MECHANICAL WEED CONTROL FOR COTTON

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Abstract

Weed competition with cotton, particularly early season competition, can severely reduce cotton lint yield. Many studies have investigated various levels of herbicide inputs and cultivation for weed control in cotton. In general, both herbicide use and cultivation reduce cotton yield losses caused by weed competition but none of the studies obtained acceptable control with cultivation alone. Poor weed control in the seed row is the major shortcoming of mechanical weed control. Many growers achieve some in-row weed control by covering small weeds with soil but this technique is limited by the size of the cotton.

Before effective cotton herbicides became available, growers relied on meticulous cultivations and hand hoeing for weed control. Torsion weeders and spring-hoe weeders were employed on some cultivators to mechanically remove weed seedlings from within the seed row in larger cotton. These devices are sets of spring steel rods which compress and crumble the soil around the base of cotton plants in such a way that small weed seedlings are uprooted. Although effective, the in-row weeders demand careful attention from tractor drivers and slow travel speeds to minimize crop damage. These disadvantages combined with a shrinking agricultural labor pool and the introduction of preemergence herbicides for cotton in the 1960's resulted in the virtual abandonment of mechanical in-row weeding techniques.

The development of precision guidance systems for farm implements has removed many of the impediments to using in-row weeding techniques. The two basic types of guidance systems are mechanical and electro-hydraulic. Mechanical guidance systems generally use cone guide wheels which follow the shoulders of the beds and steer the implement. This type of guidance system has limitations and requires well formed beds and precise alignment of the seed row on the bed. These requirements are not met in many Arizona, plant to moisture cotton production systems.

Electro-hydraulic guidance systems actively steer the tractor or implement using a sensing device to detect a furrow or crop row. The sensing device sends electrical signals which actuate a hydraulic steering system. There are four general types of these systems. Tractor steering systems generally have their sensing unit attached to the front of the tractor and actuate the tractor steering system. Tractor steer systems do not eliminate the problem of implement "tailout" which limits how close steel can be placed to the crop row. "Tailout" refers to a tractor-implement geometry characteristic which causes the implement on the rear of the tractor to move laterally with respect to the crop row in the opposite direct that the front of the tractor is steered. Disk-steer guidance systems typically have a frame mounted on the rear of the implement to which one or more steering disks are attached. The signal from a sensing device on the implement turns the steering disks which act like rudders, generating side forces that laterally shift the implement. Disk steer systems work well and eliminate the problem of implement tailout but are cumbersome and are difficult to move from implement to implement. Side-shift guidance systems move the implement laterally with respect to the tractor (and crop row) in response to a sensing system mounted on the implement. Side-shift guidance systems have problems moving cultivators laterally with respect to the crop row because cultivators with a lot of steel in the ground have a large amount of lateral stability as they are pulled through the soil. Most side-shift and articulated guidance systems are packaged in a quick-attach hitch configuration. Articulated guidance systems, like side-shift systems, also move the implement relative to the tractor, but rather than shifting laterally, the implement pivots about a king pin, which is a part of the hitch mechanism. As the implement pivots, resistance on the soil engaging tools increases, which in turn causes the implement to move sideways. Because of the convenience of the quick-hitch configuration and the superior steering capability of articulated guidance systems, we used articulated guidance systems, either a Buffalo Scout or a Sunco Acura-Trak, in our research and demonstration experiments. The Acura-Trak is a unique system which does not have a king pin and articulates by moving the lower hitch pin positions on the tractor side of the quick hitch.

The recent development of Staple herbicide and transgenic cotton varieties that can be sprayed with Buctril or Roundup Ultra now allow growers to chemically control weeds in the cotton seed row. These herbicides complement the use cultivation with in-row weeders by giving growers the means to control weeds in the cotton seed row early in the season when the cotton is not large enough (i.e., generally less than 8 inches tall) to allow the use of in-row weeders. Electro-hydraulic guidance systems facilitate the use of in-row weeders by keeping the cultivator precisely aligned on the seed row and also allow close cultivation without crop damage early in the season, thereby reducing the amount of herbicide used (i.e., by reducing the width of the spray band). Additional benefits of the guidance systems are reduced operator fatigue and higher operating speeds.

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Since combining these new herbicide technologies and precision guidance systems appeared to hold promise, a research and demonstration project was initiated to examine the integrated use of precision guided cultivation and the new chemical technologies. The objectives were to: (1) improve weed control by cultivating close to the row and within the row; (2) obtain effective early season in-row weed control with narrow band applications of Staple, Buctril and Roundup Ultra sprayed on the appropriate cotton varieties; (3) reduce hand weeding costs; and (4) increase yields by reducing weed competition.

Replicated research trial were conducted at the University of Arizona Maricopa Agricultural Center and replicated research/demonstration experiments were conducted in grower's fields that contained substantial annual morningglory infestations. Plots were 6 rows wide by the length of the irrigation run and treatments were replicated three times in a randomized complete block design. The demonstrations included three herbicide treatments; Roundup Ultra sprayed on Delta, Pine and Land (DPL) Company variety 5415RR, Staple herbicide sprayed on the growers choice of variety (e.g., DPL5461 and DPL90B), and Buctril sprayed on Stoneville BXN 47. All demonstration treatments were cultivated with an articulated guidance system. Dry planted fields were sprayed over-the-top with the three herbicides at the 1 to 2 leaf growth stage of cotton and were sprayed post-directed a second time when the cotton was at the 6 inch growth stage. The wet planted field were treated once with post-directed herbicide sprays after the first post-planting irrigation when the morningglory was at the two true leaf growth stage and the cotton was about 6 inches tall. These fields (and many others) were then cultivated with in-row weeding tools and an articulated guidance system in a series of demonstrations across the state.

In general, the demonstrations were well attended by growers who were impressed by how close steel could be placed to the crop row (within 1.5 inches), at the tractor speeds (5 to 6 mph) that were attained, and at the ability of the guidance system to keep the cultivator precisely aligned on the seed row as the tractor slalomed through the field in the demonstrations. In both the research experiments and demonstration experiments, the combination of the early season herbicide sprays and precision guided cultivation with in-row weeding tools made hand weeding of fields unneccessary by nearly eliminating annual morningglory from the fields. In addition to the substantial saving associated with the elimination of hand weeding costs, the greater tractor speeds attained with precision guidance also increased productivity and reduced cultivation costs.