EMERGENCE AND EPIDEMICS OF A NEW DISEASE IN ARAGUAIA VALLEY: ANTHRACNOSIS OF COTTON CAUSED BY *Colletotrichum truncatum*, VARIETAL REACTION AND DIFFICULTIES OF CHEMICAL CONTROL

**ABSTRACT:** Cotton culture (*Gossypium hirsutum* L.) is trending in an upward expansion amidst Brazilian “cerrado”. Due this growth, new pathosystems are growing in incidence on tropical fields in the region of Araguaia Valley - MT. Surveys and material collection were conducted out in production areas on two counties (Bom Jesus - MT and Canarana – MT), both regions represents a total amount of 50.000 hectares of cultivated area. The region also is characterized by succession areas previously sowed with soybean plants (main cover crop season). Previously surveys revealed the incidence of target spot (*Corynespora cassiicola*), ramularia spot (*Ramularia areola*) and cercosporiosis (*Cercospora gossypii*). Disease incidence is commonly observed on several crop management methods and cultivars. Due to a reduction in efficacy of chemichal control by fungicides spray programs, this disease is increasing and spreading in a faster rate in production areas with previous harvested soybean at the biggest soybean producer group in the world (Bom Futuro). Plants on field were selected due to differences in symptoms, and isolation methods were carried out on PDA (potato-dextrose-agar) before “in vitro” pathogenicity tests conducted on seedlings, detached leaves and bolls (growth chamber conditions of 23°C / photoperiod of 12 hours). After *Colletotrichum dextructor* sp. pathogenicity confirmation, bioassays were carried out with several different fungicide’s groups (i.e. registered for usage on Brazilian jurisdiction). This test consisted of the employment of a solution with 500 ppm of each different fungicide/a.i. that is applied on infected bolls and detached leaves who were inoculated with the target pathogen (concentration of $10^4$ conidia per mL). This test was followed by an infection (%) evaluation during 10 days of incubation. The incidence/prevalence index (%) was also evaluated at different parts of the plant (lower, middle, and upper canopy) on different cultivars/genotypes (130-150 days after sowing). A standard level of control by different fungicides, ranged between 0 to 100% of control. Two groups of cultivars/genotypes were separated after differences on resistance response, one with susceptible traits (FM 985 GLTP) and other with partial resistance traits. No immunity response was observed. We suggest that new efficacy tests should be carried out with combination of varietal response (resistance or tolerance) combined with other chemical fungicides for better understanding of synergism or positive interaction. Valuable information will highlight the best association for greater varietal response and yield against this necrotrophic pathogen (higher B0 – initial inoculum) survival during successive years of rotation main crop (cotton x soybean). Isolated spray of benzimidazoles, cupric (except cuprous oxide) and triple associations with triazoles or triazolinthione (prothioconazol) combined with strobilurins and carboxamides should be wisely administrated to manage this disease due to low efficiency (below 50%). New field and laboratory essay must be carried out to input data about resistance risk and clarify damage levels on leaves and bolls impacting yield.

**KEYWORDS:** Anthracnosis. Cotton. New disease. Chemical control. Genetic Control. Management.
been reported in Brazil and are growing in importance in recent years. The damage by an aggressor is fungus (biotrophic or necrotrophic), or bacteria in vegetative or reproductive parts, can reflect in addition losses to industrial product (cloth) performance. Adding up the Covid-19 Pandemic, after the oil prices fell worldwide contributed to the stimulation of synthetic fiber production that ended up affect the textile industry cost production per pound of cotton fiber weight. Ramularia spot is the main leaf disease, the optimum conditions for its development and development of field epidemics are stated in literature to a combination of 20-28°C and leaf wetness of at least 6 hours daily (mild rains or foliar dew). Also, incidence of sun (photo stimulation) on leaves, can lead to an abundant sporulation of the pathogen leading to defoliation of plants who also impairs the development of cotton bolls. Additional incidence of other leaf diseases caused by Cercospora spp., Alternaria spp., Colletotrichum gossypii var. cephalosporioides (ramulosus) could extend several impacts on plant overgrowth affecting the final products. Colletotrichum gossypii var. cephalosporioides characteristic conidia are ovoid with size of 6 to 17 μm with hyaline conidiophores generating numerous acervuli spikes, authors suggested that higher incidence usually is related to long periods of prolonged rain and its teleomorph form Glomerella gossypii Edg. was also described in Venezuela (COSTA, FRAGA, 1937; MALAGUTI, 1955). The pathogenicity and inoculation of several isolates can be confirmed by relatively simple methods, like an application of a solution of water and of conidia spray on younger cotton plants.

In the last 4 years, cotton became a great cover crop (“safra”) option to Brazilian farmers after succession/rotation with soybean in previously first option of harvest season (“safra”), this led to a certain difficulty in obtaining superior genotypes with broad resistance to disease complex that affects both crops (surplus in initial inoculum B0) . Genotypes such as Redenção and IAC 20 presents higher levels of resistance to leaf disease complex those as well are being unused over the years and became obsolete sources after showing lower yield on field (POLIZEL, JULIATTI, HAMAWAKI, PENNA, 2008). Currently, the most planted cultivars/genotypes in Brazil are the cultivar FM 985 GLTP and FM 911 GLTP, both shows superior boll quality and yield on the Araguaia Valley (northern region Mato Grosso state), but showed as well higher susceptibility that grew in importance in the last season (unknow etiology). This new disease was observed by farmers and growers in the region of Bom Jesus - MT and Canarana MT, they also reported that several fungicides spray (9-10 applications) could not reduce the higher levels of incidence thus affecting fiber quality and yield (kg.ha⁻¹). Several fungicide programs have been used by farmers, including the intense spray and rotation of several (multi-sites, strobilurins, triazoles and carboxamides) active ingredients. This also could be main reason of a growing concern that could be related to fungi isolates selection process on field after a wrong choice in timing spray and application interval in combination of fungicides groups without research data to support the Integrated plant disease management (IDM).

Vale do Araguaia – MT is a production region inside Brazilian transition between savannah (cerrado) and Amazon rainforest (equatorial climate), this region is characterized by well distributed precipitation closely to 2.000 mm by year during wet season (7 months) and a prolonged dry period (another 5 months). Cotton became a popular choice for growers after higher performance of yield and quality of cotton plants, who generates fibers with desirable characteristics. The averages in temperatures usually ranges between 25 to 28 °C. Leaf wetness after prolonged dew periods and optimum temperature contributes to the development of several foliar fungal etiologies. In this scenario, of a chemical control losing efficacy compromising yield after the vegetative development and fiber loss quality being affected by growth regulators promotion, there is an urgent need to carry out systematic and periodic surveys on the main diseases that occur in this culture that is strategic for agribusiness in Brazil and Araguaia region. The development of data to support sustainable management programs with fungicides (chemical and biological combination) in different cultivars/genotypes must be priority to cotton phytopathological research.

MATERIAL AND METHODS

Location of collection and sampling experiments

The collections of symptomatic material were carried out in Bom Jesus - MT (Fazenda Malú of the Bom Futuro group - MT) and Canarana - MT (Fazenda Cocal - Bom Futuro group - MT). The collections were carried out in areas with higher incidence and severity of phytopathogens in the lower, medium, and upper canopy of cotton plants in all cultivars/genotypes used experimentally and commercially by the farmer group. Samples of leaves, bolls and stems were stored in plastic bags and placed on foam boxes with ice (10 to 15 °C) and
transported to the Laboratory of Mycology and Plant Protection at the Institute of Agricultural Sciences in UFU (Uberlândia-MG) them stored again at 5 °C (refrigeration). Fungi isolation was conducted in PDA media (potato-dextrose-agar, with antibiotic agrimicina at 200 ppm) and placement at growth chamber (23 °C). Gerboxes tests were also conducted (wet growth chamber) at 20 different cultivars detached infected leaves, stems, and cotton bolls. The composition of genotypes/cultivars of Fibermax-Basf: FM 906 GLT, FM 911 GLTP, FM 944 GL, FM 954 GLT, FM 974 GLT, FM 975 WS and FM 985 GLTP possess technologies like Glitol (G), Liberty Link (L), Twin Link Plus (T) and Wild Strike (WS) technology, these OGM cultivars possess proteins related to resistance against defoliating caterpillars and glyphosate herbicide spray. Other plants samples had RX technology that confers partial resistance or tolerance to Ramularia areola, considered the main fungal disease of the crop. The multivariate samples were also composed by genotypes of Tropical Genetic Improvement: TMG 42 WS, TMG 44 B2RF, TMG 44 B2RF, TMG 47 B2RF, TMG 50 WS, TMG 61 RF, TMG 62 RF, TMG 81 WS and TMG 91 WS3. Lastly the cultivars 2106 GL, IMA 5801 B2RF, IMA 7501 WS and IMA 8405 GLT genotypes from the Instituto Mato Grossense do Algodão – Cotton Mato Grosso Institute (IMA) were as well sampled and tested. Most of the samples tested possessed several OGM technologies that varied from multiple genes that confers resistance to defoliating caterpillars, to multispectral herbicide (glyphosate) spray resistance. The company holders described that some cultivars/genotypes possess different levels of tolerance/resistance against ramulose (Colletotrichum gossypii var. cephalosporioides), gall nematode infection (Meloidogyne spp.), bacteriosis (Xanthomonas campesstris pv. malvacearum) and blue disease caused by cotton leafroll dwarf virus (CLRDV).

Isolation in culture medium from possible plant pathogens

To perform direct fungi isolation, sections of infected tissue were marginally cut close to the lesions (peripheral) or sporulation structures and placed in a moist chamber on Gerbox (ZAMBOLOM, PEREIRA, 2012), to obtain pure culture in PDA culture medium, routinely used to obtain isolates. Candidate cultures without the presence of saprophytic fungi, were selected to represents isolates with potential for association with the new pathology (disease). The candidate cultures obtained were grown in test tubes with PDA and stored by suitable methods for pathogenicity preservation. At least one hundred different samples were identified with presence of viruses or bacteria that could be contamination sources and were discarded as well (JULIATTI and POLIZEL, 2003; WATHINS 1968 and KIRKPATRICK, T.L.; ROTHROCK 2001).

Inoculations and pathogenicity tests

Inoculations were carried out on detached leaves and green cotton bolls not yet fully ripen or in the process of burst. Leaves and cotton bolls were superficially disinfected with a combination of solutions with 50 % alcohol after submitted to in 2 % sodium hypochlorite, and then washed with sterile water. Samples (separating bolls from leaves) were packed in Gerboxes with a thin layer of moistened sterile germitest paper and then inoculated with conidia at a concentration of $10^4$ per mL. Incubations were performed in growth chambers (GC) chambers at 12-hour photoperiod in 23 °C for 10 days. The evaluations consisted in incidence data whether the sample had pathogenic infection. Pair of leaves (unifoliolate leaf) of seedlings (cultivar NuOpal) were also inoculated, to confirm the etiology of the fungi involved (Koch postulate).

Reaction of Genotypes / cultivars

Genotypes resistance ranking was carried out in field with visual assessment of the prevalence index in each cultivar/genotype present in Bom Futuro group farms (50.000 ha), located in the municipalities of Canarana - MT and Bom Jesus - MT. Commercial plots of the following were evaluated: Fibermax (BASF) genotypes evaluated - FM 906 GLT, FM 911 GLTP, FM 944 GL, FM 954 GLT, FM 974 GLT, FM 975 WS and FM 985 GLTP; IMA cultivars - 2106 GL, IMA 5801 B2RF, IMA 7501 WS and IMA 8405 GLT genotypes from the Instituto Mato Grossense do Algodão – Cotton Mato Grosso Institute (IMA) were as well sampled and tested. Most of the samples tested possessed several OGM technologies that varied from multiple genes that confers resistance to defoliating caterpillars, to multispectral herbicide (glyphosate) spray resistance. The company holders described that some cultivars/genotypes possess different levels of tolerance/resistance against ramulose (Colletotrichum gossypii var. cephalosporioides), gall nematode infection (Meloidogyne spp.), bacteriosis (Xanthomonas campesstris pv. malvacearum) and blue disease caused by cotton leafroll dwarf virus (CLRDV).

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Healthy bolls and leaves were harvested in two cultivars (DP 1746 and FM 985 GLTP), both respectively corresponded to a collection on a field experimental area inside the research station JuiAgro B, G & P and LAMIP – UFU (growth chamber) both places are located in Uberlândia – MG. This biological material was treated for asepsis in solutions containing alcohol, sodium hypochlorite and sterile distilled water. Samples them were packed in Gerbox containing sterile Germtest paper for incubation after spray with 55 different commercial fungicides (Table 1), at doses of 500 mg kg\(^{-1}\) (ppm). These products consisted in registered or in process of crop registration (RET 3 - Temporary registration Level 3 - MAPA). The fungicides evaluated can be an important strategy in the management of this new disease. The fungicide spray was carried out by a hand manual sprayer used in gardening. The material was sprayed at run off point (detached leaves and cotton bolls) and them immediately a conidial suspension containing \textit{Colletotrichum truncatum} conidia at a concentration of 10\(^4\) conidia per mL was inoculated. Incubation took place at 23ºC for 10 days. Two repetitions were performed over time (separated by 10 days) the overall experiment was reproduced another time. After incubation, the percentage of severity (%) of diseased boll and leaf area was determined. The experimental design was completely randomized (CRD).

**Seedling inoculation**

Cotton seedlings with younger leaves were sprayed with all the fungicides reported in Table 1 (500 mg Kg\(^{-1}\)) and then inoculated with the virulent isolate (\textit{Colletotrichum dematium}) obtained in production area of Canarana - MT at a concentration of \(10^4\) conidia per mL. Incubation was carried in a growth chamber for 15 days. At least a 24-hour period inside a moist chamber (100 % of humidity) is needed for the germination and infection of conidial initial inoculum (B0) on leaves and plant stem. Fifteen days after inoculation, the seedlings were evaluated by percentage of severity (%). The experiment was carried twice replication over time and overall reproduction (vessels). Plots consisted of a single cotton plant grown up in 200 mL plastic cups, containing organic substrate.

**Data analysis**

The data were analysed using the SASM-AGRI software (ALTHAUS, CANTERI, GIGLIOTTI 2001; CANTERI et al. 2001). The averages were grouped in the same software by the Scott and Knott test at 1% probability (p <0.01) (CANTERI et. al. 2001).

**RESULTS AND DISCUSSION**

**Analysis of infected material from Canarana MT and Bom Jesus MT**

After sampling and processing infected leaves and cotton bolls on GC (growth chamber), the following fungi were isolated in culture media: \textit{Colletotrichum} spp., \textit{Alternaria alternata} and \textit{Fusarium} spp. The fungi with falcate conidia with dimensions ranging from 3 to 5 microns (width) and 25-30 microns (length) were selected in visual inspection on microscope (40 x). The forms of conidia’s visualized were similar the \textit{Colletotrichum truncatum} from soybeans, since this pathogen is not reported in cotton plants the name was attributed to the newly pathogen. Further studies in molecular biology must be conducted for better understanding and discard the hypothesis that the \textit{Colletotrichum truncatum} how adapted to a new host. This fungus is prevalent in infected leaves, stem, and cotton bolls (figures 1, 2, 3 and 4).
Figure 1. Symptoms of anthracnosis (*Colletotrichum truncatum*) in cotton plants. Leaves (A, C, D, E and F) and cotton bolls (B). Photograph. F.C.Juliatti. 2020.

Figure 2. Aggressive loss of lower leaves at bottom plant region by the new disease infection (A and B), detail of the infection in the reddish stem on the main stem (C) and symptoms in the cotton bolls (D and E). Photograph by F.C.Juliatti 2020.
Figure 3. Details of the infection of the pathogen, with mycelial formation (A and C) and production of acervuli (B) characteristic of the species and symptoms in newly bolls formation (D, E and F). Photograph by F.C. Juliatti 2020.

Figure 4. Production of acervuli by *C. truncatum* with spikes and formation of sickle-cell (falcate - dimensions 3-5 microns-25-30 microns) (A) and infection on cotton boll generating deformation (B). Photograph by F.C. Juliatti 2020.

Pathogenicity Test

The pathogenicity test after inoculation of the fungus *Colletotrichum truncatum* was confirmed, both in leaves and in detached cotton bolls. The phytopathogen grows and sporulates in PDA medium easily, at a temperature of 23 °C and photoperiod of 12 hours (figures 4 and 5).
Pathogenicity in young seedlings with 15 to 30 days, was observed 5 days after inoculation, with symptoms on the younger unifoliate leaf, showing symptoms typical of anthracnosis demonstrated and observed in field (Figure 6 – A, B, C and D). Initial circular necroses were observed five days after inoculation. They evolved from hydrosis lesions to circular and irregular necrosis. Symptoms were also observed in the reddish stems like the anthracnosis of beans and soybeans. Epidemic studies are being carried out to clarify on hosts if occurs transmission by seeds and the increasing sensitivity by genotypes / cultivars in younger plant phase (15-30 days) impacts on severity development.

Evaluation of fungicide efficiency in detached leaves and bolls

Fungicides (active ingredients - a.i.), trade names, chemical groups used in the essay are presented in Table 1, some are being used to supress...
disease development, but without field data to better clarify and solve the hypothesis of a defined strategy for this phytopathogen evolution on cotton cultivation in Vale do Araguaia - MT. All fungicides were adopted at a concentration of 500 ppm (mg.Kg⁻¹).

### Table 1. Fungicides used in the leaf and cotton bolls (boll) method applied in the control of cotton anthracnose caused by *Colletotrichum truncatum*. Uberlândia - MG, 2020. UFU, Uberlândia, 2020.

| Commercial Name or RET | Active Ingredient[^] | Concentration g.L⁻¹ | Chemical Group | Severity Medium-Leaves (%)[^] | % Control | Severity Medium-Bolls (%)[^] | % Control |
|------------------------|-----------------------|---------------------|----------------|-------------------------------|-----------|-------------------------------|-----------|
| 1- A20944 WG           | protioconazole + + 5.6 + 6.7 | Triazolinthione Carboxamide | + 20 k | 80 | 10 j | 90 |
| 2- ABACUS® SC          | pydiflumetofen piraclostrobin + + 260 + 160 | Strobilurin Triazole | + 55 e | 45 | 49 f | 51 |
| 3- ADA FF (Armern) WG  | ppxiconazole + + 40 + 500 | Triazolinthione | + 0 n | 100 | 0 k | 100 |
| 4- Alto 100 CE         | panocezoe piprocnonazol 100 | Ditiocarbamate Triazole | 0 n | 100 | 0 k | 100 |
| 5- APPROX Wg           | fluazinam tiophanate metic + + 375 + 375 | Fenilpiridinilamine + Benzimidazole | + 22 k | 78 | 20 i | 80 |
| 6- APPROACH PRIMA SC   | picoxistrobin ciproconazole + + 50 + 50 | Strobilurin Triazole | + 8 l | 92 | 30 h | 70 |
| 7- ATIVUM® CE          | epoxiconazole fluxapioxide + + 200 + 81 | Strobilurin Triazole | + 43 g | 57 | 10 j | 90 |
| 8- AUTHORITY SC        | azoxytrotisbion + + 125 + 125 | Strobilurin Triazole | + 5 m | 95 | 98 b | 2 |
| 9- BIOFAC SC           |.SetActive|Difecure|Set|Penicillium spp|Clorotalonil|2720|Isoftalonitile|5 m|95|40 g|60|
| 10- BRAVONIL® 720 SC   | metryam piraclostobin carbadazim + + 550 + 50 | Ditiocarbamate | + 0 n | 100 | 30 h | 70 |
| 11- CABRIO TOP® WG     | tiophanate metic 700 | Benzimidazol | 30 i | 70 | 30 h | 70 |
| 12- CARBOMAXx SC       | dificonazole ciproconazole + + 250 + 150 | Strobilurin | 0 n | 100 | 0 k | 100 |
| 13- CERCORIN 700 WP    | ciropconazole + + 250 | Strobilurin | 25 j | 75 | 0 k | 100 |
| 14- CYPRESS SC         | cupper oxychloride 1196.8 | Cupper | 80 b | 20 | 30 h | 70 |
| 15- COMET CE           | cupper oxychloride 588 | Cupper | 53 f | 47 | 30 h | 70 |
| 16- CUPRAL 700 WP      | cripoxistrobin + + 80 + 100 | Strobilurin | + 80 l | 70 | 30 h | 70 |
| 17- DIFERE SC          | azotrozinotisbion + + 300 + 150 | Strobilurin | + 50 f | 50 | 30 h | 70 |
| 18- DOMARK EXCELL SC   | benzoavindiflipyr mancoezb 800 | Strobilurin | + 80 f | 50 | 30 h | 70 |
| 19- ELATUS® WG         | chlorothalonil tebucazonol tebucazonol + + 450 + 50 | Isoftalonitile | + 10 l | 90 | 20 i | 80 |
| 20- ELEVE WP           | tebucazonol trebucazonol 200 | Strobilurin Triazole | + 80 l | 90 | 0 k | 100 |
| 21- FEZAN® GOLD        | tebucazonol trebucazonol 200 | Strobilurin Triazole | + 80 l | 90 | 0 k | 100 |
| 22- FOLICUR CE         | triffloxistrobion + + 150 + 175 | Strobilurin Triazole | + 58 d | 42 | 60 d | 40 |
| 23- FOX CE             | protioconazole + + 110 + 165 | Strobilurin Triazole | + 40 h | 60 | 100 a | 0 |
| 24- FOX XPRO SC        | metominostrobion trebucazonol cupper oxychloride 840 | Strobilurin Triazole | + 40 h | 60 | 100 a | 0 |
| 25- FUSÃO® CE          | cupper oxychloride 98 a | Cupper | 98 a | 2 | 100 a | 0 |
| No. | Product Name                      | Active Ingredients                  | CV (%) |
|-----|-----------------------------------|-------------------------------------|--------|
| 27  | HBD 276 SC                        | Chlorothalonil + Tebuconazole + Flu-trialol |        |
| 28  | HELMSTAR PLUS® SC                 | Chlorothalonil + Tebuconazole + Triazole | 4.96   |
| 29  | IMPACT 125 SC                     | Carbendazim + Tebuconazole + Cresoxy-metil + Mancozeb | 0.94   |
| 30  | LOCKER® SC                        | Mancozeb + Tebuconazole + Triazole | 0.94   |
| 31  | MANFIL 800 WP                     | Fentin Hidroxide + Tebuconazole + Strobilurin | 0.94   |
| 32  | MERTIN® 400 SC                    | Trifloxistrobin + Tebuconazole + Triazole | 0.94   |
| 33  | NATIVO SC                         | Protopiconazole + Tebuconazole + Triazole | 0.94   |
| 34  | NKF 58                            | Piraclostrobin + Epoxiconazole + Triazole | 0.94   |
| 35  | NKF 60 CE                         | Piraclostrobin + Fluapiroxoxide + Chlorothalonil | 0.94   |
| 36  | Opera® CE                         | Trifloxistrobin + Tebuconazole + Triazole | 0.94   |
| 37  | Orkestra® SC                      | Trifloxistrobin + Tebuconazole + Triazole | 0.94   |
| 38  | PREVINIL® SC                      | Trifloxistrobin + Tebuconazole + Triazole | 0.94   |
| 39  | PRIORI® SC                        | Trifloxistrobin + Tebuconazole + Triazole | 0.94   |
| 40  | PRIORI® TOP® SC                   | Trifloxistrobin + Tebuconazole + Triazole | 0.94   |
| 41  | PRIORI® XTRA® SC                  | Trifloxistrobin + Tebuconazole + Triazole | 0.94   |
| 42  | PRISMA PLUS CE                    | Trifloxistrobin + Tebuconazole + Triazole | 0.94   |
| 43  | RECONIL WP                        | Cupper Oxychloride + Strobilurin | 0.94   |
| 44  | REDSHEL5 750 WP                   | Cupper Oxychloride + Strobilurin | 0.94   |
| 45  | SCORE CE                          | Difenoconazole + Strobilurin | 0.94   |
| 46  | SERENADE SC                       | Bacillus subtilis + Strobilurin | 0.94   |
| 47  | SPHERE MAX SC                     | Difenoconazole + Strobilurin | 0.94   |
| 48  | STATUS SC                         | Difenoconazole + Strobilurin | 0.94   |
| 49  | SULFURMAX SC                      | Difenoconazole + Strobilurin | 0.94   |
| 50  | SUMILEX 500 WP                    | Proimidone + Difenoconazole + Strobilurin | 0.94   |
| 51  | TRIZIMAN WG                       | Azoxystrerin + Difenoconazole + Strobilurin | 0.94   |
| 52  | UNIZEB GLORY WG                   | Azoxystrerin + Mancozeb + Difenoconazole + Strobilurin | 0.94   |
| 53  | UNIZEB GOLD WG                    | Mancozeb + Difenoconazole + Strobilurin | 0.94   |
| 54  | VERSATILIS® SC                    | Fenpropimorph + Difenoconazole + Strobilurin | 0.94   |
| 55  | VESSARYA SC                       | Picoxistrobindox + Mancozeb + Difenoconazole + Strobilurin | 0.94   |

1 Experimental dose used of each active ingredients was 500 mg.L\(^{-1}\) (500 ppm); 2 Averages followed by the same letter vertically (column), do not differ by the Scott and Knott at 5% Probability; 3 Significant by Scott & Knott's 1% Probability test.
If we trace a limit in consideration of evaluated fungicides (Table 1) with a standard control percentage above 80%, 28 fungicides with possibilities of use in the management of the disease were categorized for foliar and 33 fungicides for cotton boll spray. We also need to establish a clear strategy for rotation of fungicides since some fungicides showed bellow of 10% control for both leaf and boll infection (reproductive and vegetative stage). The fungicides that showed 100% control in this initial screening for leaves and cotton bolls were duo and trio associations of protioconazole + mancozeb, cyproconazole, difeconazole + cyproconazole, mancozeb, procimidone, tebuconazole and azoxystrobin + mancozeb + cyproconazole. The inefficacy of carbendazim and fungicides derived from metallic copper (copper oxychloride and cuprous oxide) stands out. Proticonazole + pydiflumetofen, fluazinan + methyl thiophanate, metiran + pyraclostrobin, tetraconazole + azoxystrobin, chlorotalonil + tebuconazole, fentin hydroxide, trifloxystrobin + tebuconazole, protioconazole, trifloxystrobin, chlorotoxin, chlorothalonil, cuprous oxide, sulphur SC, azoxystrobin + mancozeb, mancozebe, fenpropimorph and picoxystrobin + benzovindiflupyr showed a minimum control efficacy around 70% for leaf and boll infection. We also noted that fungicides with the lowest control efficacy were biological, cupric, benzimidazoles + triazoles + strobilurines, benzimidazoles, carboxamide + strobilurines, carboxamide + strobilurines and carboxamide + triazolintione which presented a control percentage below 50% (Table 2) for both vegetative and reproductive organs. This type of information is very important to establish integrated management systems, or rotation of fungicides or active ingredients when seeking the rational management of the new epidemic focusing on biological control assisting chemical.

**Table 2.** Level of control (%) of cotton anthracnose caused by *Colletrotrichum truncatum* on leaves and fruits (cotton bolls) detached from cotton (*Gossypium hirsutum* L.). UFU, Uberlândia, 2020.

| Medium (Fungicides Groups) | % Control (Leaves) | % Control (Bolls) - Capsules |
|----------------------------|-------------------|----------------------------|
| Biofungicides              | 92                | 46                         |
| Benimidazoles              | 35                | 35                         |
| Benimidazole + Triazole +  | 20                | 0                          |
| Strobilurine               |                   |                            |
| Carboxamide + Strobilurine | 78                | 50                         |
| Carboxamide + Triazolinthione | 80            | 90                         |
| Carboxamide + Triazole +   | 92                | 70                         |
| Strobilurine               |                   |                            |
| Carboxamide + Triazolinthione + Strobilurine | 42 | 40 |
| Cupper                     | 36                | 53                         |
| Dicarboximide              | 100               | 100                        |
| Ditiocarbamate             | 98                | 67                         |
| Ditiocarbamate + Strobilurine | 98        | 80                         |
| Tinned Organic             | 100               | 90                         |
| Strobilurine               | 75                | 100                        |
| Strobilurine + Ditiocarbamate + Triazole | 100 | 100 |
| Strobilurine + Triazole    | 65                | 76                         |
| Strobilurine + Triazolinthione | 50        | 80                         |
| Fenilpiridinilamine +      | 80                | 100                        |
| Benimidazoles              |                   |                            |
| Isofaltanitrile            | 98                | 75                         |
| Isofaltanitrile + Triazole | 93                | 55                         |
| Morpholine                 | 90                | 100                        |
| Sulphur                    | 100               | 80                         |
| Triazole                   | 100               | 94                         |
| Triazolinthione            | 100               | 90                         |
Reaction of genotypes by prevalence index in the upper, middle and lower thirds of plants under field conditions

The Table 3 shows the cultivars or genotypes cultivated in the Araguaia Valley or during the experiment period and their reaction to anthracnose considering the prevalence index in the plant in the lower, middle and upper canopy of the plant, as well as the severity of symptoms and the consequent leaf destruction by *Colletotrichum truncatum*. The cultivar with the highest levels of severity was FM 985 GLTP, with an average severity in the evaluation on field up to 70 %, followed by FM 975 WS with 30 % severity (prevalence index). The superior severity in the cultivar FM 985 GLTP could be hypothesized of its representative growth area, since it’s one of the most cultivated cultivar/genotypes in Araguaia Valley – MT and given its productivity and fiber characteristics (source of cellulose, sugar and proteins). In some locations, the cultivar even showed a reduction of more than 60% in productivity. Given the higher virulence of this disease, its estimated the yield losses in cotton areas during the last two seasons could have reached more than 3.000 kilograms of cotton bolls per hectare.

Table 3. Reaction of cotton genotypes and cultivars under field conditions to anthracnose after 8 applications of different fungicides. Bom Jesus - MT and Canarana - MT, 2020.

| Cultivars or Genotypes | Reaction to anthracnosis - *Colletotrichum dextructor* new sp. | Cycle | Days |
|------------------------|---------------------------------------------------------------|-------|------|
| FM 906 GLT³⁴ | S - 10 % | Precocious | 140-160 |
| FM 911 GLTP³⁴ | S - 10 % | Precocious | 140-150 |
| FM 940 GLT³⁴ | S - 20 % | Medium | 160-180 |
| FM 954 GLT³⁴ | S - 20 % | Medium-Late | 160-190 |
| FM 974 GLT³⁴ | S - 20 % | Late | 170-190 |
| FM 985 GLTP³⁴ | S - 70 % | Late | 180-190 |
| FM 975 WS³⁴ | S - 30 % | Medium-Late | 160-190 |
| FM 944 GL³⁴ | S - 25 % | Medium | 160-180 |
| IMA 2106 GL³⁴ | S - 10 % | Medium | 160-180 |
| IMA 5801 B2RF³⁴ | S - 20 % | Medium-Precocious | 140-150 |
| IMA 7501 WS³⁴ | S - 20 % | Medium-Precocious | 140-150 |
| IMA 8405 GLT³⁴ | S - 10 % | Late | 160-180 |
| TMG 42 WS³ | S - 10 % | Medium-Precocious | 140-150 |
| TMG 44 B2RF³ | S - 10 % | Medium-Precocious | 140-150 |
| TMG 47 B2RF³ | S - 10 % | Medium-Late | 160-180 |
| TMG 50 WS3 | S - 10 % | Medium-Late | 140-150 |
| TMG 61 RF | S - 10 % | Medium | 140-160 |
| TMG 62 RF | S - 10 % | Medium | 140-160 |
| TMG 81 WS³ | S - 10 % | Late | 160-180 |
| TMG 91 WS3 | S - 10 % | Late | 160-180 |

Acronyms: (B) - Bougard, (G) Glitol Technology, (L Liberty Link, (T) Twin Link Plus and (WS) Wild Strike
1 Prevalence index in the lower, middle and upper third of infection (S- Susceptible). Plots or plots under application of fungicides with active rotation (8 sprays).
2 Tolerant to gall nematodes and *Rotylenchus reniformis*.
3 Tolerant to glyphosate herbicide, ramularia leaf spot and ramulosis.
4 Resistant to bacteriosis, blue disease and susceptible to atypical virus disease.
CONCLUSIONS

A level of control by different fungicides ranging from 0 to 100% was confirmed for leaves and bolls.

The prevalence index (%) was also evaluated, considering the three regions of the plant (lower, middle and upper canopy), on different genotypes under field conditions in the final stage of plant production (130-150 days).

The genotypes that were considered in this initial screening as susceptible was FM 985 GLTP and others were gauged as with presence of some certain degree of partial resistance.

No genotype was immune to the pathogen.

It is suggested that programs and management with fungicides be revised in order to find the best active ingredients for this new pathogen. Also new studies with fungicides (biological chemical) being associated with genotypes with greater varietal resistance should be conducted for this necrotrophic and destructive pathogen surviving phase (considering lowering the initial inoculum B0).

Benzimidazole fungicides, cupric (except cuprous oxide), Benzimidazole + Triazole + Strobilurine and Carboxamide + Triazolinthion + Strobilurin should be wisely administrated in production fields focusing the disease management due to its low efficiency (below 50%), after laboratory initial screening survey (leaves and cotton bolls).

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