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Evaluation of Combination of fungicides *in vitro* against Corynespora Leaf Spot Disease of Cotton under South Gujarat of India

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ABSTRACT: Cotton (*Gossypium hirsutum* L.) is one of the most important fiber crops playing a key role in the economic and social scenario of the globe. India is one of the major cotton growing countries in the world. India ranks first in area and second in the total production of cotton in the world. Cotton is grown worldwide for its natural fiber and oil. Cotton is primarily a raw material for a thriving textile industry and is also one of the most ancient and essential commercial crops, second only to food grains. In the present experiment, different combination products of fungicides were evaluated against the *Corynespora cassiicola* pathogen of cotton under *in vitro* condition results revealed that carbendazim 12% + mancozeb 63% WP and fluxapyroxad 167g/l + pyraclostrobin 333g/l SC significantly inhibited the growth of the *C. cassiicola* and proved strongly fungitoxic in nature.

Keywords: *Gossypium hirsutum, Corynespora cassiicola*, Target spot, Fungicide, Cotton.

INTRODUCTION

Cotton, "The White Gold" or the "King of Fibres" enjoys a pre-eminent status among all cash crops in the country and is the principal raw material for flourishing textile industry (Patel *et al*., 2021). Corynespora leaf blight of cotton (*Gossypium hirsutum* L.), also referred as "Target spot", is caused by *Corynespora cassiicola* (Berk & Curt.) Wei. Other than cotton the pathogen attacks on several crop plants. The disease was also reported for the first time on soybean in Bolivia in 1994 and on cotton in the State of Mato Grosso, Brazil in 1995 (Mehta and Barea 1994); Mehta *et al.* (2005). Cotton is affected by a number of important diseases that limit production in all locations where, the cotton crop is grown. As a subtropical to tropical crop that is grown over a wide range of latitudes as well as a perennial plant grown as an annual crop, cotton is often under stress that may exacerbate specific disease problems (Rothrock *et al*., 2015). There are four domesticated species of cotton, to include *G. arboreum* L. and *G. herbaceum* L. which, are both diploid and native to the Old World and *G. barbadense* L. and *G. hirsutum* L., both are tetraploid, which evolved in the New World (Lee and Fang 2015). *Gossypium arboreum* remains an important crop in India, while *G. herbaceum* is grown today for local use in the drier areas of Africa and Asia. *Gossypium barbadense* also known as extra-long-staple, Egyptian and Pima cotton, supplies about 3 to 5 per cent of the current world production of fiber. This type of cotton is mostly used for the production of luxury fabrics and sewing thread (Lee and Fang 2015). It is favored for some purposes due to its long, strong and fine fibers, however its relatively low yield has limited its importance in the total world production. Upland cotton fibers are used in the manufacture of variety of textile products, cordage and other non-woven products. Modern upland cultivars are high-yielding, day-length neutral, early-cropping plants with easily ginned, abundant fiber (Wendel and Albert 1992). Sandipan *et al*. (2022) found that Fluxapyroxad 167 g/litre + Pyroclostrobin 333 g/litre SC @ 0.6 g/litre of water with two sprays first from the initiation of the disease and second after the interval of 15 days recorded the lowest incidence of Bacterial leaf blight, Alternaria leaf spot disease and boll rot and recorded the highest seed cotton yield. The disease may cause heavy losses in the cotton growing regions of Gujarat. In the South Gujarat region from the survey results, it is found and evident that the disease inoculum level and pressure is low at this point/ period of time for this particular disease.

Information on Taxonomy. Taxonomically, *C. cassiicola* belongs to the kingdom Fungi, phylum Ascomycota, class Dothideomycetes and order Pleosporales, which contains other known plant

pathogens like Alternaria, Pyrenophora and Cochliobolus. On the basis of morphological characteristics, the fungus was initially classified as Helminthosporium, as both genera have similar conidial structure. However, subsequent phylogenetic analyses revealed that the genus Helminthosporium belongs to the family Massarinaceae while, the genus Corynespora is revealed to be polyphyletic (Voglmayr and Jacklitsch 2017). *Corynespora cassiicola* is closely related to and in the same clade as *C. smithii* but does not show a clear relationship to any other currently established families (Schoch *et al.,* 2009).

Symptoms. The pathogen causes infection on all above ground parts of cotton. Symptoms on the cotyledonary leaves appear as small circular spots. Infection on hypocotyls may cause seedling death. The foliar phase of the disease is characterized as small circular spots, varying between 2 mm and 10 mm. The well developed lesions are necrotic and show typical "target spot" symptoms, with some depression at the center of the lesion Mehta *et al*. (2005). In severe cases of infection the lesions coalesce and the leaves show severe necrosis followed by complete premature senescence and death of the leaf. Hence, the present investigation was undertaken to highlight intensely and thoroughly this disease by the use of different combination of fungicides to control in this study.

MATERIALS AND METHOD

Different combination of fungicides (Table 1) were tested for their effect on the growth of *C. cassiicola* using the poisoned food technique (Sinclair and Dhingra 1985). The technique involves cultivation of test organisms on a medium containing the test chemicals. In all the experiments, PDA was used as a basal medium. The required quantity of each chemical was incorporated aseptically in 100ml of PDA in 250ml flasks at the time of pouring the media in Petri plates. The medium is shaken well to give uniform dispersal of the chemicals and then in each Petri plate 5ml of medium was poured aseptically and allowed to solidify. The Petri plates were inoculated with a 5mm diameter mycelial disc cut from the periphery of seven days old fungal cultures. The mycelial disc was placed in the center of the plates in an inverted portion to make a direct contact with the poisoned medium and incubated at 27±2ºC for 10 days after inoculation. Simultaneously, as suitable control was also maintained by growing the fungus on chemical free PDA medium. Observations on the linear growth were recorded when, full growth of the fungus is observed in the control Petri plate.

The Per cent Growth Inhibition (PGI) of growth of the fungus in each treatment was calculated by using the formula given by Asalmol *et al.* (1990).

$$PGI = \frac{C - T}{C} \times 100$$

Where,
PGI - Per cent Growth Inhibition
C - Growth in control (mm)
T - Growth in treatment (mm)

Table 1: List of combination product of fungicides.

Treatment No.	Fungicides	Concentrations (ppm)		
		1	2	3
T_1	Pyraclostrobin 5% + Metiram 55%WG	1500	2000	2500
T_2	Captan 70% + Hexaconazole 5% WP	1500	2000	2500
T_3	Carbendazim 12% + Mancozeb 63% WP	1500	2000	2500
T_4	Metalaxyl 8% + Mancozeb 64%WP	1500	2000	2500
T_5	Fluxapyroxad 167g/l + Pyraclostrobin 333g/l SC	1500	2000	2500
T_6	Control	-	-	-

Design: Completely Randomized Design
Treatments: 16
Repetitions: 3
Method: Poisoned food technique
Location: Department of Plant Pathology, Post Graduate Laboratory, N. A. U., Navsari, Gujarat

RESULT AND DISCUSSION

The different combinations of fungicides *viz.,* pyraclostrobin 5% + metiram 55% WG, captan 70% + hexaconazole 5% WP, carbendazim 12% + mancozeb 63% WP, metalaxyl 8% + mancozeb 64% WP and fluxapyroxad 167g/l + pyraclostrobin 333g/lSC were evaluated at 1500, 2000 and 2500ppm concentrations using the poisoned food technique. The data revealed that as the fungicidal concentration increased the growth of the pathogen decreased. The regarding per cent inhibition of linear growth is presented in Table 2 and depicted in Photo 1 with Fig. 1.

Out of five combination products of the fungicides tested, efficacy of a carbendazim 12% + mancozeb 63% WP and fluxapyroxad 167g/l + pyraclostrobin 333g/lSC was the best with cent per cent growth inhibition of *C. cassiicola* at all the three concentrations inhibited cent per cent growth of the *C. cassiicola* and proved extremely fungitoxic.

The next best fungicide combination in order of merit at 2500ppm concentration was captan 70%+ hexaconazole 5% WP (96.66%) followed by pyraclostrobin 5% + metiram 55%WG (86.66%) and metalaxyl 8% + mancozeb 64%WP (79.26%). The next best treatment combination at 2000ppm concentration was captan 70% + hexaconazole 5% WP (90.00%) followed by pyraclostrobin 5% + metiram 55%WG (84.44%) and metalaxyl8% + mancozeb 64%WP (76.66%) and at 1500ppm concentration was captan 70% +

hexaconazole 5% WP (83.33%) followed by pyraclostrobin 5% + metiram 55% WG (80.00%) and metalaxyl 8%+ mancozeb 64% WP (79.26%).

These results are in agreement with the results obtained by Price *et al.* (2015), who reported fluxapyroxad + pyraclostrobin yielded the best against the *C. cassiicola.* Vishwakarma *et al.* (2020), who reported that carbendazim+ mancozeb at 50, 100 and 200 ppm completely inhibited the mycelium growth and sporulation of *C. cassiicola.*

Table 2: Inhibitory effect of combination products of the fungicides against the *Corynespora cassiicola* under *in vitro* condition.

Sr. No.	Technical name of fungicide	Conc. (ppm)	Average colony diameter of pathogen (mm)	Per cent inhibition over control
T_1	Pyraclostrobin 5% + Metiram 55%WG	1500 2000 2500	18.00 14.00 12.00	80.00 84.44 86.66
T_2	Captan 70% + Hexaconazole 5% WP	1500 2000 2500	15.00 9.00 3.00	83.33 90.00 96.66
T_3	Carbendazim 12% + Mancozeb 63% WP	1500 2000 2500	0.00 0.00 0.00	100.00 100.00 100.00
T_4	Metalaxyl 8% + Mancozeb 64% WP	1500 2000 2500	24.00 21.00 18.66	73.33 76.66 79.26
T_5	Fluxapyroxad 167g/l + Pyraclostrobin 333g/l SC	1500 2000 2500	0.00 0.00 0.00	100.00 100.00 100.00
T_6	Control	-	90.00	-
	SEm±		0.47	
	CD at 5%		1.40	
	CV%		3.62	

NOTE: Those treatment values are zero in all the repetitions are discarded from the ANOVA

Sr. No.	Technical name of fungicide	Concentration (ppm)		
		I	II	III
T_1	Pyraclostrobin 5% + Metiram 55% WG	1500	2000	2500
T_2	Captan 70% + Hexaconazole 5% WP	1500	2000	2500
T_3	Carbendazim 12% + Mancozeb 63% WP	1500	2000	2500
T_4	Metalaxyl 8% + Mancozeb 64%WP	1500	2000	2500
T_5	Fluxapyroxad 167g/l + Pyraclostrobin 333g/l SC	1500	2000	2500
T_6	Control	—	—	—

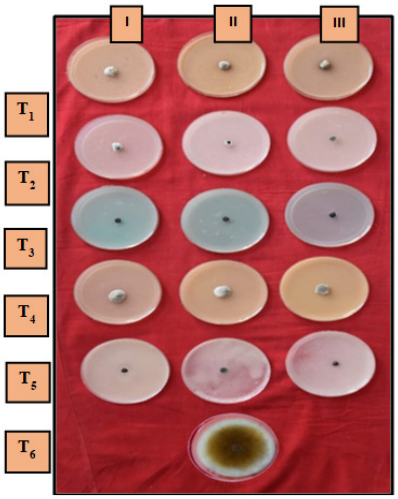

Photo 1: Evaluation of combination product of the fungicides against the *Corynespora cassiicola.*

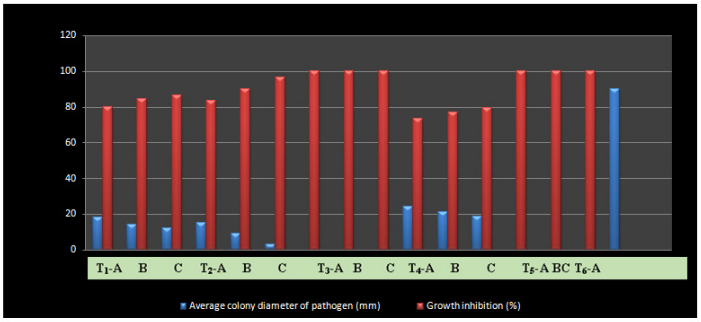

Fig. 1. Inhibitory effect of combination products of fungicides against the *Corynespora cassiicola* under *in vitro* condition.

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