

**COMPARISON OF EFFECTS OF GLUFOSINATE TO MULTIPLE WIDESTRIKE® ROUNDUP FLEX®
AND LIBERTY LINK® BOLLGARD II® TRANSGENIC COTTON VARIETIES ON PLANT
DEVELOPMENT AND YIELD**

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Introduction

Herbicide-resistant cottons have revolutionized cotton production since Roundup Ready cotton was first introduced by Monsanto and DeltaPine in 1996. Because of the effectiveness and ease of use of Roundup Ready and subsequently Roundup Flex herbicide-resistant technology, growers rapidly adopted the technology in cotton and other crops as well in the late 1990's, including corn and soybeans. This led to widespread, repeated use of glyphosate applications yearly and has subsequently resulted in numerous *Amaranthus* (pigweed) species becoming tolerant/resistant to glyphosate throughout the Cotton Belt. As a result, growers began looking at other options to help manage the glyphosate resistant *Amaranthus* species.

One option was to use the herbicide Ignite (glufosinate), which has a relatively wide spectrum of activity, and had been reported to be an option for over-the-top application in PhytoGen Widestrike cotton varieties. In 2011, PhytoGen had at least seven varieties with WideStrike technology, a unique Lepidopteran two-gene Bt technology. One inherent trait linked to the WideStrike technology is some level of tolerance to the broad-spectrum herbicide, glufosinate. Glufosinate is the active ingredient in the cotton herbicide Ignite that is manufactured by Bayer CropSciences as well as other brands of herbicide. Bayer CropSciences has developed their own herbicide resistant technology in cotton, called Liberty Link Cotton. With Liberty Link technology, producers are able to apply Ignite over-the-top of cotton throughout the growing season with good crop tolerance; however, varieties containing the LL technology have not consistently performed well in the Upper Gulf Coast region of Texas which was the first region in Texas to experience glyphosate resistant *Amaranthus* species.

Both the Roundup and Ignite herbicide systems provide acceptable weed control on both susceptible grass and broadleaf weeds species, if applications are applied to the label. The Roundup system has been shown to be slightly more effective on susceptible broadleaf weeds than the Ignite system (Mott et al., 2011). In addition, previous studies suggest that PhytoGen 375 WRF cotton showed less phytotoxicity injury from the application of Ignite herbicide @ 22 oz/A and 29 oz/A over-the-top when it was applied to younger cotton, but the phytotoxicity injury increased as the plants progressed in their physiological development (Figures 1 & 2). Furthermore, the untreated check out-yielded both sequential Ignite treatments by 12% or more.

It should be noted that neither Bayer CropScience nor Dow AgroSciences stands behind the application of Ignite herbicide over-the-top of Widestrike, Round-up Flex cotton.

Objective

To evaluate the tolerance of over-the-top applications of Ignite to several Bayer Liberty Link and PhytoGen WideStrike cotton varieties, to multiple maximum-label rate applications of Ignite herbicide.

Materials and Methods

A field study was conducted at the Texas AgriLife Research and Extension Center near Snook, Texas (Burleson County). The study was planted on April 14, 2011. Plot sizes were 4 (40") rows by 40' long, with 3 replications arranged in a randomized complete block design. The previous crop was corn and fertility consisted of 80 lbs/A of N applied side-dressed on May 19. Herbicide applications were made at 15 gal/A with a self-propelled Lee Spider sprayer using 8002DG tips on a 20 inch spacing. See Table 1 for additional treatment information.

Table 1. Summary of application information, Snook, Texas, 2011.

	Application	
	A	B
Date	April 28	May 25
Placement	Foliar	Foliar
Crop Stage	1-2 TL	6-7 TL
Air Temp (°F)	78	84
Relative Humidity (%)	71	53
Wind (MPH) Direction	6 NW	7 S
Nozzle Size/Type	8002 DG	8002 DG
Nozzle Spacing	20"	20"
Carrier	Water	Water
Spray Volume (GPA)	15	15

The main treatments were over-the-top Ignite herbicide treated twice at 29 oz/a and hand-weeded. The secondary treatments consisted of 5 different varieties. See Table 2. Application A was applied on April 28 to cotton that was at 1-2 true leaves and application B was applied on May 31 to cotton that was at 6-7 true leaves.

Table 2. Summary of treatments, Snook, Texas, 2011.

Ignite 280 Treatment (2x @ 29 oz/a)	Hand-weeded Check
PHY 375 WRF	PHY 375 WRF
PHY 499 WRF	PHY 499 WRF
FM 1773 LLB2	FM 1773 LLB2
FM 4145 LLB2	FM 4145 LLB2
FM 1244 GLB2	FM 1244 GLB2

Data collection included stand counts on May 11, a visual vigor rating on May 11 and May 25 (1-9 scale, where 1 is the least vigorous and 9 being the most vigorous), plant height, total nodes and phytotoxicity ratings (1-9 scale, where 1 is no phytotoxicity injury to the plants and 9 being the most phytotoxicity damage to the plants) on June 13, and nodes above white flower were taken on July 7. Weed control for all plots was excellent throughout the length of the study. The center two rows of each plot were mechanically harvested on September 23 with a 2-row John Deere 9910 picker to determine lint yield. Cotton fiber quality was analyzed using HVI. Data were analyzed with ARM 8 using LSD at 5% level.

Results and Discussion

The 2011 growing season was characterized by record setting heat and drought which greatly affected cotton development and performance in this study, even though 6.15" of water was added through sprinkler irrigation and receiving 6.05" of rain during the growing season.

There were no differences in stand counts or visual vigor ratings among treatments on May 11. However, on May 25, differences in visual vigor ratings were observed. The hand weeded PHY 375 WRF and FM 1244 GLB2 treatments had a better vigor rating, than the Ignite treated.

On June 13, PHY 375 WRF and PHY 499 WRF varieties were shorter when treated with Ignite (Figure 1). No differences among treatments were observed based on total nodes at the same date (Figure 2). There were some slight differences in mean phytotoxicity ratings on June 13.

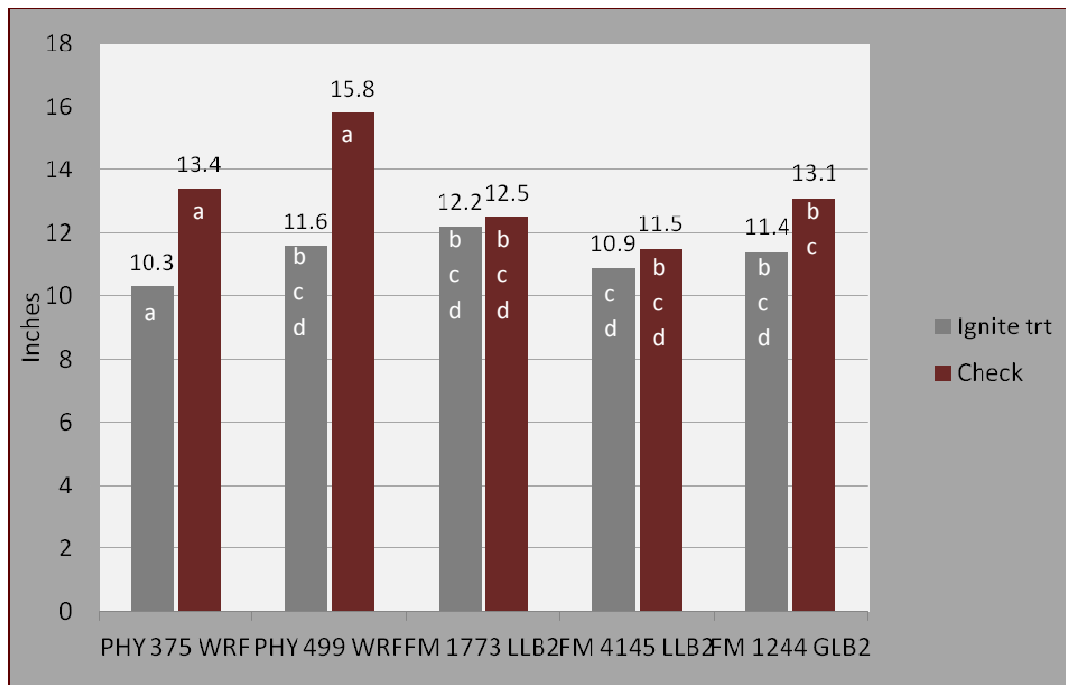


Figure 1. Mean plant height in inches among the Ignite and check (hand weeded plots), Snook, Texas, June 13, 2011.

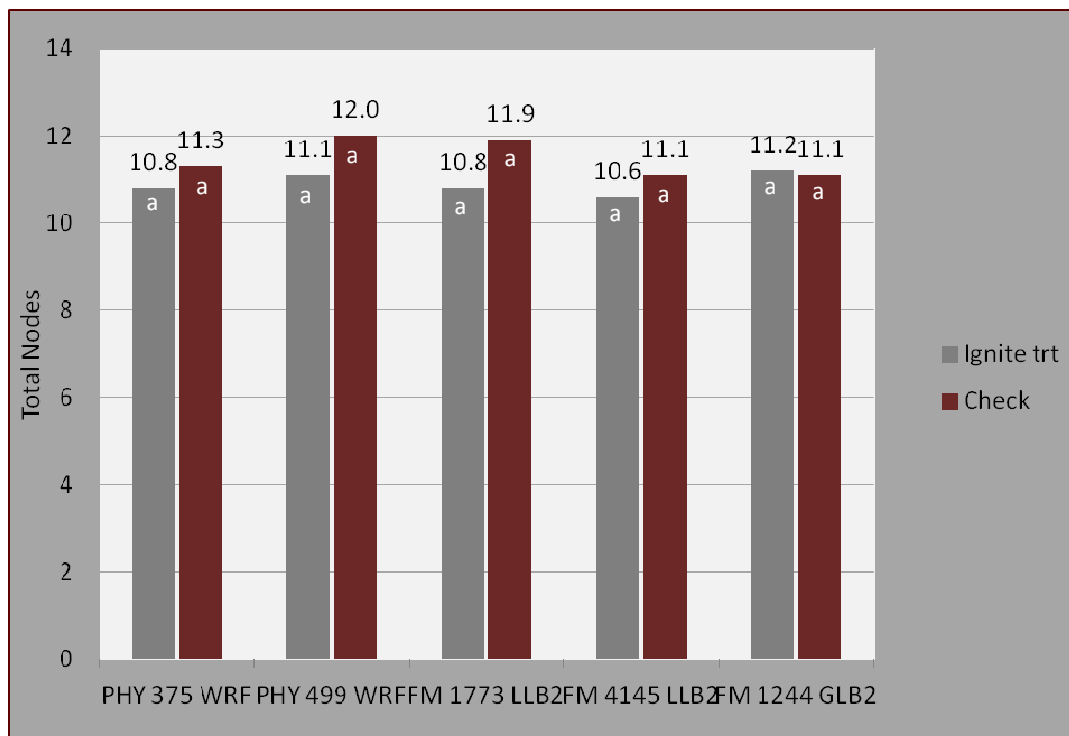


Figure 2. Mean plant nodes among the Ignite and check (hand weeded plots), Snook, Texas, June 13, 2011

On July 7, the Ignite treated PHY 375 WRF had a higher average nodes above white flower (NAWF) (Figure 3). This was likely due to Ignite applications detrimentally affecting PHY 375WRF, causing a delay in fruiting.

Both hand-weeded PhytoGen varieties, 375 WRF and 499 WRF, had higher mean yields than any other treatments, 535 and 615 lbs of lint/ac (Figure 4). The two Ignite treated PhytoGen varieties yielded similar to the Ignite treated and hand-weeded LLB2 varieties.

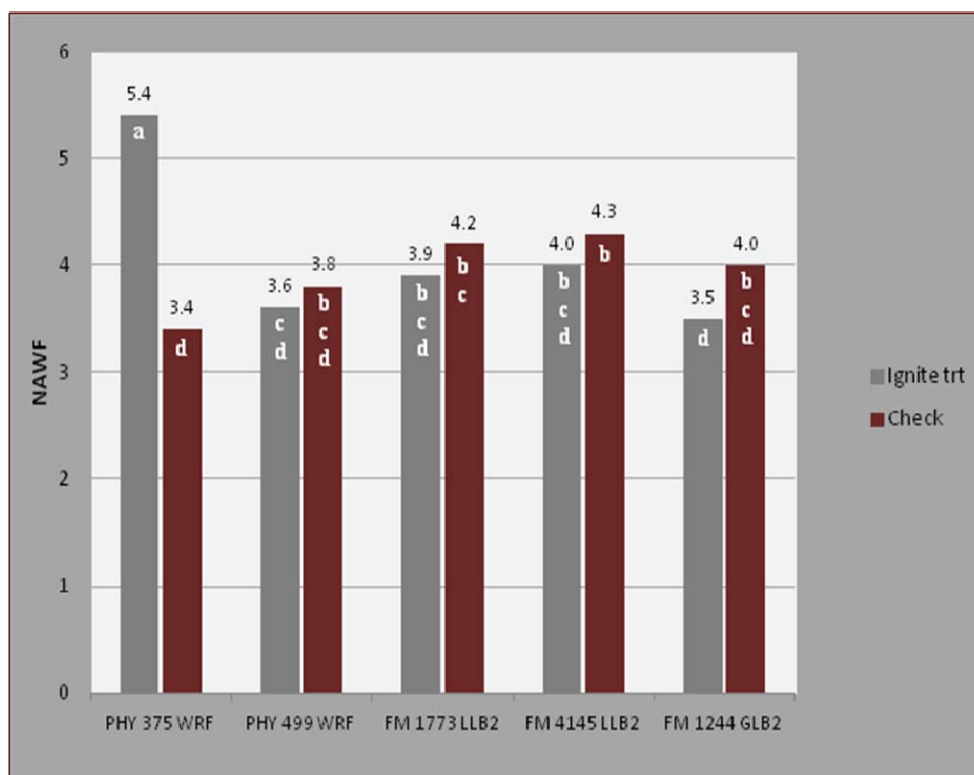


Figure 3. Mean nodes above white flower (NAWF) among the Ignite and check (hand weeded plots), Snook, Texas, June 13, 2011.

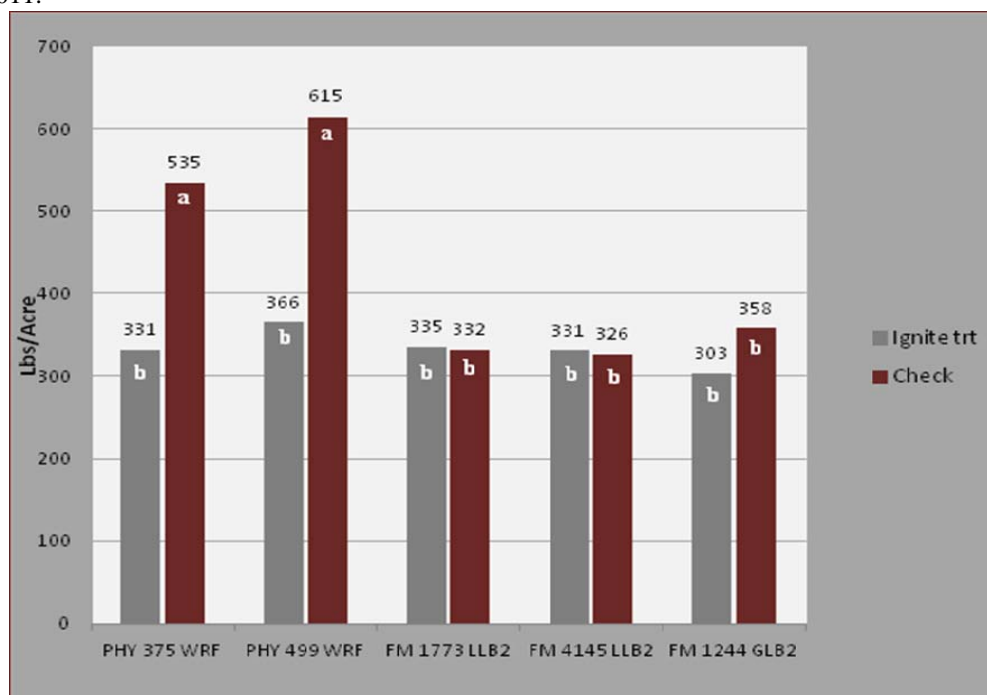


Figure 4. Mean yields among the Ignite and check (hand weeded plots), Snook, Texas, June 13, 2011.

There were no differences between individual varieties that were treated or un-treated with Ignite for mean lint length, strength or loan values (Table 2). In addition, there were no differences among any treatments in regards to mean micronaire and uniformity.

Table 2. Summary of fiber properties (length, strength, micronaire, uniformity and loan value) from Ignite treated and hand weeded plots, Snook, Texas, 2011.

Treatment		Length	Strength	Mic	Unif	Loan Value \$/Ac
Ignite Trt	PHY 375 WRF	1.08 cd	27.5 c	3.43	81.27	50.63 c
Ignite Trt	PHY 499 WRF	1.07 d	30.7	3.83	82.03	52.82 ab
Ignite Trt	FM 1773 LLB2	1.10 abc	29.8	3.97	81.07	53.37 a
Ignite Trt	FM 4145 LLB2	1.11 ab	28.9	3.80	81.63	53.28 a
Ignite Trt	FM 1244 GLB2	1.13 a	28.9	3.87	81.87	53.42 a
Hand Weed	PHY 375 WRF	1.06 d	27.0 c	3.73	80.83	51.80 bc
Hand Weed	PHY 499 WRF	1.08 bcd	31.7 a	3.83	82.57	53.23 a
Hand Weed	FM 1773 LLB2	1.12 a	29.8	3.87	81.57	52.98 ab
Hand Weed	FM 4145 LLB2	1.08 bcd	27.4 c	3.67	81.37	52.62 ab
Hand Weed	FM 1244 GLB2	1.13 a	28.7	3.67	81.13	52.77 ab
Mean		1.10	29.0	3.77	81.53	52.69
P>F		0.0002	0.0027	0.393	0.460	0.014
LSD (P=0.10)		0.0276	2.048	NS	NS	1.413
Std Dev		0.0161	1.194		0.882	0.824
CV%		1.47	4.11	6.49	1.08	1.56

The hand-weeded PHY 499 WRF and PHY 375 WRF treatments had the highest overall mean per acre lint values, \$327 and \$277, of all treatments (Figure 5). There were no differences in per acre lint value amongst the any of the other treatments.

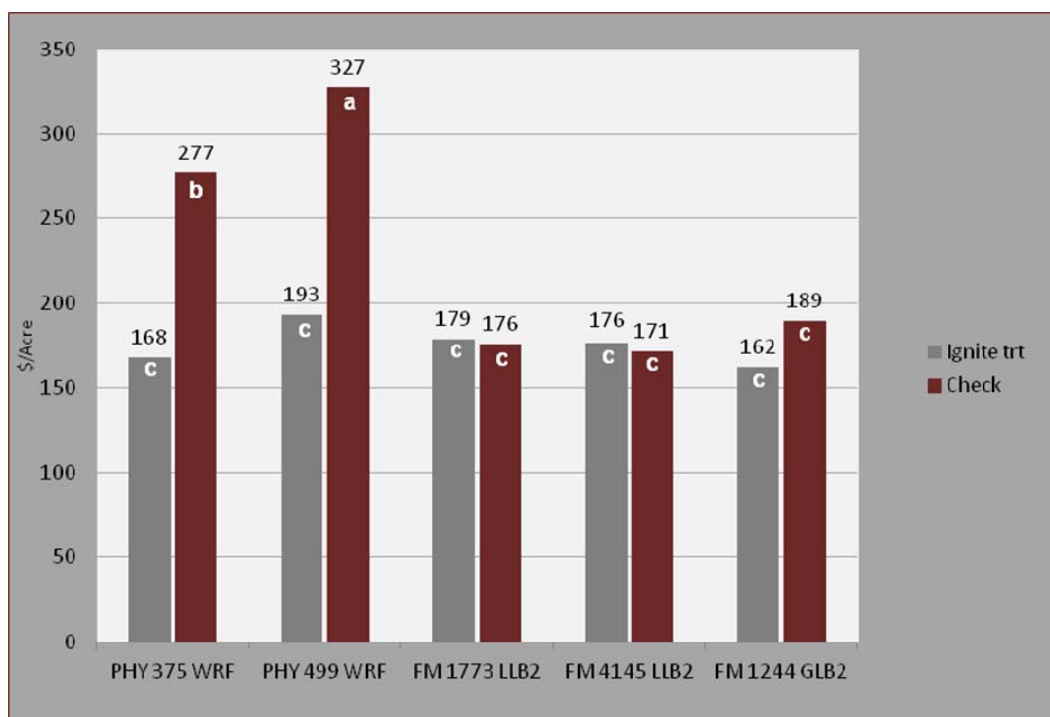


Figure 5. Mean lint value (\$/a) among the Ignite and check (hand weeded plots), Snook, Texas, 2011.

It is interesting to note that the only yield differences that were observed were from the 2 Phytogen WRF varieties. The two hand-weeded Phytogen varieties both out-yielded all other treatments, including their Ignite treated counterparts. These two hand-weeded varieties also had a greater mean plant height than their Ignite treated counterparts.

Conclusions

The LLB2 varieties demonstrated good crop tolerance to the over-the-top applications of Ignite herbicide. However, the yield potential of LLB2 varieties was not as high as the Phytogen varieties at this location.

The Phytogen WRF varieties that were not specifically designed for over-the-top applications of Ignite herbicide did exhibit detrimental physiological affects and yield response.

As previously mentioned, neither Bayer Crop-Science nor Dow AgroSciences stand behind applications of Ignite herbicide over-the-top of WRF cotton.

Acknowledgements

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References Cited

Mott, D.A., G.D. Morgan and J.D. Kerns. 2011. WideStrike Cotton Variety Tolerance to Ignite Applications in Texas. 2011 Beltwide Cotton Conference Proceedings, 1532-35. January 4-7, 2011, Atlanta, GA.