



Weed Management Guide

A regional look at weed resistance issues
and recommendations

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LETTER FROM THE PRESIDENT

Dear farmers and crop consultants,

Not long ago, very few people spent their winter months mapping out weed resistance plans for the coming year. The situation in 2007, however, is quite different. A variety of glyphosate- and ALS-resistant "tough" weeds are popping up in many states, soil types and crops.

Researchers tell us the battle against weed resistance can be won with planning, smart practices and carefully chosen crop protection products.

We at Valent have several key commitments in this fight against weed resistance:

Innovative products

Valent is one of the few crop protection firms today with a strong innovation culture and new product focus. Our researchers work closely with university experts to anticipate and address such emerging problems as resistant weeds, insects, mites and diseases.

Stewardship

Each of us plays a role in sustaining the health and future of our industry. We are committed to stewardship in all aspects of our business. Valor®, Chateau® and Gangster® Herbicides are just three products in our growing portfolio that experts recommend to add residual power in glyphosate programs.

Commitment to farmers

Coming from a long line of farmers, my commitment to you is sincere. Your field challenges become our team's mission in our research facilities. We at Valent commit to providing you with outstanding crop protection tools — living our corporate motto of "products that work, from people who care."

I encourage you to use this guide to help develop your 2007 weed resistance management plan. And, thank you for your role in growing the best food and fiber in the world.

Sincerely,

A handwritten signature in black ink that reads "Trevor Thorley". The signature is fluid and cursive, written over a light gray rectangular background.

Trevor Thorley
President and Chief Operating Officer
Valent U.S.A. Corporation

Weed Management Guide

In the Southeast, more and more producers are becoming concerned about glyphosate- and ALS-resistant Palmer amaranth (pigweed) in their cotton, peanut and soybean crops. The resistance problem is being attributed to using the same mode of action (MOA) chemistries year after year as well as not including residual herbicides in their weed

management programs.

In an online survey conducted by One Grower Publishing, the biggest concern with regard to resistance was Palmer amaranth/pigweed with 57 percent. In this section, farmers, a custom applicator and a crop consultant share their experiences and tell how they are adjusting their herbicide programs to adapt. Stanley Culpepper, a weed scientist with the University of Georgia, also comments on the resistance issue.

Southeast

Dean Elmore – SC farmer

ALS-resistant pigweed affects cotton and peanuts on my farm. I know it's ALS-resistant because Staple and Cadre don't work anymore. In Roundup Ready (RR) cotton we've started using more pre-emerge chemicals. Last year I used Reflex behind the planter, and it worked real well. I usually apply Dual Magnum when the cotton gets to two to four true leaves when I'm spraying Touchdown over-the-top for the first time. I want to incorporate Valor into the program with a hooded sprayer as a layby treatment so it will carry me through the rest of the year.

I rotate 500 acres of corn, 500 acres of cotton, 500 acres of wheat and 350 acres of peanuts. The wheat is followed by grain sorghum rather than soybeans to keep the four-year rotation for peanuts. With corn and grain sorghum I can use atrazine and Bicep.

In peanuts I apply a yellow herbicide and Valor behind the peanuts being planted, then come back with a Gramoxone, Basagran and Dual Magnum treatment when the peanuts are six weeks old. I add Dual to get residual for pigweed control. A month later I apply Cadre. Where it doesn't work, I come back over-the-top with a Cobra or Blazer product.

Carl Coleman – SC farmer/applicator

I grow soybeans and corn and custom spray a lot of cotton. I'm 100 percent no-till and so far in corn we don't have a glyphosate-resistant pigweed problem because we use atrazine and don't plant RR varieties. We went from zero resistant pigweeds in 2005 to six or seven fields in '06. This year we are going to change our herbicide program to adapt to that.

We're going to be using Valor in all of our RR soybeans. At planting, we'll mix Valor and glyphosate pre-emerge. Valor enhances the burndown and you get residual control of pigweed and some other weeds. Our goal is that this will carry us through to canopy, and we won't have a problem with pigweed trying to come through. A lot of my cotton customers used Valor last year for pigweed and were very happy. Growers are realizing that they need a pre-emerge product like Valor or Reflex because they know when the pigweed comes up, it will be impossible to kill with Roundup.

If you don't use a pre-emerge program, you could lose your crop to weeds.



To avoid a problem like this – pigweed in peanuts – Dean Elmore plans to mix Valor and glyphosate at planting in all of his soybeans this year.



The presence of ALS-resistant Palmer amaranth (pigweed) in fields in the Southeast is “potentially devastating,” according to Dr. Stanley Culpepper, with the University of Georgia.

Hugh McLaurin – SC farmer

ALS-resistant pigweed is more of a concern all of the time. That’s why I keep using Valor. If the pigweeds don’t come out of the ground, you don’t have to worry about resistance. I apply two ounces of Valor pre-plant. If your pre-plant consists of something like Roundup, add Valor and you’ll get six weeks of no pigweed. Then we run Redballs and apply another two ounces of Valor for the second application.

However, with peanuts, we apply Dual Magnum and three ounces of Valor at planting. Later we come back with Cadre. We rotate cotton, corn and peanuts. We are in a four-year rotation with peanuts.

Jack Royal – Georgia crop consultant

As far as my customers, we haven’t had a lot of problems with glyphosate-resistance in cotton because we rotate our chemistries. We have more problems with ALS-resistance in our peanuts.

We apply a yellow herbicide at planting. About 18 days later, we come back with a combination of Storm and Gramoxone Inteon. We use a little 2,4-DB where we have to. We come back with Cadre about seven days after burndown. In the north part of my area, the pigweed is ALS-resistant

because we’ve been using Staple on our cotton and Cadre in peanuts, and they are the same chemistry. To combat that, we are applying Valor pre-emergence before the peanuts come up.

I think growers are going to have to go back to using residuals, or they could mess up the Roundup and Roundup Ready Flex technology.

It would help here in the Southeast if growers would grow some non-RR corn, so we could use some Accent and atrazine. We could get some residuals down and use different chemistries, too.

Stanley Culpepper – University of Georgia

In a report given by Dr. Stanley Culpepper at the 2007 Beltwide Cotton Conferences, the weed scientist posed the question, “Why is resistance such a big deal now?” His answer was that so many resistant weeds have been confirmed as significant: ALS-resistant pigweeds, glyphosate-resistant horseweed and glyphosate-resistant ragweed. He also noted that ALS-resistant pigweed is potentially devastating.

Resistant pigweed is “practically in a class of its own” and has been confirmed in 19 states.

“Once you have ALS-resistant pigweed, none of the products on the ALS herbicide list works,” he says. See Table at

left for Culpepper’s Georgia and North Carolina recommendations.

Culpepper also offered suggestions for resistance management practices in all crops:

- Reduce herbicide reliance (as practical)
- Diversify MOAs; Multiple MOAs
- Multiple MOAs within a crop
- Crop rotation; different MOAs
- Detect resistance early

To learn more about resistance, he referred everyone to the Weed Resistance Learning Module at <http://www.cotton.org> or the International Survey of Resistant Weeds at <http://www.weedscience.org/in.asp>. He also noted that Cotton Incorporated is nearing completion of a Resistance Management Bulletin.

Georgia/North Carolina Recommendations

At Planting	Topical (1-to 4 if cotton)	Layby Directed
Yellow + Reflex	Glyphosate + Dual Magnum (no emerged pigweed) Glyphosate + Staple (pigweed 1-2")	MSMA + Valor MSMA + Layby Pro MSMA + Suprend MSMA + diuron

Source: Dr. Stanley Culpepper, University of Georgia

Mid-South

The Mid-South region includes Arkansas, Louisiana, Mississippi, Missouri and Tennessee, and the main weed problem that producers are experiencing in this area is glyphosate-resistant horseweed.

In tallying the results of a recent One Grower Publishing online survey, 68 percent of the respondents indicated that they expect glyphosate-resistant weeds to be a problem on their operations in 2007. Ninety-five percent said they are very concerned to somewhat concern.

They were also asked which practices have you implemented within your operation to address glyphosate-resistant weeds. Twenty-three percent said they were going to put greater interest on early-season burndown, while 23 percent implemented crop rotation strategies. Twenty-one percent tank mixed a post-emerge herbicide with glyphosate.

Other categories included a pre-emergence residual into the rotation (17 percent), greater emphasis on year-round management (9 percent) and greater emphasis on early-season tillage (7 percent). Zero percent said no changes were made to address glyphosate-resistant weeds.

In this section, we will concentrate primarily on resistant horseweed in cotton and soybeans.

Jimmie Moon, Jr. NE Arkansas farmer

I've had glyphosate-resistant horseweed in my cotton for the last two years, so we've had to use other herbicide programs to control them. One program that did work very well was Valor in the late fall – mid-November – after we harvested the crop.

We mixed it with 2,4-D to kill the broadleaves, and Valor provided the residual. The main thing we worry about is pigweed becoming resistant to glyphosate.

I farm about 2,500 acres of cotton, and it only took about two years to go from having very little horseweed resistance to having almost all of our horseweed being resistant. Once the resistance starts, you'll notice that you have a few patches of horseweed in your field. These patches are from a resistant horseweed plant that seeded out and spread. And horseweed has millions of seed that blow in the air.

I always felt like farmers who try to reduce rates below labeled rates helped create resistance. When a farmer tries to save money, he may get control.

But if you're not completely killing the weed and it survives, then it has a tendency to start building resistance to whatever you are putting on it.



This cotton field is packed with glyphosate-resistant horseweed. This prolific plant has millions of seed.

Tom Barber – Mississippi State

Mississippi Extension cotton specialist Tom Barber says the most affected area in the state for glyphosate-resistant horseweed is from Hwy. 82 North.

"The main reason it's giving us trouble is because it can emerge in the fall, in late winter, and also in the spring when the cotton is coming up," Barber says. "We have to rethink the way we do spring burndown in those areas and utilize the products that work well against horseweed. Mainly dicamba products such as Clarity at an eight ounce rate mixed with glyphosate."

Barber notes that farmers have to start early (mid February) and go for a two-shot program in the Roundup system. If you wait too late, the overwintering horseweed is extremely hard to kill. If glyphosate is used for burndown, it needs to be applied early (before March) and tankmixed with eight ounces of dicamba.

"Under extreme horseweed pressure it pays to have a residual in there like Valor, too," he notes. "So for horseweed control we need an early shot of glyphosate plus 8 oz Clarity (middle to the end of February) with a residual (Valor 2oz). Second applications of glyphosate alone would be toward the end of March if needed."

Barber says Valor or Envoke applied in the fall seem to do very well controlling overwintering horseweed.

"Fall applications will reduce overwintering horseweed populations, making them easier to manage in the spring. If a fall residual is applied, spring burn-

down applications will not have to be as timely; however, the fall residual will probably not last to planting. Therefore Clarity and a residual at burndown will most likely be needed," he says.

Barber also addresses the Ignite/Liberty Link program and makes recommendations.

"In the Ignite system we can wait a little later because Ignite works in warmer conditions," he says. "But we still need to think about using a residual in the program because we've got to hold the horseweed down in-season."

As far as pigweed resistance, Barber says Mississippi has a few pockets, but no reported cases of glyphosate resistance to date. He says a corn/cotton rotation is good because farmers can use different products and rotate mode of actions, such as atrazine with corn.



In this soybean field, the “good guy,” left, is a susceptible horseweed next to the “bad guy,” a glyphosate-resistant horseweed.

Larry Steckel – University of Tennessee

In west Tennessee, all of the cotton acres have glyphosate-resistant horseweed, according to Larry Steckel, University of Tennessee weed scientist. Now, the attention is turning to Palmer amaranth (pigweed).

The question, Steckel says, “Is the level of tolerance to glyphosate for some Palmer populations increasing?” He says farmers can “hope for the former, but manage their cotton for the latter.”

His recommendations for glyphosate-tolerant Palmer amaranth management are as follows:

- Consider a pre of Valor or Reflex
- Use max rate of glyphosate
- Dual over-the-top with first or second glyphosate shot
- PD – Caparol or Dual
- Hooded – Valor or Caparol

“Glyphosate-tolerant Palmer biotype appears to be localized to a few areas,” Steckel says. “Glyphosate Palmer-pigweed prevention is a must-do for more competitive Palmers.”

Bob Scott – University of Arkansas

In 2003, two counties in Arkansas were infested with glyphosate-resistant horseweed. In 2006, that number had jumped to 25, according to Arkansas weed specialist Bob Scott. In 2005, they had moved into soybeans.

Today, glyphosate-resistant pigweed has been confirmed in Georgia, Tennessee and Arkansas.

Soybeans: Horseweed Control Options

Must begin at burndown

- Apply dicamba (Clarity, etc., at 8 ounces/acre) or 2,4-D (1 quart/acre) at burndown
- Apply Valor (2 ounces/acre) or Synchrony XP (1.5 ounces/acre) at burndown or prior to planting for added residual control

Soybeans: Pigweed Control Options

Tillage or burndown to start clean

- Gramoxone or Gramoxone plus Valor tankmix

Valor pre-emerge or Dual (or equiv.)

Sequence early post if no pigweed is up

- Flexstar (1.25 pints early post). Six-ounce rate of Flexstar in glyphosate tankmix may work, but the rate may be too low
- Blazer weaker, but an option

If rotating with rice, watch levees for pigweed

Source: Dr. Bob Scott, University of Arkansas

Southwest

Farmers in the Southwest region, which includes Texas, Oklahoma and Kansas, also participated in the One Grower Publishing online survey. When asked if they had experienced glyphosate-resistant weeds on their operations, 55 percent said “no” and 18 percent said “not sure,” which amounted to almost 75 percent of total respondents for that area.

However, when quizzed about their practices to address or prevent glyphosate-resistant weeds, 23 percent of the respondents said they have implemented crop rotation strategies, 17



ALS-resistant pigweed has been found in peanuts in south Texas.

percent have included pre-emergence residuals into the rotation, 17 percent have placed greater emphasis on year round management and 17 percent have placed greater emphasis on an early-season burndown program.

James Grichar – Texas A&M University

“In south Texas, we’ve found Cadre (ALS)-resistant Palmer amaranth (pigweed) in peanuts,” says James Grichar, weed scientist with Texas A&M University. “It’s probably suspected in the northern and western part of the state, but I don’t think it has been confirmed.”

This past summer, Grichar says the team ran a test and applied a 1 and 2X rate of Cadre and didn’t get any control.

“We’re trying to confirm the resistance,” he says, “but when you put on a 2X rate of Cadre, and it looks as healthy as the non-treated, then you know you have problems.”

The Texas weed scientist says they will be looking into some new weed control programs this year. Typically in south Texas, he says, the herbicide program for peanuts has consisted of applying a yellow herbicide, then coming back with Cadre herbicide.

“This has been a good program for us in the past, but it’s going to have to change,” Grichar says. “Cadre will still control sedges and other weeds, but we’ve got to do something that includes the use of pre-emerge materials, such as Valor; and post-emergence, such as Cobra or Blazer.”

West

The West – California, New Mexico and Arizona – is a land of diversity when it comes to crops. There is weed resistance in many of the crops, but cotton is not one of them.

“We’re looking closely at this issue,” says Kurt Hembree, with the Fresno County Extension Service. “Lambsquarters and some of the pigweed species have shown some signs of resistance, but so far everything has been negative.”

In One Grower Publishing’s online survey, respondents indicated that the weeds they are most concerned about becoming glyphosate-resistant are lambsquarters and morningglory, both at 21 percent.

“We haven’t seen it (resistance) in the RR crops yet,” he says. “We use a lot of pre-emerge herbicides and cultivate, and we just haven’t found the resistance. But I expect it to happen.”

However, as fortunate as cotton is out West, rice is a very different story.

Resistance in rice

California rice farmers are very familiar with weed resistance and the ramifications it brings. The “big one” is resistant watergrass – early watergrass and late watergrass. They also have some broadleaves, such as smallflower umbrella sedge, bulrush and California arrowhead, that are resistant to Londax, an ALS inhibitor.

In the past, Londax and Ordram made up a very effective herbicide program, but both chemicals don’t work very well these days because of resistance.

“The good news is farmers have gone to Bolero and Regiment CA in an effort to alternate chemistries and help manage resistance issues” says J.R. Gallagher with Valent. “In California, however, we see resistance to Ordram, Bolero and Whip within grasses. Because Clincher and Whip are both ACCase inhibitors, there is a cross-resistance potential. The bottom line is farmers need to alternate these MOAs to man-



This rice field in Sutter County, California, was treated with Regiment CA and is weed-free compared to the untreated levees, which are covered in watergrass.

age resistance across a variety of weeds and reduce problems moving forward.

“According to the University of California, we don’t have resistance to propanil yet, but many times we can’t control the grass when it’s most susceptible,” he adds.

The grass grows very fast, so farmers often look to Regiment CA, which has a wider window. At 0.8 ounces, it appears to do a better job on resistant watergrass.

“Typically, we try to work in chemicals with different MOAs,” he says.

“Cerano is a herbicide with a different MOA for watergrass in California. Cerano slows it down, then you look at other options, such as Regiment CA or propanil.

“We strive for two chemical applications during the year for early season watergrass and sprangletop control,” Gallagher notes. “The secondary chemical application is applied 30 to 40 days after seeding to clean up any escapes and any late-germinating aquatics and sedges.

“If you go with Cerano, propanil this year, then you may switch to Bolero, Regiment CA the next year,” he explains. “Then the year after that you might go with Clincher, propanil or Clincher, Shark.”



California Arrowhead



Monochoria



Waterhyssop



Watergrass



Gregg's Arrowhead



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