WEED MANAGEMENT: TRANSGENICS & NEW TECHNOLOGIES - A WEED SCIENTISTS PERSPECTIVE

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Abstract

The development of transgenic cotton varieties resistant to Buctril and to Roundup Ultra, and the development of Staple herbicide has provided growers with opportunities to improve weed control, reduce reliance on preemergence herbicides, and reduce costs. In the irrigated cotton production regions of the West, these new herbicide technologies combined with precision guidance systems for cultivation and herbicide applications are being used to develop new strategies for cotton weed control.

The most significant benefit of the new herbicide technologies is improved weed control without early season crop injury. These technologies provide a new window for herbicide applications, specifically over-the-top and post-directed applications from the cotyledon up to the 6 to 8 inch tall growth stage of cotton. Postemergence chemical weed control during this period reduces or eliminates early season weed competition which in turn increases yield and earliness. The absence of crop injury during early season cotton growth also increases yield and earliness. The new herbicide technologies have the potential to reduce crop injury in two ways. Buctril, Roundup Ultra, and Staple herbicide applications on small cotton replace postemergence applications of other less selective, injury causing herbicides such as MSMA (and other organic arsenicals), Caporal (prometryn), Cotoran (fluometuron), and Karmex (diuron). In addition, in some situations the use of Buctril, Roundup Ultra, and Staple may allow reduced use of preemergence herbicides (e.g, Caparol, Cotoran and Zorial) which can cause crop injury under adverse weather conditions.

The new herbicide technologies increase farming flexibility and provide opportunities for reducing costs. An obvious benefit has been the reduction of hand weeding costs for annual morningglory species in Arizona, California and New Mexico and for nightshade species in California. Another benefit of the new herbicide technologies is cost savings through reduced use of preplant- incorporated (PPI) and preemergence (PRE) herbicides. However, reduced reliance on PPI and PRE herbicides should be approached cautiously by performing a risk-benefit analysis on a field by field basis and by considering several options for reducing the use of PPI and PRE herbicides. Broadleaf herbicides (e.g., Caparol and Diuron) can be eliminated while continuing to use the DNA herbicides (e.g., Treflan and Prowl). Band applications of DNA herbicides can be used rather than broadcast applications. Eliminating all PPI and PRE herbicides, including DNA herbicides, can be considered although this is a relatively risky approach. Another obvious option for reducing herbicide costs is to make band applications of postemergence herbicides rather than broadcast applications. Application costs, the time required to make an application, weather, and equipment availability must also be considered when choosing a strategy.

Relying entirely on the new herbicide technologies for cotton weed control with out using preemergence herbicides increases the risk of weed control failure. This risk can be mitigated by combining the use of Buctril, Roundup Ultra and Staple with precision guidance systems which provide for very accurate implement placement with respect to the crop row. Quick-hitch, articulated, precision guidance systems for implement control can help reduce costs in several ways. Guidance systems equipped with furrow probe sensors facilitate close cultivation and early season applications of over-the-top herbicides on small cotton. In “dry planted” (i.e., seed planted in dry ground and irrigated up) fields, the planter makes a reference furrow while in “wet planted” (i.e., seed planted to moisture) field both the planter and “decapper” must make a reference furrow. Then the furrow probes and guidance system follow the reference furrow in order to spray narrow bands of herbicide (e.g. 6 to 8 inches wide) and to cultivate close to the crop row. Precision guidance systems allow accurate sprayer and nozzle control resulting in precise spray pattern placement. They also precisely control cultivators allowing the placement of steel very close to the crop row.

The new herbicide technologies and precision guided cultivation can also be combined effectively on larger cotton up to layby. Crop wands are used to sense the location of crop row and control farm implements. Accurate post-directed spray placement improves spray coverage of weed seedlings, improves weed control, reduces the potential for crop injury with some herbicides (e.g., Roundup Ultra), and allows the use of narrow herbicide bands in conjunction with close cultivation. Accurate control of cultivators allows the placement of steel within 1.5 inches of the crop row and allows the use of in-row tine weeders or torsion bar weeders to remove morningglory and other weed seedlings in the crop row.

Another new weed control technology is the Weed Seeker technology originally developed by Patchen, Inc. Over-the-top herbicide technology can be used to control weeds in the crop row combined with use of higher rates or other herbicides under spray hoods that cover the ground between rows. Herbicide spray under the hoods is controlled using infrared chlorophyll sensors that only spray weeds, not bare

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ground, thereby reducing herbicide costs in reduced tillage and no-till cotton production systems.

Several issues and problems have been identified with respect to the use of Buctril, Roundup Ultra and Staple herbicides. With all three herbicides, weeds must be sprayed when they are small because larger weeds are not controlled. In addition, these herbicides should not be applied during cultivation because dust on the leaf surfaces inactivates them and reduces weed control. The burndown mode of action of Buctril is popular, especially on morningglory, and after several years of use, applications are being made at the correct weed growth stage. The advantages of the Buctril-BXN system include: (1) excellent crop tolerance with no yield loss, (2) no surfactant or adjuvant is needed for activity, and (3) Buctril efficacy is not affected by water quality. The disadvantages of the Buctril-BXN system are that Buctril only controls broadleaf weeds and that a limited number of varieties are available. Staple was in its second year of widespread use in 1997 and most problems with surfactants were corrected and appropriate weed growth stages were being sprayed. The advantages of Staple include that it c an be used on any cotton variety and that there is good crop tolerance with no yield effects. The disadvantages of Staple are: (1) it is effective only on broadleaf weeds with inconsistent stunting of nutsedges, (2) water stressed weeds are more difficult to control, and (3) residual Staple in the soil can affect following crops. In the first year of widespread use of the Roundup Ultra/Roundup Ready (RR) cotton system in 1997 several performance issues were identified: (1) it is essential to treat weed seedlings at the correct stage of growth (as it is for Buctril and Staple), (2) water stressed weeds are more difficult to control, particularly nutsedge species, and (3) poor water quality reduces Roundup efficacy making it is essential to add ammonium sulfate to the spray solution. The advantages of the Roundup Ultra/RR Cotton system are that Roundup controls a broad spectrum of weed species allowing more flexible weed control practices and that many varieties are or will be soon available. The disadvantages are that (1) RR cotton tolerance to Roundup Ultra is not as good as with the Buctril/BXN system or Staple herbicide, (2) water stress affects efficacy, and (3) water quality in the spray tank affects efficacy. However, despite some problems and challenges, the new herbicide technologies have the potential to make controlling weeds in cotton easier and to improve economic returns to growers.