Overview of PPO Inhibitor Cotton Harvest Aids in West Central Texas

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Abstract

In West Central Texas, four herbicides/defoliants that inhibit the production of protoporphyrinogen oxidase (PPO) in the cotton plant performed well as defoliants. The level of desiccation including new growth varies between the products tested. The PPO inhibitors evaluated were carfentrazone-ethyl (Aim® EC from FMC), pyraflufen-ethyl (ET™ from Nichino America), fluthiacet-methyl (Blizzard™ from Chemtura Corporation) and flumiclorac-pentyl (Resource® from Valent USA Corporation). PPO inhibition in cotton results in a quick disruption of cell membranes and a build up of ethylene in the leaf causing it to abscise. From 1999 through 2005, 22 replicated small plot tests have been evaluated that had 109 different PPO inhibitor harvest aid treatments. The harvest aids were applied alone or in combinations with other harvest aids and/or adjuvants. In these tests, the use of PPO inhibitor harvest aids generally resulted in increased leaf defoliation, desiccation, and regrowth suppression. However, environmental conditions, maturity of the crop, variety of cotton and the management of soil moisture and nutrients are important variables that impact the performance of the harvest aid materials applied.

Introduction

Cotton produced in West Central Texas is usually ready for harvest 30 days before the first killing freeze in the Fall. Due to the extra time that the cotton lint is exposed to weather, both yield and quality are reduced. Harvest aids are usually applied in the region in late September and October when the night temperatures are cool. Tests were initiated to determine the performance of PPO inhibitor harvest aids under West Central Texas environmental conditions.

For five of the six years included in this summary, 19 different treatments of Blizzard™ (fluthiacet-methyl) formerly CGA-248757, Action™ and Appeal™ were evaluated. Since 1999, 41 different treatments of Aim® EC (carfentrazone-ethyl) have been evaluated. Starting in 2000, 44 different treatments of ET™ (pyraflufen-ethyl) have been evaluated. Beginning in 2003, five different treatments of Resource® (flumiclorac-pentyl) have been evaluated in harvest aid tests in West Central Texas.

Materials and Methods

Test Plot Establishment Information

Established:	Late September to late October
Test Locations:	West Central Texas (counties include: Glasscock, Howard, Jones, Mitchell, Nolan, Reagan, Runnels, Scurry and Tom Green)
Cotton Variety:	Deltapine, FiberMax and Stoneville Picker Cotton Varieites
Application Device:	Small plots were established with a self-propelled sprayer
Nozzle Arrangement:	2 or 3 nozzles per row
Nozzle Type:	Combination of flat fan

Pressure: 30 to 40 p.s.i.
Carrier: 11.5 to 17 gallons of water per acre
Boom Height: 3 to 6 inches above average plant height
Plot Size: all replicated small plots were 13.33 feet wide by 60 feet long or more
Test Design: All small plots were replicated 3 or 4 times

Number of Harvest Aid Tests Conducted			
Year	Type of Test Conducted	Number of Treatments	Plot Size
1999	1 Replicated Small Plot	8	13.33' X 60'
2000	1 Replicated Small Plot	9	13.33' X 60'
2001	4 Replicated Small Plots	45	13.33' X 60 to 70'
2002	2 Replicated Small Plots	21	13.33' X 60'
2003	5 Replicated Small Plots	92	13.33' X 60 to 70'
2004	3 Replicated Small Plots	52	13.33' X 60'
2005	6 Replicated Small Plots	87	13.33' X 60 to 70'
Total	22 Tests	314	13.33' X 60 to 70'

Data Collection

Prior to applying harvest aids, an area in each treatment was marked to make ratings on the percent open bolls, percent defoliation, percent desiccation, and regrowth in the top and bottom portion of the plants. A rating system was used to reflect the growth of new leaves in the top and bottom portion of the plants within each marked area. The regrowth rating system used was: 0= no regrowth, 1 = regrowth up to the size of a quarter, 2 = regrowth between the size of a quarter and half-dollar, 3 = bigger than a half-dollar. The entire rating system has a scale that goes to 5, however, that has not occurred in any West Central Texas harvest aid test conducted since 1992.

From 1999 through 2005, 22 replicated small plot tests have been evaluated that had 109 different PPO inhibitor harvest aid treatments. The harvest aids were applied alone or in combinations with other harvest aids and/or adjuvants. Materials used included:

Harvest Aid Chemicals Applied in Test Plots from 1999-2005 in West Central of Texas		
Trade Name	Common Name	Marketed By:
Accelerate	Endothall	Elf Atochem North America, Inc.

Acetic Acid	Acetic Acid	Different Groups
Action	Fluthiacet-methyl	Tested for Novartis
Aim	Carfentrazone-ethyl	FMC
Appeal	Fluthiacet-methyl	Tested for K-I Chemical U.S.A. Inc.
Blizzard	Fluthiacet-methyl	Chemtura Corporation
CottonQuik	AMADS + Ethephon	DuPont Crop Protection
Cyclone Max	Paraquat	Zeneca Ag Products
DEF 6	Tribufos	Bayer CropScience
DROPP 50W	Thidiazuron	Bayer CropScience
ET	Pyraflufen-ethyl	Nichino America
Finish 6 Pro	Ethephon + Cyclanilide	Bayer CropScience
Ginstar	Thidiazuron + Diuron	Bayer CropScience
Gramoxone Inteon	Paraquat	Syngenta
Gramoxone Max	Paraquat	Syngenta
Inspire	Butafenacil	Tested for Syngenta
Prep	Ethephon	Bayer CropScience
Resource	Flumiclorac-pentyl	Valent USA Corporation
Roundup WeatherMAX	Glyphosate	Monsanto Company

Results and Discussion

Instead of giving a plot by plot summary for the six years, this discussion will reflect the combined information from the 22 replicated small plot tests conducted from 1999 - 2005. A plot summary is available for each test upon written request. Requests can be sent to: 7887 U.S. Highway 87 North, San Angelo, TX., 76901.

Tests were established in late September to late October. In most tests, cool nighttime temperatures slowed the activity of the harvest aids applied. The nighttime temperatures usually ranged from 50 to 60 degree Fahrenheit. It was not unusual to have two to five nights in the 40 to 50 degree range during the two week period after test establishment.

The reduction in cotton plant development caused by the cool night temperatures is important to PPO

inhibitor harvest aid applicators because they need to delay the followup application of a desiccant until the abscission layer is formed between the stem and the leaf petiole. An early application will result in more desiccated leaves remaining on the plant, which can increase the leaf trash content of the cotton lint.

Coverage is critical since all PPO inhibitor harvest aids used in these tests are contact materials. The selection and use of the proper nozzle combined with adequate gallonage to cover the target, can increase the amount of defoliation and regrowth suppression. The regrowth suppression is due to the PPO inhibitor's ability to burn juvenile growth and axilary buds. When coverage by the PPO inhibitor harvest aid is adequate then regrowth maybe delayed as much as 14 days.

One of the best tank partners for PPO inhibitor harvest aids is Ethephon or harvest aids that contain Ethephon. The use of 16 to 21 ounces of Ethephon has resulted in faster leaf defoliation and increased boll opening in 10 to 14 days. Whether you use PPO inhibitor harvest aids alone or in combination with other harvest aids the use of a crop oil concentrate is recommended. A followup application of a desiccant generally has the field ready to be harvested.

PPO inhibitor harvest aids are a useful tool to control regrowth before it becomes a problem. A complete application of 0.75 to 1.0 ounce of Aim, 1.5 to 2.0 ounces of ET, 0.5 to 0.6 ounce of Blizzard, or 8 to 10 ounces of Resource should provide 10 to 14 days of regrowth suppression.

Mature, picker cotton responds the best to applied PPO inhibitor harvest aids. Within hours you can see the plants response to the application and within five to seven days defoliation is often more than 50 percent. There has been no increase in boll opening in any of the tests conducted.
However, the level of defoliation has been equal to any of the other defoliants used in the tests when applied at the proper rate.

The cotton needs to be mature with at least 80 percent of the bolls open if you plan to tank mix PPO inhibitor harvest aids with paraquat. A tank mix of 10 ounces or less can provide increased leaf defoliation. However, leaf dessication is often increased because the abscission layer did not have time to form before the desiccation of the leaf was complete.

Some of the major factors impacting harvest aid performance in West Central Texas are:
1) Environmental conditions that effect the cotton plants response to the harvest aids applied. Weather conditions throughout the growing season impacts plant development and ultimately the plants response to harvest aids applied. Low temperatures and cloud cover after harvest aids are applied can slow plant development and response.

2) Environmental conditions at the time of application. Temperature, relative humidity and wind speed are factors that impact the amount of time spray droplets remain on the plant. Some wind is beneficial for the distribution of the material throughout the plant canopy. Wind speeds above five miles per hour reduce the time the droplet remains on the plant. Relative humidity above 70 percent allows a droplet twice as much time on the plant as relative humidity below 30 percent. Temperature above 80 degrees

reduces the amount of time the droplet remains on the plant. In most instances concerning harvest aids, an extended period of absorption generally increases the response of the cotton plant to the materials applied.

3) Maturity of the cotton when harvest aids are applied. Whether a defoliant or a desiccant is used, it is advantageous to allow the cotton as much time as possible to mature. Once the desired maturity range is reached the response of the plant to harvest aids applied is significantly increased.

4) Picker-type cotton varieties are easier to defoliate and open bolls on rather than stripper-type cotton. It is interesting to note that the number of acres being planted to picker-type cottons has increased from 40 percent to 90 percent in the last ten years.

5) Management to reduce available soil moisture and nutrients is important for regrowth suppression. Soil moisture and nutrients at the end of the production season should be depleted to the point that regrowth potential is limited. However, soil moisture and nutrients levels should be high enough to keep the plant from suffering stress which would reduce the absorption of the harvest aid materials applied.

6) Application of harvest aid materials to mature cotton as the air temperature is increasing combined with high relative humidity, cloudless days, warm daytime and nighttime temperatures resulted in better performance from the harvest aids tested.

Experience gained from conducting these tests resulted in increased success in reaching specific goals of boll opening, defoliation, desiccation, and regrowth suppression. It was noted early in the testing program that desiccation up to 20 percent was not economically detrimental and often the benefit of regrowth suppression obtained from desiccation offset the potential loss in the value of the lint.

Conclusions

In West Central Texas, four herbicides/defoliants that inhibit the production of protoporphyrinogen oxidase (PPO) in the cotton plant performed well as defoliants. The level of desiccation including new growth varies between the products tested. PPO inhibition in cotton results in a quick disruption of cell membranes and a build up of ethylene in the leaf causing it to abscise. From 1999 through 2005, 22 replicated small plot tests have been evaluated that had 109 different PPO inhibitor harvest aid treatments. The harvest aids were applied alone or in combinations with other harvest aids and/or adjuvants. In these tests, the use of PPO inhibitor harvest aids generally resulted in increased leaf defoliation, desiccation, and regrowth suppression. However, environmental conditions, maturity of the crop, variety of cotton and the management of soil moisture and nutrients are important variables that impact the performance of the harvest aid materials applied.

Product Information and Disclaimer

Accelerate® is a product marketed by Cerexagri, Inc.,
Action™ is a product tested for Novartis,

Aim® is a product marketed by FMC,
Appeal™ is a product tested for K-I Chemical U.S.A. Inc.,
Blizzard™ is a product marketed by Chemtura Corporation,
CottonQuik® is product marketed by DuPont Crop Protection,
Cyclone® Max is a product marketed by Zeneca Ag Products,
Def® 6 is a product marketed by Bayer CropScience,
DROPP® 50WP is a product marketed by Bayer CropScience,
ET™ is a product marketed by Nichino America, Inc.,
Finish® 6 Pro is a product marketed by Bayer CropScience,
Ginstar® is a product marketed by Bayer CropScience,
Gramoxone Inteon™ is a product marketed by Syngenta,
Gramoxone® Max is a product marketed by Syngenta,
Inspire™ is a product tested for Syngenta,
Prep™ is a product marketed by Bayer CropScience,
Resource® is a product marketed by Valent USA Corporation,
Roundup WeatherMAX® is a product marketed by Monsanto Company,