# EVALUATION OF MAGGROW TECHNOLOGY FOR DEFOLIATING COTTON IN MISSISSIPPI AND GEORGIA

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## Abstract

Harvest-aids are an important input in cotton production that effect harvest efficiency as well as help preserve cotton yield and quality. Correct spray volume and adequate spray coverage is critical for attaining the desired harvest-aid efficacy. The new MagGrow technology (magnetic manifold and rods installed on a sprayer), as per the manufacturer, claims to increase the spray coverage at current application rates (mostly 10 GPA) or provide same coverage at lower application rates. Therefore, two large-scale field trials were conducted in Mississippi and Georgia to evaluate the potential of MagGrow technology for defoliating cotton. The main objective of these studies was to evaluate and compare the harvest-aid efficacy of a commercial boom sprayer equipped with and without the MagGrow technology.
At both locations, harvest-aid applications were performed with two similar sprayers where one sprayer was equipped with the MagGrow technology and the other was not. An application rate of 10 GPA was used for the study in Mississippi whereas the Georgia Study utilized two different application rates – a standard rate of 10 GPA and a reduced rate of 8 GPA. For assessing efficacy, harvest-aid ratings including defoliation (%), green leaves (%), desiccated leaves (%), and green bolls (%) were performed at 7 and 10 days after application in Mississippi and Georgia, respectively. In Georgia, spray coverage was assessed using water-sensitive paper at top, middle and bottom of the plants during application for each treatment. Results indicated no differences in any of the harvest-aid measurements (defoliation (%), green leaves (%), desiccated leaves (%), and green bolls (%)) between the sprayer equipped with the MagGrow and the sprayer without the MagGrow technology at both locations. In Georgia study, spray coverage between the two spray systems was also not significantly different at both standard (10 GPA) and reduced (8 GPA) application rates. In summary, the MagGrow technology does not improve or reduce spray coverage and efficacy of harvest-aid products in these trials.

## Introduction

Cotton defoliation using chemicals is an important aspect of cotton production as natural defoliation is usually inadequate and not timely. Therefore, harvest-aids are an important input in cotton production as they can affect harvest efficiency as well as help preserve cotton yield and quality. Several factors including plant condition, weather at the time of application, spray coverage, and canopy penetration can influence the efficacy of a harvest-aid (Cathey, 1986; Oosterhuis et al., 1991). Siebert et al. (2005) suggested that harvest-aid applications should be made with flat-fan or hollow cone nozzles at carrier volumes of at least 10 gallons per acre to maximize efficacy. Ineffective applications due to comprised spray coverage or low spray volumes can result in reduced efficacy which either requires second application or can increase trash or leaves during harvest which reduces cotton yield and quality. Defoliation is a time-sensitive process and growers want to cover and spray more acres to maximize use of time. Thus, cotton growers are continuously looking for ways to improve harvest-aid application practices to attain increased efficacy while still being efficient with application volume and time.

The new MagGrow technology is currently being offered in the US to be utilized on commercial boom sprayers as an add-on system, which as per the manufacturer claims can help increase spray coverage from 20 to 50%, lower carrier volume (water usage) up to 50% and reduces spay drift up to 70% (MagGrow, 2021). The MagGrow technology (shown in Figure 1) consists of multiple magnetic manifolds (Figure 1a) installed between the tank and the section control on a sprayer as well as small stainless steel encased magnetic rods (Figure 1b) fitted inside the entire length of the spray boom. As per the manufacturer, the MagGrow technology helps achieve higher coverage at current application rates or same coverage at lower application rates. This technology is currently being evaluated across different spray applications and in different row and specialty crops across the United States. The MagGrow technology has not been fully evaluated for spray applications in cotton, specifically for application of harvest-aid products. Therefore, it needs an unbiased research-based evaluation to explore the potential benefits for defoliating cotton.


Figure 1. MagGrow technology installed on a boom sprayer. (a) Manifold and (b) stainless steel encased magnetic rods (Image source: www.maggrow.com).

## Objectives

The goal of this study was to investigate the potential of MagGrow technology for defoliating cotton. The main objective of this study was to evaluate and compare the harvest-aid efficacy of a commercial boom sprayer equipped with and without the MagGrow technology.

## Materials and Methods

Field studies were conducted in Mississippi and Georgia in 2020. In Mississippi, the study was conducted in a grower field located near Glendora, MS. The original treatments were to include a 2-pass harvest-aid system spaced about 7 days apart and both applications were going to include applications with the sprayer equipped with and without the MagGrow technology. However, the cooperator decided to apply the second application aerially. In Georgia, the study was conducted in a grower field in Lilly, GA. The study treatments consisted of a single application of harvest-aids at two different rates (standard rate of 10 GPA and a reduced rate of 8 GPA) with two similar CASE IH Patriot 3340 sprayers where one sprayer was equipped with the MagGrow technology and the other sprayer was not. In Mississippi, only one application rate of 10 GPA was used for comparison between the two sprayers. The study treatments for both locations are provided in Table 1. The treatments were implemented in strips across the field where each strip (sprayer pass) represented a study treatment. In Mississippi, the study treatments were replicated six times in an alternating pattern in the field whereas the treatments were replicated three times in the field in Georgia. At both locations, the harvest-aids were mixed before the application and applied at the same time with both sprayers. In Mississippi, both John Deere sprayers were equipped with the John Deere ExactApply Pulse Width Modulation (PWM) system, which can help maintain a constant pressure irrespective of the flow/ground speed changes during application. The Case IH sprayers used in Georgia were equipped with a standard Raven Technologies rate controller with a Viper 4 display for application control, and conventional spray nozzles without any PWM system or individual nozzle control.

Table 1. Information on study treatments for MagGrow evaluation studies conducted in Mississippi and Georgia.

| Treatments | Mississippi | Georgia |
|---|---|---|
| 1 | Conventional | Conventional – 10 GPA |
| 2 | MagGrow | MagGrow – 10 GPA |
| 3 | - | Conventional – 8 GPA |
| 4 | - | MagGrow – 8 GPA |

Beside study treatments, all other application parameters including nozzle type and size, harvest-aid products, and rate were kept consistent between the two spray systems (with and without the MagGrow technology) at both locations. Table 2 provides detailed information on application timing, equipment, weather, harvest-aid products, and other details for the studies conducted in Mississippi and Georgia. Both sprayers were calibrated to verify the application rate and check spray pattern across the boom prior to any applications (Figure 2a).

Figure 2. (a) Sprayer calibration before application, and (b) harvest-aid products being applied during the study in Georgia.

Table 2. Application information for the location, equipment, weather, and harvest-aid products for MagGrow evaluation studies in Mississippi and Georgia.

| Location | Glendora, MS | Lilly, GA |
|---|---|---|
| Application Date | 9/7/2022 | 10/15/2020 |
| Sprayer | John Deere R4023 (2) | Case IH Patriot 3340 (2) |
| Control System | John Deere ExactApply | Raven Viper 4 |
| Nozzle Spacing | 20 in. | 20 in. |
| Nozzle Type | PS3DQ008 | Wilger ER11004, ER11003 |
| Pressure | 50 PSI | 28 PSI |
| Boom Height | 60 in. | 60 in. |
| Application Rate | 10 GPA | 8 & 10 GPA |
| Application Width | 90 ft. | 90 ft. |
| Products | Dropp 1-50, Prep 1-4, 80/20 0.25% | Tribufos 6, Daze 4SC, Boll’d 6 SL |
| Weather | Sunny | Sunny |
| Humidity | 69% | 44% |
| Wind | S 4 mph | SE 3.5 mph |
| % open bolls before application | 60 | 75-80% |
| % green bolls before application | 40 | 20-25% |

Prior to any harvest-aid application, defoliation (%) and green bolls (%) were recorded in the field (Picture in Figure 3a) at both locations. For Georgia study, five plants were randomly selected along the center 60 ft. of the boom length within each strip for assessing spray coverage by placing water-sensitive paper at three different locations within the plant canopy – top, middle and bottom (Figure 3b). Prior to the application, percent open boll (%) and green bolls (%) were also recorded on all five plants within each strip. After being sprayed with the chemicals, the water-sensitive paper was carefully collected and analyzed using DepositScan software (WRK of, Oklahoma, Stillwater, OK) for percent coverage.

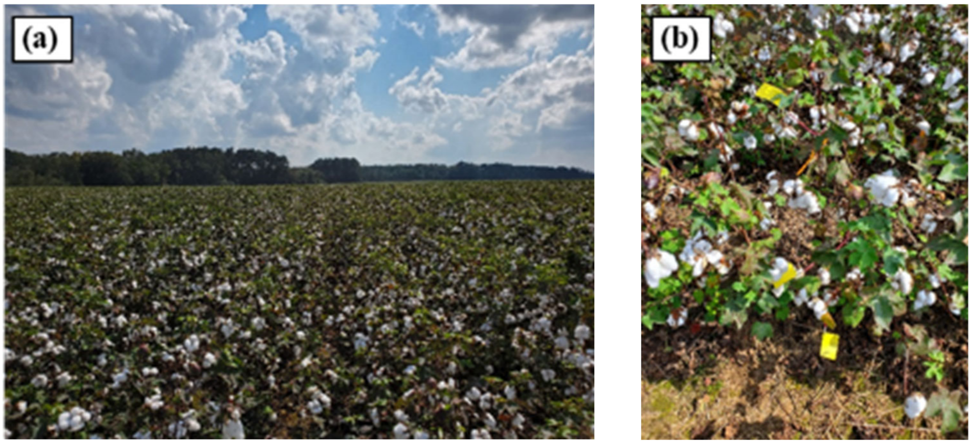


Figure 3. Pictures showing (a) foliage and defoliation in the field prior to harvest-aids application, and (b) placement of water-sensitive cards at different locations within the canopy.

In Mississippi, data were collected at 7 days after application which included defoliation (%), green leaves (%), desiccated leaves (%), and green bolls (%) for each treatment. Similar data were collected in Georgia at 10 days after application. These harvest-aid ratings were also collected on the same five plants by counting the number of green and open bolls before and after the application, and spray coverage data was collected during the application. Aerial imagery of the trial area in the field was also collected with a UAV equipped with an RGB camera before and after the applications at both locations. Data was analyzed using ANOVA using SAS 9.4 (SAS Institute, Cary, NC) and treatment means were compared using Tukey's HSD test at a significance level of $p \leq 0.10$.

## Results and Discussion

### Mississippi

Tables 3 presents harvest-aid ratings for the study conducted in Mississippi. At 7 days after application, the harvest-aid products had removed nearly 80% of the foliage based on visual ratings. The remaining leaves in the treatments nearly evenly split for either desiccated or green leaves. About 8% of the bolls remained unopen at the 7 days after application but this was a fairly dramatic increase from 40% prior to harvest-aid applications. There were no differences observed in any of the harvest-aid measurements between the sprayer equipped with the MagGrow and the sprayer without the MagGrow technology in this trial. Aerial imagery collected with a UAV (Figure 4) also showed no visual differences between the study treatments in these RGB images as well.

Table 3. Harvest-aid efficacy ratings for the MagGrow comparison.

| Trt# | Sprayer | Defoliation[a] (%) | Green Leaves (%) | Desiccated Leaves (%) | Green Bolls (%) |
|---|---|---|---|---|---|
| 1 | Conventional | 78.3 | 10.0 | 11.6 | 8.3 |
| 2 | MagGrow | 78.3 | 10.0 | 11.6 | 8.3 |
| *p-value (0.10)* | | NS[b] | NS | NS | NS |

a. Means were analyzed using Tukey's HSD Test for means separation ($p \leq 0.10$).
b. Abbreviations: ns = means are not significantly different.


Figure 4. Aerial imagery of the MagGrow evaluation trial near Glendora, MS.

**Georgia**

Based on the visual ratings before the harvest-aid application, there were about 15-20% green bolls and 80-85% open bolls in the field. Also, the cotton plants seemed to have about 85-90% of the green leaves as shown in figure 3 (a) before any harvest-aid applications. Similar visual ratings and observations were also noticed on the individual (five) plants that were marked for spray coverage data collection within each strip.

**Spray Coverage:**

Table 2 presents the spray coverage (%) at top, middle, and bottom of the plants for conventional sprayer and the MagGrow equipped sprayer at 10 and 8 GPA application rates. The data indicates that the spray coverage was slightly reduced at the middle and bottom of the plants compared to the top of the plants; however, no significant differences existed between the spray coverage at all three plant locations. There were no significant differences in the spray coverage between the conventional and MagGrow equipped sprayers at both application rates of 10 and 8 GPA. Figure 5 and 6 shows the spray coverage on water-sensitive paper at different locations in the canopy for conventional and MagGrow systems for applications at 10 and 8 GPA, respectively. It can be noticed that the spray coverage measured at all three plant locations (top, middle, and bottom) was pretty consistent and comparable between the two sprayer systems for both application rates of 10 and 8 GPA.

Table 4. Spray coverage data at different plant locations for MagGrow evaluation study.

| Trt# | Description | Top[a] (%) | Middle (%) | Bottom (%) |
|---|---|---|---|---|
| 1 | Conventional – 10 GPA | 3.9 | 3.3 | 3.4 |
| 2 | MagGrow – 10 GPA | 4.8 | 3.9 | 3.5 |
| 3 | Conventional – 8 GPA | 4.7 | 4.2 | 4.0 |
| 4 | MagGrow – 8 GPA | 4.5 | 3.8 | 3.7 |
| *p-value (0.10)* | | NS[b] | NS | NS |

a. Means were analyzed using Tukey's HSD Test for means comparison ($p \leq 0.10$)
b. NS = non-significant (means were not significantly different)

**Harvest-aid Efficacy:**

Table 3 presents the harvest-aid efficacy ratings at application rates of 10 and 8 GPA for the conventional and MagGrow systems. At 10 days after application, the harvest-aid products had removed more than 90% of the foliage. The remaining foliage on the plants consisted primarily of desiccated leaves (1.7 – 6.7%), and there were about 2.0 to 3.3% bolls that remained unopen in the field at 10 days after application. Data indicated no significant differences in defoliation (%), green leaves (%), desiccated leaves (%), and green bolls (%) between the conventional and MagGrow technology at both 10 and 8 GPA application rates. As noticed in the Mississippi study, there were no differences in any of the harvest-aid ratings between the sprayer equipped with the MagGrow technology and the conventional sprayer without the MagGrow system.

Aerial imagery collected on the same day as harvest-aid ratings also showed no differences among the study treatments (Figure 7).

Table 5. Harvest-aid efficacy ratings for the MagGrow evaluation study.

| Trt# | Description | Defoliation[a] | Green Leaves | Desiccated Leaves | Green Bolls |
|---|---|---|---|---|---|
| | | % | % | % | % |
| 1 | Conventional – 10 GPA | 93.3 | 0.0 | 6.7 | 2.0 |
| 2 | MagGrow – 10 GPA | 98.0 | 0.3 | 1.7 | 0.0 |
| 3 | Conventional – 8 GPA | 97.3 | 0.0 | 2.7 | 2.7 |
| 4 | MagGrow - 8 GPA | 91.7 | 0.0 | 8.3 | 3.3 |
| *p-value (0.10)* | | NS[b] | NS | NS | NS |

a) means were analyzed using Tukey's HSD Test for means comparison ($p \leq 0.10$)
b) NS = non-significant (means were not significantly different)

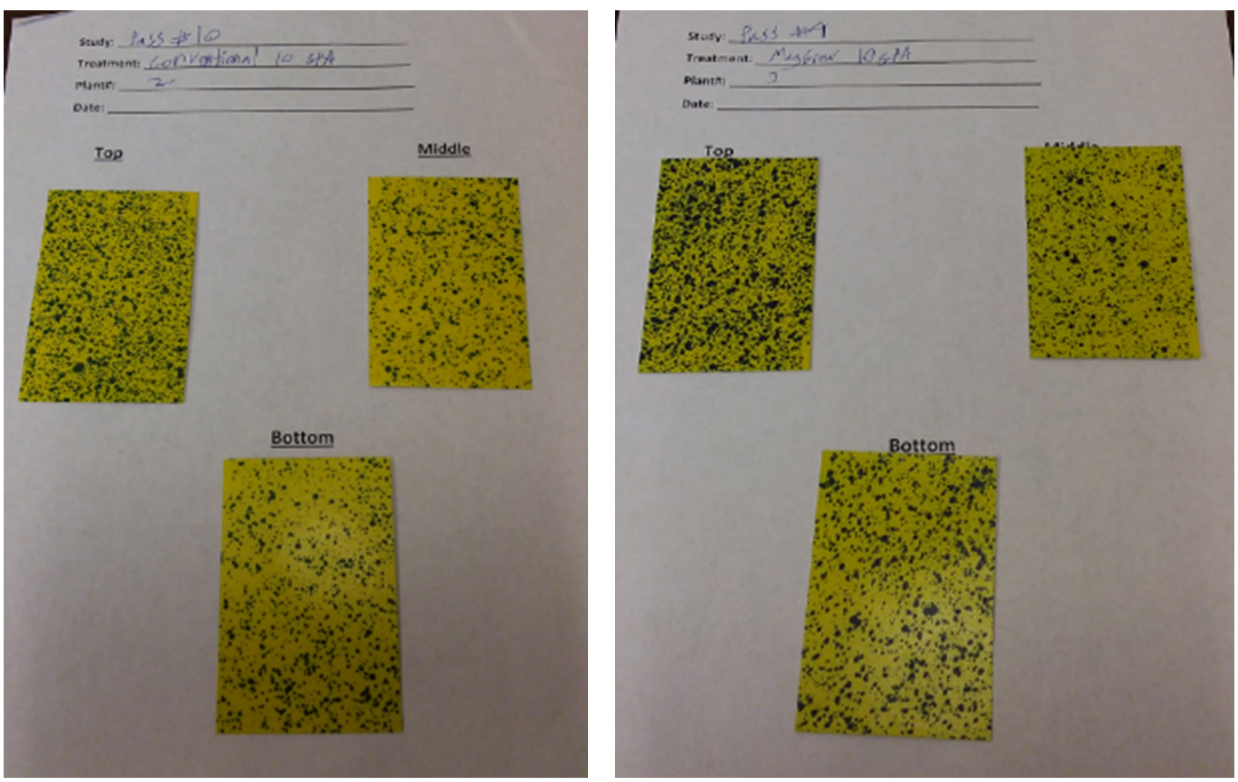


Figure 5. Illustration of spray coverage on water-sensitive paper at different locations for the conventional sprayer (left) and the sprayer equipped with the MagGrow technology (right) at 10 GPA rate.

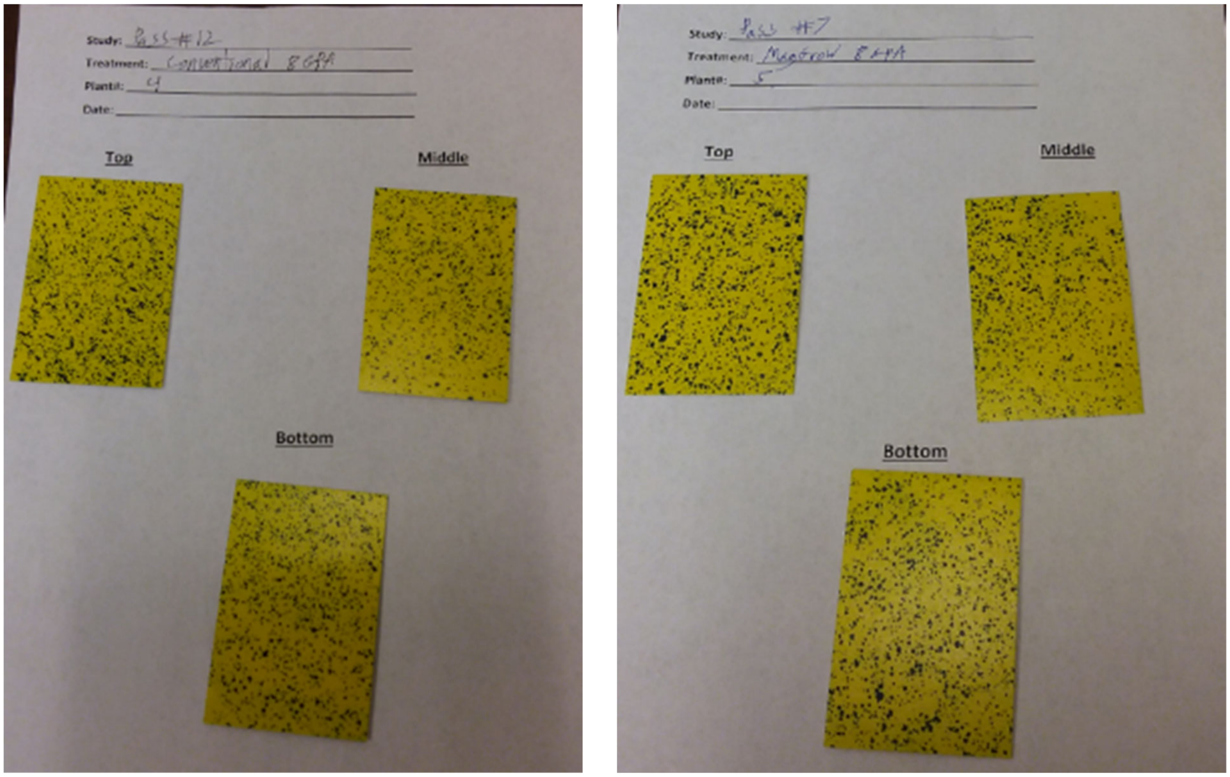


Figure 6. Illustration of spray coverage on water-sensitive paper at different locations for conventional sprayer (left) and the sprayer equipped with the MagGrow technology (right) at 8 GPA rate.

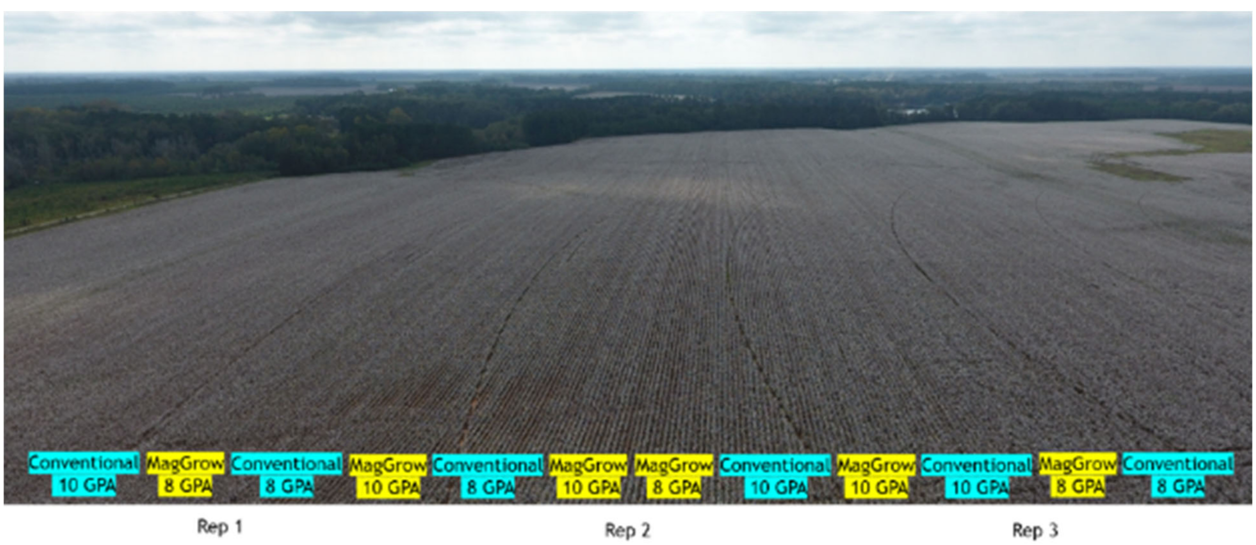


Figure 7. Aerial imagery of the field (with treatments labelled within each replication) at 10 days after harvest-aid applications in Georgia.

## Summary

Results from the studies conducted in Mississippi and Georgia indicated no differences in the harvest-aid efficacy (and spray coverage) between the sprayer equipped with the MagGrow technology and the sprayer without the MagGrow technology. In these trials, the MagGrow technology did not improve (or reduce) spray coverage and efficacy of the harvest-aid products used for defoliating cotton.

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