

**Integrating Weed Management Tools in Cotton and Corn:
GMO's and Conventional Herbicides**

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Integrating herbicide resistant crop technology and conventional herbicides makes sense for many reasons. One of the main concerns is preventing weed resistance. There is a high probability of developing resistant weed species and/or weed shifts when solely relying on one type of herbicide. For example, we have Roundup resistant annual ryegrass and marestail in California. Growers have also reported poor control of barnyardgrass and lambsquarter in some cases. Some of this reduction in control could also be due to applying glyphosate to drought stressed weeds. There are many reports of reduced control of barnyardgrass with continual use dinitroanilines in cotton in the San Joaquin Valley. Some California growers have observed reduced nutsedge control with continuous use of thiocarbamate herbicides in corn.

Herbicide tolerant crop acreage has increased dramatically in the United States and amounts to approximately 30 percent of the California cotton and corn acreage (Table 1.) The herbicide tolerant acreage of both cotton and corn should continue to increase as higher yielding varieties receive these traits. Fig. 1. and Fig. 2 shows the dramatic increase in herbicide tolerant acreage in just a few years.

<u>Crop</u>	<u>U.S. Percent</u>	<u>California Percent</u>
Cotton	69	29
Corn	26	30
Soybeans	68	
Canola	55	

Table 1. Herbicide Tolerant Crop Percent of Total Acreage 2002.

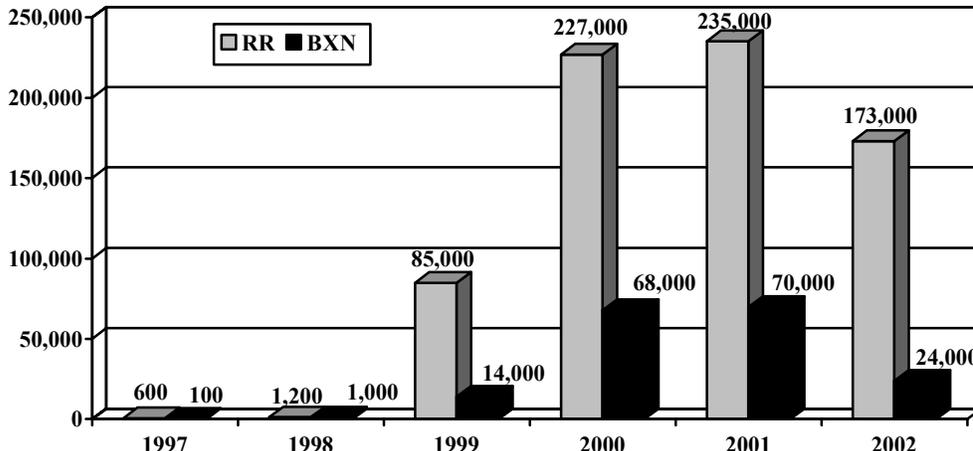


Fig. 1. Progression of Herbicide Tolerant Cotton in San Joaquin Valley.

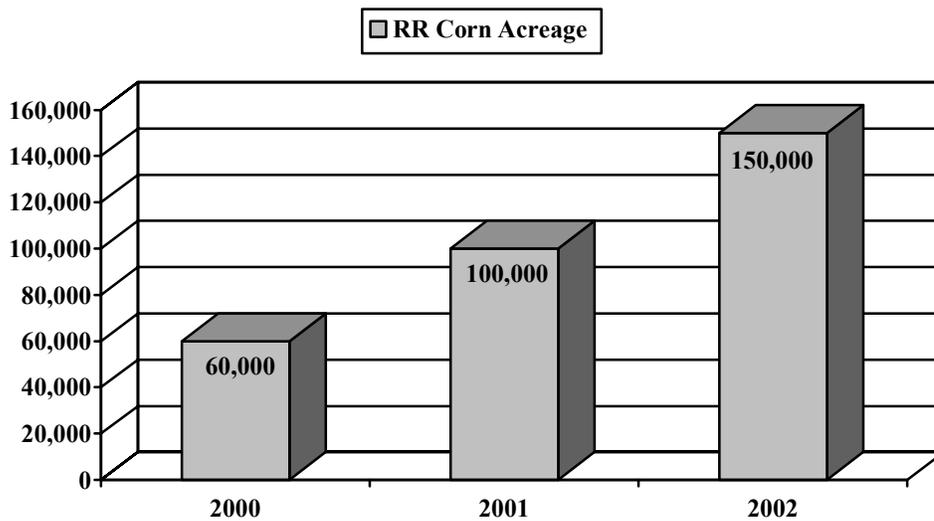


Fig. 2. Progression of Roundup Ready Corn in California.

The decision to use herbicide tolerant crops is largely based on the following criteria: 1) Can the crop be marketed? 2) Does the acreage of the weed infestation justify this use? 3) Is the weed pressure enough to impact yield? 4) Is hand weeding or cultivation eliminated or reduced? 5) How does this compare to the cost of alternative herbicides? 6) Cost of technology fee? 7) Are there well-suited transgenic varieties with favorable agronomic characteristics for both yield and quality?

Roundup Ready Technology in Cotton

The Roundup Ready technology has provided growers with an excellent tool for managing many annual and perennial grasses, broadleaves such as nightshades and annual morningglory, and nutsedge in cotton. Some of the advantages to this system include the following: 1) Glyphosate can be applied post emergence so growers can wait and see the weeds present. 2) There are no plant back restrictions. 3) Glyphosate has a wide spectrum of weed control controlling or suppressing many annuals and perennials.

Some of the problems associated with this system include the following: 1) There is a narrow window of application. 2) It must be applied before cotton has 5 leaves. 3) Hooded sprayers are needed to safely apply later directed applications. 4) Nutsedge and annual morningglory are still a challenge. 5) Variety selection can be limited in that the technology is somewhat behind. The highest yielding varieties often do not have this trait. Even with the herbicide tolerant technology weeds like annual morningglory are increasing especially when growers are only relying on glyphosate.

BXN System

The advantages of the BXN system or Buctril (bromoxynil) tolerant cotton is that there is not a concern about crop safety since it has a wide application window. With this system only broadleaf weeds are controlled. Only plant BXN cotton back if more than 1 pt. is used. Reduced grass control is sometimes observed if tank mixed with grass herbicides. Buctril controls many small broadleaf weeds like black and hairy nightshade, lambsquarter, Chinese thornapple, and annual morningglory. Annual morningglory control with Buctril is still a challenge. Treat before the 3-leaf stage. Best control (80-90%) is achieved at the 2-leaf stage. Studies in Madera County showed control dropping to (20-60%) at 4 to 6 leaf weeds. Layby preemergent herbicides like Caparol or Goal are usually needed even with either the Roundup Ready or BXN systems because annual morningglory comes up in different flushes (Fig. 3). Annual morningglory can be controlled by other herbicides and the best control is sometimes achieved using tank mixes. Table 2. lists herbicide options for annual morningglory control in cotton.

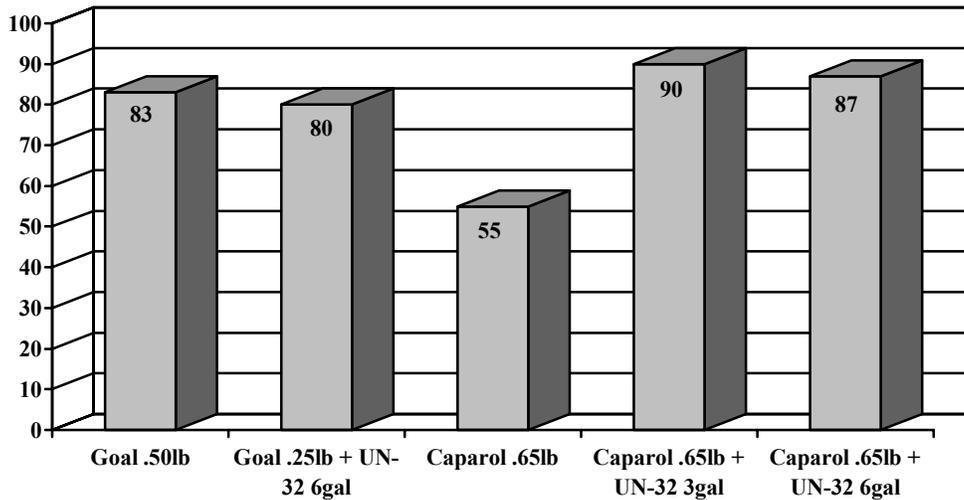


Fig. 3. Postemergent Annual Morningglory Control in Cotton-Tulare Co. 1999.

<u>Current</u>	<u>Future</u>
Glyphosate	Shark
BXN-Buctril	Harvade
Caparol	CGA 362622
Goal	MON 78270
Staple plus MSMA	Valor

Table 2. Annual Morningglory Control Tools in Cotton.

Integrated Nutsedge Control

An integrated approach is required especially for purple and yellow nutsedge by using herbicides associated with different crops and using tillage. The following preemergent herbicides are available in field crops for nutsedge control and also control other weeds: Vapam in cotton; Sutan and Eradicane in corn for both purple and yellow nutsedge, grasses, and some broadleaves; Lasso and Dual in corn for control of yellow nutsedge, grasses, and some broadleaves. Postemergence nutsedge herbicides include: MSMA in cotton for nutsedge; glyphosate and Touchdown for nutsedges, grasses and broadleaves; and Sempra (Halsulfuron) in corn for nutsedges, and some broadleaves.

Integrated Control of Nutsedge in Cotton

When used alone, the foliar-applied herbicide MSMA can suppress nutsedge in the seed row after cotton has emerged. MSMA is more effective on yellow than purple nutsedge. It is safest to use on cotton in the cotyledon stage however it is not registered to use until cotton plants have two or more true leaves. Make a second application 1 to 3 weeks later using a directed spray aimed at the base of the cotton. Apply before first cotton bloom. MSMA will often cause a purplish discoloration and may retard cotton growth. Injury to cotton can be severe when plants are stressed for water. Don't use MSMA more than twice per season as it may leave a soil residue that can damage some rotation crops.

Glyphosate is applied in two applications over the top of glyphosate-tolerant cotton before the fourth leaf stage of cotton. A 3rd application is often needed as a directed spray. Other generic glyphosates have shown similar results in a couple University studies. More consistent control is obtained when ammonium sulfate at 5 to 15 lbs/A is mixed with Roundup. Careful cultivation is essential for early season control even when using herbicides. After cotton has emerged, use precision equipment to cultivate as closely as possible to the crop row. Use sweep type cultivators (Alloways). Rolling cultivators are ineffective for nutsedge suppression and spread nutsedge tubers creating larger areas of infestation.

Integrated Control of Nutsedge in Corn

Nutsedge is very competitive with corn in the early stages of growth. Running a sweep four inches below the top of the bed or power tilling the beds with L-shaped knives 3 to 4 inches deep before planting is effective in inhibiting nutsedge that has already sprouted. It is important to cultivate a second time for nutsedge after the crop has emerged. In the second cultivation, throw soil to the corn plants to suppress nutsedge growth and allow corn growth to shade the furrow. Keep at least 4 inches from corn plants to avoid pruning fibrous roots and use sweep type cultivators.

Metolachlor (Dual) and alachlor (Lasso) herbicides can give effective preemergence yellow nutsedge control. EPTC (Sutan, Eradicane) applied preplant incorporated provides good control of both yellow and purple nutsedge in corn. Use the higher labeled rates for the most effective control. Disturb nutsedge by using sweeps or power mulchers before planting. Plant immediately after the herbicide application to achieve the longest control.

Halsulfuron (Sempra) gives excellent control applied postemergent to purple or yellow nutsedge. Two applications are preferable. Make the applications when nutsedge is less than 5 leaves. Do not cultivate within 7 days following application. Halsulfuron can be applied over the top of corn or with drop nozzles from the spike stage through layby. Glyphosate applied to Roundup Ready corn varieties will provide partial control. Two applications are most effective. Tank mix combinations of Sempra and glyphosate should enhance control.

Summer Fallow Programs

Purple nutsedge tubers are susceptible to drying and can be destroyed with repeated summer tillage. Spring-tooth harrows are usually the best tools for this purpose; disking is often ineffective. Work conducted by Paul Keely at Shafter Research Station showed 95 percent control by listing and splitting the beds in summer. The remaining 5 percent still remains a problem the next season. Tillage is not likely to be successful in soils that form large clods or in fields where a high water table keeps soil near the surface moist. Tillage is not as practical for control of yellow nutsedge, because the tubers can survive up to 4 years in dry soil. Reports on the effectiveness of tillage are variable and often contradictory partly because of a general failure to distinguish between the species of nutsedge.

Integrated Weed Management Costs

The herbicide tolerant cotton and corn systems have allowed growers to effectively control most annual and perennial weeds, to reduce or eliminate hand hoeing, and reduce the number of cultivations. Cost savings range from \$25 to \$120/acre is achieved. Even if growers use an herbicide tolerant system it is still advisable to use one of the following preplant incorporated herbicides in cotton: Prowl, Treflan, Caparol, or Caparol + Treflan/Prowl. The cost is low (\$6-\$8/A) and controls most annual grasses and many broadleaves. Ultimately the decision to use one herbicide tool over and how to integrate different herbicides will depend on costs and effectiveness (Fig. 4 and Fig.5).

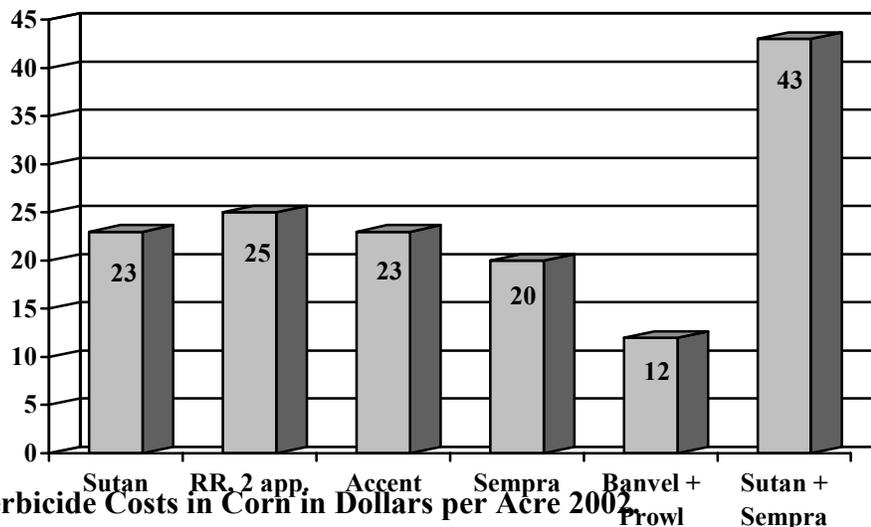


Fig. 4. Herbicide Costs in Corn in Dollars per Acre 2002.

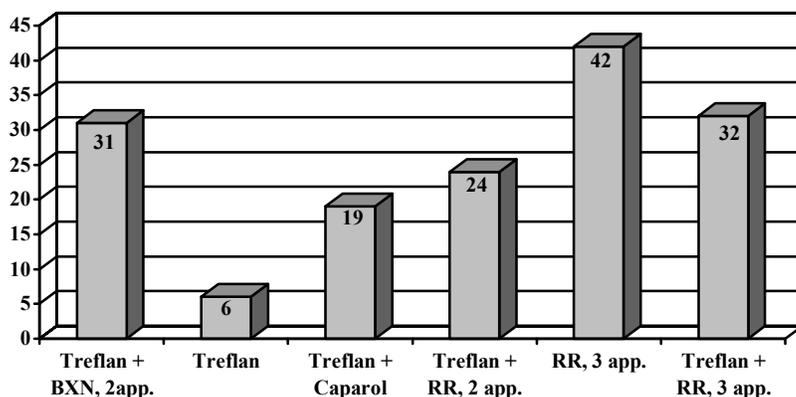


Fig. 5. Herbicide Costs in Cotton in Dollars per Acre 2002.

Summary

The herbicide tolerant systems in cotton and corn has reduced weed control costs and given growers greater flexibility. This has allowed growers and researchers to explore alternative production systems such as conservation or reduced tillage, double row configurations, and ultra narrow row systems. In the future we look forward to enhanced Roundup Ready varieties that have more crop safety with a greater application window; Liberty Link Cotton by Bayer, Sulfonyureas by Dupont, and more Stacked Genes/Multiple Genes with both herbicide tolerance and insecticidal properties together. A resistance management approach must incorporate crop/herbicide rotation and control of weed escapes by tillage or hand. An integrated weed management system supplements an existing transgenic or conventional weed control program and uses a variety of the available pre-plant, selective over-the-top and layby herbicides along with tillage.

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