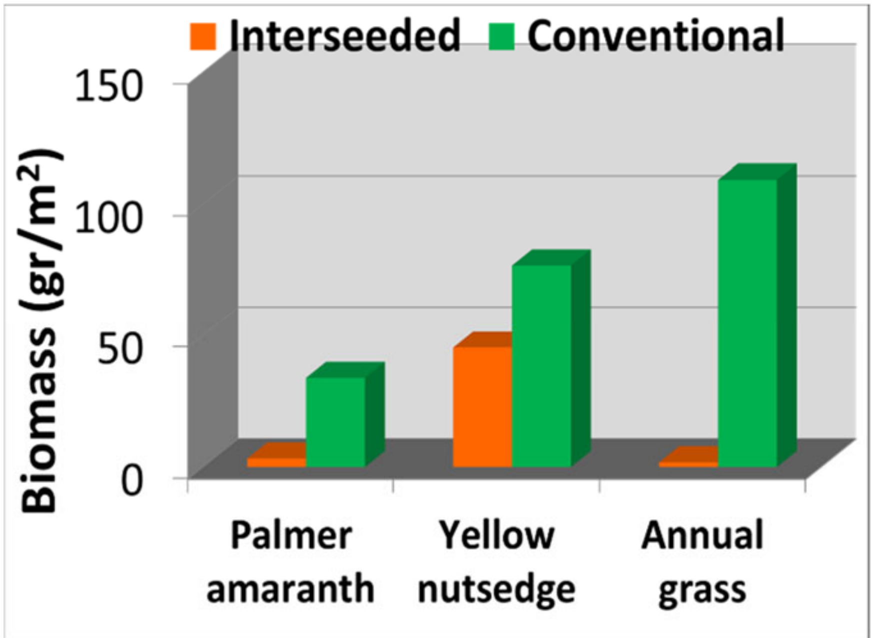

Figure 3. Weed biomass as affected by cropping practice (2014).

Thrips were not a problem in interseeded cotton. Thrips populations were reduced by 74% in the interseeding production system (Table 1). Small grain crops are good hosts or trap crops for southern root-knot and Columbia lance nematodes. The interseeding system helped to reduce population densities of Columbia lance nematodes by 35% in 2013 and by 83% in 2014 without a nematicide application (Table 1). Interseeding production positively impacted soil properties by increasing organic matter content and available K by 56 and 33%, respectively (Table 1).

Summary

Cotton was successfully interseeded into standing wheat with yields comparable to those of the conventional full-season cotton. The crop residue associated with the interseeding production system reduced weed densities, and required significantly less herbicide inputs in the interseeding production system compared with the conventional system. Populations of Columbia lance nematodes were reduced in the interseeding system by 83% without a nematicide application. Populations of thrips were reduced by 74% in the interseeding production system. In addition, interseeded systems required 35% less fuel than conventional production systems.

Acknowledgments

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References

Hood, C.E., A. Khalilian, T.H. Garner and J.H. Palmer. 1992. Improved interseeding methods and equipment. ASAE Paper No. 92-1595, ASAE St. Joseph MI.

Khalilian, A., C.E. Hood, J.H. Palmer, T.H. Garner, and G.R. Bathke. 1991. Soil compaction and crop response to wheat/soybean interseeding. Transactions of the ASAE 34(6): 2299-2303.

Williams, M.R. 2011. Cotton insect losses - 2010. In Proceedings of the Beltwide Cotton Conferences, National Cotton Council of America, Memphis, TN.