# YIELD EVALUATION OF THE GREY MILDEW (*Ramularia areola*) RESISTANCE TRAIT IN TWO COTTON CULTIVARS

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## INTRODUCTION

The importance of the cotton crop Brazilian agribusiness has been increasing considerably. This past season, the cultivated area of cotton in Brazil reached 1.4 million of hectares, 70% higher than in 2010. The success of Brazilian cotton production, in terms of yield potential and fiber quality, is recognized worldwide. However, in many production regions, cotton yields are hindered due to the occurrence of many constraining factors. In the Cerrado, one of the main causes of yield losses is the high incidence of Grey Mildew (*Ramularia areola,* Suassuna et al., 2008). In the past, infestation of Grey Mildew was specific for the end of the season; now the incidence of the disease is occurring earlier resulting in yield losses that can reach 35% (Iamamoto et al., 2002). The main damage of Grey Mildew to cotton boll rot and extensive defoliation that can result in premature cut out (Gondim et al., 1999). Previously considered a disease of little importance, Grey Mildew control now requires up to 10 fungicide applications during a growing season. The reasons for the complex management of the disease could be attributed to frequent rainy weather during the season and appearance of a strain resistant to the active ingredients of some fungicides.

The cotton crop in Brazil is cultivated under two distinct row spacing systems: conventional and narrow row. Conventional-row consists of a row spacing ranging between 0.76 m and 0.90 m; with this method cotton is the only crop, usually planted from Mid-December to Mid-January. In the Narrow-row spacing production system, cotton is usually planted after the end of January, following the harvest of the soybean crop (double-crop system) with a row spacing of 0.45 m or 0.50 m.

## OBJECTIVE

The objective of this research was to evaluate the performance of two cotton cultivars (FMT705 and FMT707) that confer resistance to Grey Mildew (*Ramularia areola*) in two different production systems.

### Hypothesis

It was hypothesized that the incidence of Grey Mildew will negatively affect the development and yield of cotton and that the cultivars with the disease resistant trait (FMT705 and FMT707) will minimize this effect.

## MATERIAL AND METHODS

### Experiment I (Conventional Row Spacing)

The field-trial was planted in Campo Verde, located in the southeast region of Mato Grosso state, in December 23$^{rd}$ of 2009 with a row spacing of 0.90 m. Treatments consisted of two factors: cultivars and fungicide application. The cultivars were divided in two categories based on resistance to Grey Mildew disease. Two cultivars (FMT705 e FMT707) developed by Fundação Mato Grosso were selected as the resistant genotypes and three susceptible cultivars (FMT701, DP604 BG, and FM993) were used as the control check. Fungicide treatment consisted of 5 different application frequencies (0, 2, 3, 4 and 5).

### Experiment II (Narrow Row Spacing)

The field-trial was planted in Primavera do Leste, also located in the southeast region of Mato Grosso state, in March 2$^{nd}$ of 2010 with a row spacing of 0.45 m. The treatments were similar to Experiment I with an inclusion of one additional susceptible cultivar (FMT523) and an exclusion of the treatment with 5 applications of fungicide.

**Common Aspects of Both Experiments**

The fungicide used was a commercial product with a mixture of Azoxystrobin (200 g $l^{-1}$) and Cyproconazole (80 g $l^{-1}$) and was applied at a rate of 0.3 l $ha^{-1}$. Treatment application was carried using a $CO_2$ backpack sprayer regulated to deliver a volume of 120 l $ha^{-1}$. The first treatment application was done at 50 days after planting and the subsequent treatments were applied in the interval of 2 weeks. The parameters measured included severity of the disease and lint yield. The severity of the Grey Mildew disease was measured as percent of infected leaves following methods of Aquino et al. (2008) at 90 days after the treatment initiation. The experiments were arranged in a randomized complete block design with four replications. Each trial was analyzed separately using ANOVA and means were separated with Scott-Knott test at a probability level of 0.05.

## RESULTS AND DISCUSSION

**Experiment I (Conventional Row Spacing)**

Results of Grey Mildew severity indicated a significant (*P<0.0001*) interaction effect between cultivars and fungicide application. The cultivars FMT705 and FMT707 were immune to Grey Mildew, exhibiting no occurrence of the disease in all fungicide treatments (Table 1). Among the susceptible cultivars the most sensitive to Grey Mildew was the DP604, followed by FMT701 and FM993. In general, the severity of the diseases decreased with increased fungicide application. The treatment with five applications was the best treatment, exhibiting the lowest amount of infected leaves; in this case it was observed a severity reduction of 16%, 22% and 17%, in the cultivars FMT701, DP604, and FM993, respectively. However, in the FMT701 no significant difference was observed between the treatments with four and five fungicide applications.

**Table1. Rating of Grey Mildew severity in the conventional row spacing experiment with cultivars FMT701, DP 604 BG, FM 993, FMT705, and FMT707.**

| Fungicide Treatment | Disease Severity (%infected leaves) | | | | |
|---|---|---|---|---|---|
| | FMT701 | DP604 | FM993 | FMT705 | FMT707 |
| 1-Control | 62.0 a* | 70.3 a | 57.0 a | 0.0 a | 0.0 a |
| 2- Two Applications (2X) | 54.0 b | 60.3 b | 49.0 b | 0.0 a | 0.0 a |
| 3- Three Applications (3X) | 51.0 b | 54.5 c | 45.0 c | 0.0 a | 0.0 a |
| 4- Four Applications (4X) | 49.0 c | 51.5 c | 43.0 d | 0.0 a | 0.0 a |
| 5- Five Applications (5X) | 46.0 c | 48.3 d | 40.0 e | 0.0 a | 0.0 a |

***Rows with the same letters are not significantly different (P=0.05).**

Data of lint yield had only a significant cultivar effect (*P<0.0001*); no significant interaction (*P=0.5999*) and fungicide treatment (*P=0.3222*) effects were observed. The highest lint yield was exhibited by the resistant cultivar FMT705 (2232.0 kg $ha^{-1}$); its value was significantly greater than all other cultivars (Fig. 1). The cultivar FMT707 had the second highest yield (2116.5 kg $ha^{-1}$), statistically different than the susceptible cultivars FMT701 (2023.5 kg $ha^{-1}$) and DP604 (1891.5 kg $ha^{-1}$), but not different than the cultivar FM993 (2074.5 kg $ha^{-1}$). Yield ranking (Fig. 1) of the susceptible cultivars followed the sequence of its sensitivity to Grey Mildew disease: FM993, FMT701, and DP604. It was expected that the analysis of yield data would have a significant interaction effect similar to the results of disease severity. However, the absence of interaction indicated that the reduction in disease severity observed with 5 fungicide applications was not sufficient to impact lint yield (Fig.2). Thus, a better a Grey Mildew control management (i.e. increase number of fungicide application) is recommended to protect cotton yields of susceptible cultivars.

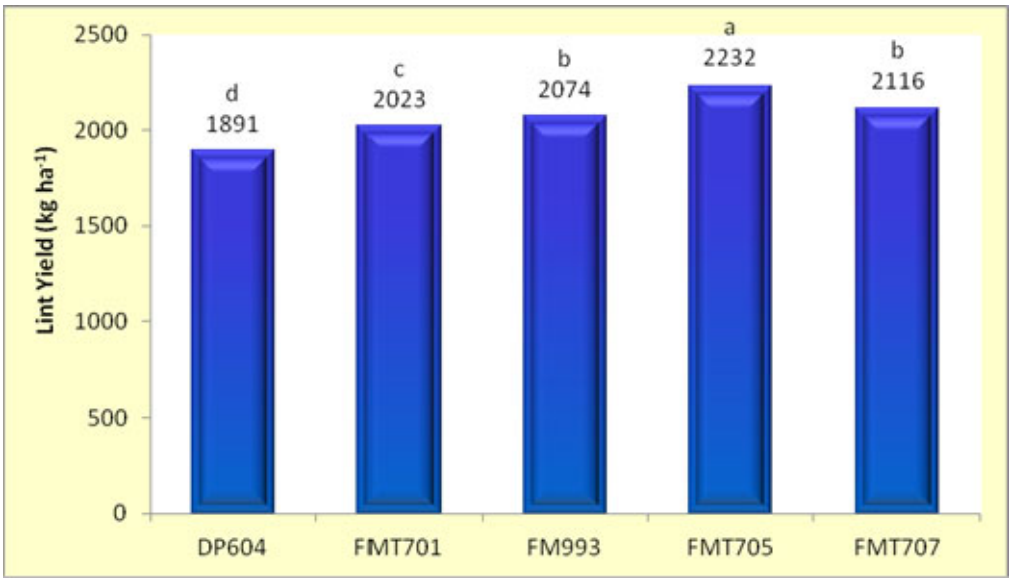


**Fig. 1. Effect of cultivars on cotton lint yield. Data averaged across fungicide treatments in the conventional row experiment. Columns not sharing a common letter are significantly different (P=0.05).**

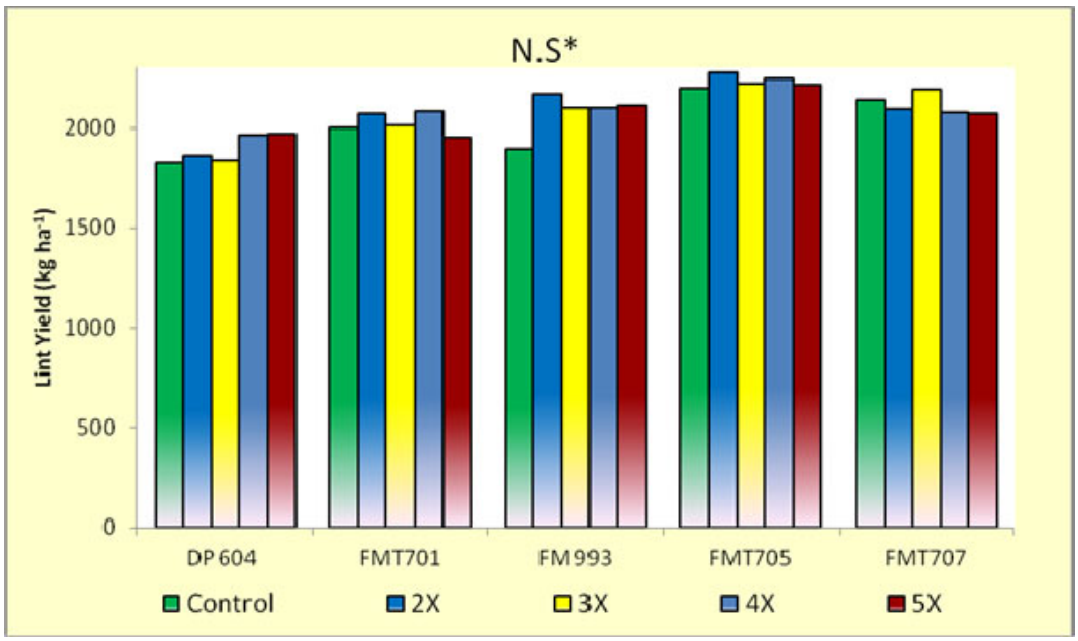


**Fig. 2. The interaction effect between cultivar and fungicide treatment on cotton lint yields in the conventional row experiment. N.S. = not significant (P=0.05).**

**Experiment II (Narrow Row Spacing)**

Similar to the conventional row spacing, the narrow row experiment indicated a significant (*P<0.0001*) interaction effect between cultivars and fungicide application in the measurement of disease severity, and only a significant (*P<0.0001*) cultivar effect in the data of yield (seedcotton). The main characteristics of the narrow row spacing (double-crop) are the precocity and drier growing conditions, which can result in low pressure of Grey Mildew in comparison with the conventional system. Cultivars FMT705 and FMT707 had no incidence of Grey Mildew (Table 2) and the best management to control the disease was the treatment with the highest (4x) fungicide application. Response of the susceptible cultivars to Grey Mildew, in the sequence of high to low sensitivity was: DP604, FM993, FMT523, and FMT701. The highest lint yields were exhibited by the resistant cultivars FMT707 (1123.2 kg

ha$^{-1}$) and FMT705 (1093.8 kg ha$^{-1}$), their values were significantly greater than all other cultivars (Fig. 3). The cultivars FMT701 (1023.0 kg ha$^{-1}$) and FMT523 (999.6 kg ha$^{-1}$) had the second highest yields and the lowest yields were observed in the cultivars FM993 (885.6 kg ha$^{-1}$ and DP604 (915.6 kg ha$^{-1}$).

**Table 2. Rating of Grey Mildew severity in the narrow row spacing experiment with the cultivars: FMT701, FMT523, DP 604 BG, FM 993, FMT705, and FMT707.**

| Fungicide Treatment | Disease Severity (%infected leaves) | | | | | |
|---|---|---|---|---|---|---|
| | FMT701 | FMT523 | DP604 | FM993 | FMT705 | FMT707 |
| 1-Testemunha | 44,5 a* | 48,8 a | 55,0 a | 48,5 a | 0,0 a | 0,0 a |
| 2- Two Applications | 37,8 b | 37,5 b | 45,0 b | 39,0 b | 0,0 a | 0,0 a |
| 3- Three Applications | 32,0 c | 34,5 b | 40,8 b | 33,3 c | 0,0 a | 0,0 a |
| 4- Four Applications | 26,8 d | 28,3 c | 32,5 c | 30,8 c | 0,0 a | 0,0 a |

***Rows with the same letters are not significantly different (P=0.05).**

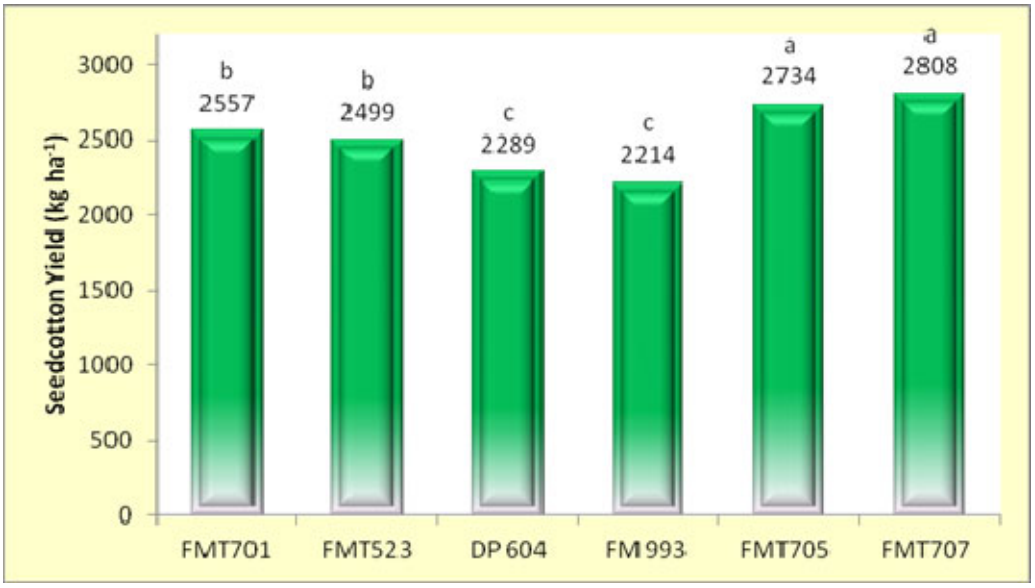


**Fig. 3. Effect of cultivar on seedcotton yield. Data averaged across fungicide treatments in the narrow row experiment. Columns not sharing a common letter are significantly different (P=0.05).**

## CONCLUSIONS

Incidence of Grey Mildew resulted in a significant reduction of cotton yields. Fungicide application decreased the severity of the disease in all susceptible cultivars but did not affect the yield parameters, possibly due to an unsatisfactory disease control. Highest yield values were obtained by the two Grey Mildew resistant cultivars, FMT705 and FMT707. The use of Grey Mildew resistant cultivars can be an effective tool to protect cotton yields in Mato Grosso.

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