COMMERCIAL SCALE RESEARCH EVALUATIONS OF ROUNDUP READY® COTTON, CROP TOLERANCE AND WEED MANAGEMENT SYSTEMS

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Abstract

Replicated large scale commercial size plots were established at seven locations in Arkansas and West Tennessee to evaluate the effects of Roundup Ultra® herbicide on Roundup Ready® cotton varieties. The objectives of these studies were to compare fruiting characteristics, yield, and weed management costs of three weed management systems: 1. Conventional herbicide program (CON), 2. Roundup Ultra overtop prior to the four leaf stage followed by conventional herbicides post directed (RUP fb CON) and 3. Roundup Ultra overtop prior to the four leaf stage followed by Roundup Ultra post directed (RUP fb RUP). Fewer first position harvestable bolls and greater first position abnormal bolls were detected at sympodia 8 for the RUP fb RUP system, however, consistent treatment differences failed to develop on subsequent fruiting positions. Compensation occurred on both first and second positions above sympodia 8. The average herbicide costs for the conventional system were $10.34 and $9.52 per acre greater than the RUP fb CON and the RUP fb RUP, respectively. The RUP fb RUP system yielded 121.1 and 54.5 pounds more lint per acre than the CON and RUP fb CON systems, respectively. Reduced input costs and greater yields in the RUP fb RUP systems resulted in higher net returns of $23.99 and 75.71 per acre more than the RUP fb CON and CON systems, respectively.

Materials and Methods

During the 2000 season, cotton herbicide system comparisons were conducted at five locations in Arkansas and two in West Tennessee. Soil types ranged from sandy loam to heavy clay loams. Four of the seven locations were irrigated and four of the seven locations were under minimum or no-till production. Irrigation and minimum tillage practices were not inclusive among locations. All locations were planted to either Delta and Pineland 451BR, Paymaster 1218BR, or Stoneville 4892BR Bollgard with Roundup Ready cotton varieties. The herbicide systems consisted of a conventional herbicide program (CON) where no Roundup Ultra was applied, Roundup Ultra applied overtop followed by conventional herbicides post-directed (RUP fb CON), and Roundup Ultra applied overtop and post-directed (RUP fb RUP). At planting residual herbicides e.g. fluometuron and pendimethalin were recommended in the conventional herbicide system but were optional in both herbicide systems, which received Roundup Ultra in crop.

The overtop conventional herbicides utilized in these studies were either Select® (clethodim) @ 0.13 to 0.19 lbs. ai./A broadcast and/or Staple® (pyrithiobac) @ 0.063 lbs ai./A broadcast or equivalent on a 10 or 18 inch band. Preemergence and post-directed conventional herbicides varied by location but included Bladex®4L (cyanazine) @ 0.75 lbs ai./A, Bueno® 6 (MSMA) @ 0.75 to 1.5 lbs. ai./A, Caporal®4L (prometryn) @ 0.25 to 0.65 lbs. ai./A, Cobra® 2EC (lactofen) @ 0.05 to 0.09 lbs. ai./A, Cotoran®4L @ 0.75 to 1.5 lbs. ai/A, Direx® 4L (diuron) @ 0.5 to 1.0 lbs. ai./A, Dual II Magnum® (*S*-metolachlor) @ 0.5 lbs. ai./A, and Prowl® 3.3EC (pendimethalin) @ 0.62 to 0.83 lbs. ai./A.

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For systems in which Roundup Ultra was applied, all locations received a single overtop application of Roundup Ultra @ 0.75 lbs ae./A while these systems at three locations received a second overtop application of Roundup Ultra @ 0.5 to 0.75 lbs. ae./A. The post directed Roundup Ultra system received 1 to 2 applications @ 0.75 lbs ae/A at all locations. A tank mix of Roundup Ultra + Direx was utilized at all locations as the final application in the RUP fb RUP system.

The herbicide systems were replicated 2 to 4 times and randomized as strips (ranged in length from 500 to 1800 ft.) through the field at each location. Since growers equipment varied considerably, the width of the strips ranged from 8 to 72 rows. This was necessary because planters, sprayers, and post direct equipment needed to match configurations. The strips were mechanically harvested and weighed independently. Seed cotton yields were converted to lint yields based on gin turnout data.

Final plant mapping data were collected from each location. Ten plants per strip (five consecutive plants from two random locations) were mapped for the number of abnormal and harvestable bolls in first, second, and third positions. Criteria for discriminating abnormal from normal bolls was very conservative. A boll was considered abnormal if it was roughly 15-20% smaller than other bolls of the same position, lacked perfect bi-lateral symmetry, or possessed a 'pinched' apex. Plant mapping, yield and economic data were analyzed with PROC MIXED (SAS Institute 1994). Location and replicates were treated as random effects for the evaluation of both yield and economic analyses. Location, replicates, and plant number (sub-sample) were treated as random effects when analyzing plant mapping data.

Net returns were calculated by subtracting the input costs associated with the Bollgard with Roundup Ready technology fee based on seed drop rate, land preparation (Table 1), herbicides (average retail price), and application from gross returns. Land preparation costs included any burndown herbicide plus their application. Gross returns were calculated based on yield with cotton valued at $0.65 per pound.

Results

Differences in yield were detected among the three herbicide systems when data were pooled across locations (Figure 1). The RUP fb RUP system yielded 54.5 and 121.1 pounds more lint than the RUP fb CON and the CON systems, respectively. Yield data were partitioned into minimum and conventional tillage among the three herbicide systems. Yield differences were detected for the herbicide system by tillage interaction (Figure 2). Lint yields increased in order of the CON, RUP fb CON, and the RUP fb RUP system when under minimum tillage. This trend was not observed among these treatments under conventional tillage.

Differences among the herbicide systems for percent first position harvestable bolls were detected for sympodia 8, 12, and 16 when data were pooled across locations (Figure 3). The RUP fb RUP system had 12.3% less first position harvestable bolls compared to the RUP fb CON system on sympodia 8. No differences were observed between the RUP fb RUP and CON systems on sympodia 8. These differences were not consistent for sympodia 12 and 16. Percent second position harvestable bolls were different for sympodia 10, 13, and 14 with data averaged across locations (Figure 4). The RUP fb RUP system possessed numerically and/or significantly higher percent second position harvestable bolls when compared to the other herbicide systems for most sympodia. The RUP fb CON system possessed the fewest second position bolls among these sympodia but was not significantly different than the CON system. No significant differences were detected among herbicide treatments for third position bolls.

A difference in the percentage of first position abnormal bolls were detected on sympodia 8 among the three herbicide systems (Figure 5). At no other position were differences in the percentage of abnormal bolls observed in our analyses.

The application and herbicide cost associated with the CON system was $9.52 and $10.34 greater than the RUP fb RUP and the RUP fb CON systems, respectively (Figure 6). Average land preparation costs associated with conventional tillage studies were $4.01 greater than the average costs associated with minimum tillage studies (Figure 7). When net returns were averaged among locations, the net revenues generated from the RUP fb RUP system exceeded those of the RUP fb CON and the CON systems by $23.99 and $75.71, respectively (Figure 8).

Discussion

These studies were conducted to address concerns that growers have raised regarding Roundup Ready cotton and the use of Roundup Ultra in place of tillage and in-crop safety. Monsanto's claims of excellent vegetative and reproductive crop tolerance of Roundup Ready cotton to labeled applications of both overtop and post directed applications of Roundup Ultra were validated in these trials. No consistent trends were detected in our plant mapping results to illustrate that either overtop and/or post-directed applications of Roundup Ultra had a negative impact on harvestable boll retention. Other than first position bolls on sympodia 8 for the RUP fb RUP system, no differences in percent abnormal bolls were observed. Though the physiological development of first position bolls on sympodia 8 may have coincided with the initial post-directed Roundup Ultra application, no differences were detected at later developing positions following the second post-directed application. Additionally, abnormal boll characterization criteria were extremely strict and a portion of these bolls may not have been classified abnormal by producers.

In these studies, the differences in yield were believed to be related to differences in weed control. Weed control was often better with increasing number of Roundup Ultra applications. Palmer amaranth, morningglory spp., cocklebur, and various grass spp. represented the predominant weed species at each location. Control of palmer amaranth and grasses were the greatest problem in the CON herbicide system. The control of these weeds with conventional herbicides tended to be less that 90-95% at most locations. Palmer amaranth emerging after the last overtop application and morningglory spp. caused the greatest problem in the RUP fb CON system.

Though the yield advantage demonstrated in this study may not routinely be duplicated, the study does indicate that significant cost savings may be gained from management approaches, which include both reduced tillage and a Roundup Ready system.

Table 1. Per acre costs associated with land preparation and tillage

Land Preparation costs / Acre	
Chisel plow	$ 2.50
Dual	$ 2.50
Disk	$ 5.00
Field cultivator	$ 5.00
Hand weed	$ 10.00
Harrow	$ 3.50
Hipper	$ 7.50
Hooded sprayer	$ 3.10
In-season cultivation	$ 3.50
Land plane	$ 3.50
Lister	$ 7.25
Moldboard plow	$ 13.00
Paratill	$ 5.00
Rodweeder	$ 3.50
Rotary hoe	$ 1.55
Rolling cultivator	$ 7.00
Sand fighter	$ 2.50
Spot spray	$ 3.50
Stalk shredding	$ 3.00
Strip till	$ 15.00
Subsoil	$ 7.25

1. Gerloff, D.C. and L. Maxey. 1997. Field crop budgets for 1997. AE & RD # 36, Tennessee Agricultural Extension Service.
2. USDA-ARS, Weslaco, TX.
3. Dr. John Bradley, Conservation Tillage Specialist. Monsanto Company, Collierville, TN.
4. Dr. Wayne Keeling, Texas A & M University, Lubbock, TX.

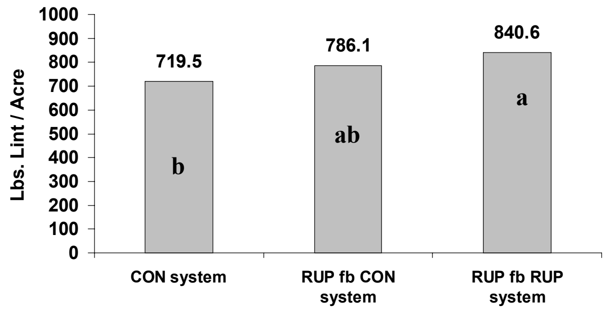

Figure 1. Per acre mean lint yield of three herbicide systems; lower case letter indicate significant treatment differences at $P \leq 0.05$.

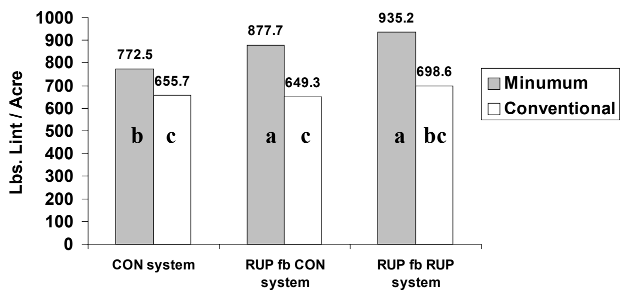

Figure 2. Per acre lint yields of three herbicide systems by tillage practices, lower case letters indicate significant treatment differences at $P \leq 0.05$.

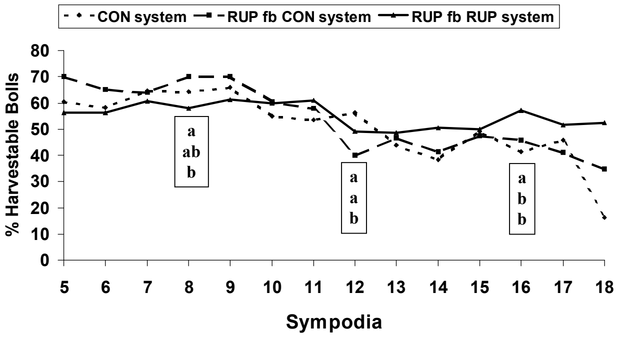

Figure 3. Percent first position harvestable bolls of three herbicide systems, lower case letters indicate significant treatment differences at $P \leq 0.05$.

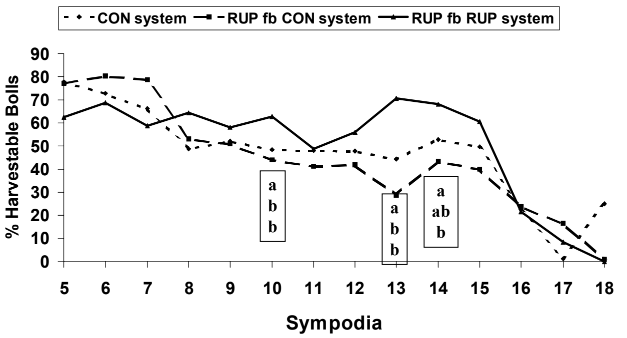

Figure 4. Percent second position harvestable bolls of three herbicide systems, lower case letters indicate significant treatment differences at $P \leq 0.05$.

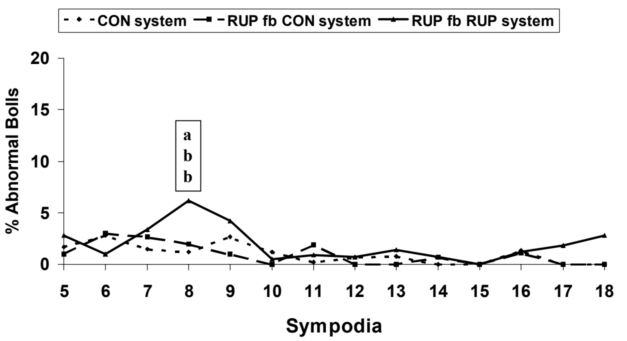

Figure 5. Percent first position abnormal bolls of three herbicide systems, lower case letters indicate significant treatment differences at $P \leq 0.05$.

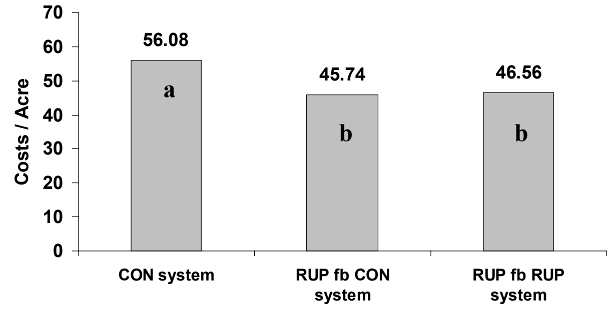

Figure 6. Herbicide and application costs ($/Acre) associated with three herbicide systems, lower case letters indicate significant treatment differences at $P \leq 0.05$.

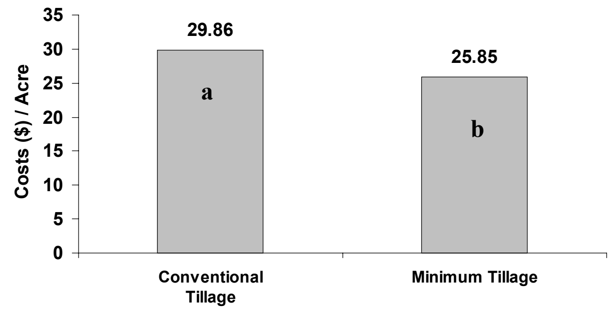

Figure 7. Comparison of conventional and minimum tillage costs ($/Acre); tillage costs included land preparation, burndown herbicides & application, and in-season cultivation costs. Lower case letters indicate significant treatment differences at $P \leq 0.05$.

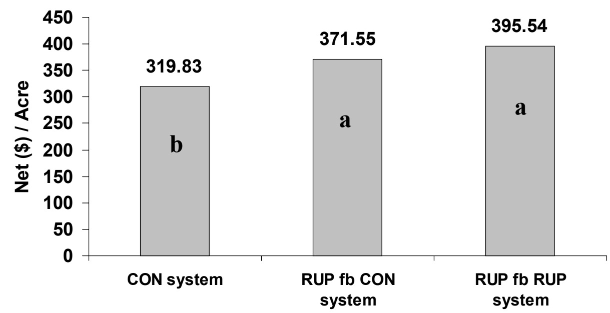

Figure 8. Net return of three herbicide systems: values derived by subtracting the herbicide, land preparation, and application input costs from the gross return (lint yield / A x $0.65 / lb lint). Lower case letters indicate significant treatment differences at $P \leq 0.05$.