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Management of anthracnose (*Vigna radiata* (L.) Wilczek] caused by *Colletotricum gleosporiodes* (Penz.) Penz. & Sacc.) disease in green gram through ready-mix fungicides under field conditions

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ABSTRACT

As a result of fungal diseases, green gram is prone to powdery mildew, anthracnose, cercospora leaf spot, and dry root rot. The one that has the most influence on the economy is anthracnose, which is caused by *Colletotricum gleosporiodes* (Penz.) Penz. & Sacc. The most important aspect of the study was the evaluation of fungicides, including Carbendazim 12%+ Mancozeb 63% WP, azoxystrobin 18.2%+ difenoconazole in three different concentrations to manage anthracnose under field conditions in 2020–2021 and 2021–2022, along with CIB recommended check metiram 55%+ pyraclostrobin 5% WG. According to the findings, treatment T_3 carbandazim 12% + mancozeb 63% 75 WP, 0.133%, had the lowest disease intensity of 11.84 and the highest disease control of 70.72, followed by T_6 azoxystrobin 18% + difenoconazole 11.4% SC, 0.133% (17.43 DI), T7 (metiram 55%) + pyraclostrobin 5% WG, 0.30% (20.15 DI), and T2 (20.92 DI). Treatments T_1 (carbendazim 12%+ mancozeb 63% WP, 0.066%), T_4 (azoxystrobin 18.2% + difenoconazole 11.4% SC, 0.066%), and T_5 (azoxystrobin 18.2%+ difenoconazole 11.4% SC, 0.010%) all achieved parity with disease control of 26.80, 27.49, and 28.08, respectively. The maximum illness intensity in the control group was 40.44.

Key words : *Green gram, Vigna radiata, Fungal diseases.*

Introduction

In India, greengram, also known as mung bean or moong, is a plant species that belongs to the family of legumes and is formally known as *Vigna radiata*. It is mostly grown in East Asia, Southeast Asia, and the Indian subcontinent, with India serving as its principal source of origin. It is the third most significant pulse crop in India, and it occupies almost 16% of the country's total pulse acreage. It includes 20–25% protein-rich seed, and occasionally, plants are chopped down and added to the soil to increase the nitrogen content of the soil. Being a short-duration pulse crop, it works well in mixed and crop rotations and can be used as a green manure crop or a crop that doubles as a soil-improving crop with leftovers added to the soil after pods are harvested.

Green gram is cultivated in practically every State and is mostly produced in India. With a productivity of 548 kg/ha and a total production of 2.5 million tonnes on around 4.5 million hectares, it accounts for 10% of the entire production of pulses. In 2020–21, 2.64 million tonnes of greengram would be produced, according to the third advance projections of the Government of India. 1.26 million tonnes of the nation's total 1.26 million tonnes of mungbean production are produced in Gujarat, which contributes the lion's share (DOA, Agriculture, farmers welfare and cooperation department, GOG). An attempt was made to assess the more recent fungicides, taking into account both the emerging and deadly character of the disease and the economic loss of the crop in this location.

The crop is affected by a number of fungi, and anthracnose, which is brought on by *Colletotricum gleosporiodes*, is one of the significant diseases that is frequently seen in green gram-growing regions of Gujarat. Its occurrence has dramatically increased over the past several years in Gujarat. Anthracnose of mungbean caused an average loss of 40.18 percent in seed output and 46.90 percent in stalk yield (Kulkarni, 2009).

The crops are susceptible to a wide range of illnesses caused by worms, bacteria, viruses, fungus, and abiotic stresses. These fungus-related illnesses include powdery mildew, anthracnose, cercospora leaf spot, and dry root rot. From an economic perspective, anthracnose is one of the most important diseases caused by *Colletotricum gleosporiodes* (Penz.) Penz. & Sacc. The first report of the green gram anthracnose was made in 1951 in Jorhat, Assam, India (Majid, 1953). The disease, which lowers seed quality and productivity and causes significant damage, has been observed in mild to severe form in all of India's major mung bean farming regions. Green gram yields are reduced by 18.2 to 86.5 percent as a result of the disease anthracnose (Fig. 1).

Materials and Methods

At the Anand Agricultural University's plant pathology farm in Anand, Gujarat, field research on the prevention of anthracnose in green gramm were conducted (22.530 N, 72.980 E). Research trials were established at permanent locations for the two years 2020-2021 and 2021-2022. The susceptible cultivar "Green gram; GM -4" was used in three replications in a randomized block design experiment. An experiment was carried out utilizing a 10 cm plant-to-plant distance and a 30 cm row-to-row distance in plots of 4.8 m by 2.4 m. There were eight treatments in total, including the control. The second week of July saw its planting. Irrigation and weeding were performed as necessary at various stages of crop growth. Conventional agronomic techniques were applied to the crop's growth. The N, P, and K dosages were applied at a rate of 60:40:00 kg ha-1 on average. The three distinct concentrations of all the ready-mix fungicides were applied at the first indication of the illness and one more 15 days later. The following treatments were utilized in the study: T_1: carbendazim 12% + mancozeb 63% WP, 0.066%; T_2: carbendazim 12% + mancozeb 63% WP, 0.10%; T_3: carbendazim 12% + mancozeb 63% WP, 0.133%; T_4: azoxystrobin 18.2% + difenoconazole 11.4% SC, 0.66%; T_5: azoxystrobin 18.2% + Spraying at a rate of 500 L per hectare (L/ha) was continued. The first spray of the matching ready-mix fungicides was sprayed 30 DAP, or at the onset of the disease. After

Fig. 1 Symptomatology of anthracnose disease of mungbean

that, one spray was sprayed after every 15 days.

The percentage disease intensity (PDI) of anthracnose was calculated using five randomly selected plants from each plot. Disease severity was assessed 10 days after each spray by randomly selecting and labelling 5 plants from each plot to obtain a percentage. Each plant has six leaves, two each from the bottom, centre, and top. Mayee and Datar (1986) evaluated the leaves on a scale of 0 to 9. Scale 0 = Leaf has no symptoms 1 = Tiny lesions no larger than a pinhead that only cover 1% of the leaf area, 3 = Pinhead-sized lesions that occupy 1–10% of the surface area of the leaf. Seven is the number of large lesions on leaves that cover 26–50% of the leaf area and are not merging. Cankers on the stem, a pod infection, and 9 = lesions that cover at least 51% of the leaf's surface. Leaf defoliation, severe cankers on the stem and pods, and plant blighting all occur. The PDI was calculated using the formula shown below (Wheeler, 1969): Calculating PDI requires multiplying [Sum of Individual Disease Ratings/Number of Observed Leaves X Maximum Disease Scale] by 100. To get the percent disease control (PDC), the following formula was used: PDC is determined by dividing [PDI in control by [PDI in treatment/PDI in control] by 100]. In order to convert the crop's seed production from kg/plot to kg/ha, a measurement was made. The observed illness intensity for anthracnose was converted into an angular format prior to statistical analysis. A difference between the treatments that was statistically significant was discovered by the Duncan's multiple range test (p 0.05).

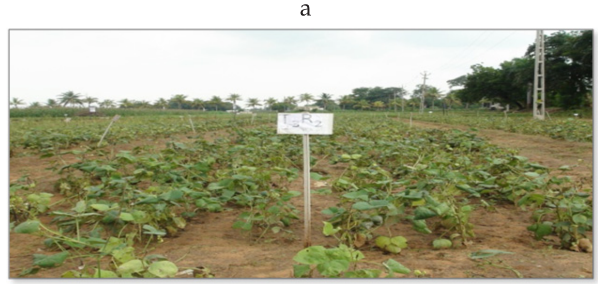
Results

The effectiveness of each treatment against anthracnose was assessed in relation to the control. The treatments T_3 (carbandazim 12%) + mancozeb (63%) 75 WP, 0.133%, T_6 (azoxystrobin 18%) + difenoconazole (11.4%) SC, 0.133% (17.43 DI), and T_7 (metiram 55%) + pyraclostrobin (5.0%) WG, 0.30% (20.15) had the lowest disease intensity and the maximum disease control, respectively (20.92 DI). Treatments T_1 and T_5 were at parity with disease control of 26.80, 27.49, and 28.08 for carbendazim 12%+ mancozeb 63% WP (T1), azoxystrobin 18.2%+ difenoconazole 11.4% SC (T4), and azoxystrobin 18.2%+ difenoconazole 11.4% SC (T_5), respectively. The control group had the highest illness intensity at 40.44. With a seed yield of 758 kg/ha and a yield increase of 89.02% over the control, treatment T_3 with carbandazim (12%) + mancozeb (63%) 75 WP, 0.133% was on par with treatment T_6 with azoxystrobin (18.2%) + difenoconazole (11.4%) SC, 0.133% (699 kg/ha), and treatment T_5 with azoxystrobin (18.2%) + difenoconazole. The lowest seed output was observed by the control group, at 401kg/ha.

The information in table 2 showed that the treatment with carbandazim (12%) + mancozeb (63%) 75 WP, 0.133% registered the highest (1:5.11) ICBR, followed by carbendazim (12%) + mancozeb (63% WP), 0.066% (1:4.16), carbendazim (12%) + mancozeb (63% WP, 0.10% (1:3.27), metiram (55% + pyraclostrobin 5% WG (1:1.26).

The current findings are the first to show that a new generation ready-mix fungicide, carbandazim (12%) + mancozeb (63%) 75 WP, 0.133%, effectively treats mungbean anthracnose infections in fields (Fig. 2). By using a combination of fungicides, each with a different mode of action, the range of diseases is broadened, activity is boosted, and resistance development is inhibited. The fungicides used in this study have a variety of mechanisms of action and have proven to be exceptionally effective against the anthracnose disease in real-world field settings. Following a two-year study, we were able

a



b

Fig. 2. Management of anthracnose disease of mungbean under field condition **a** Treatment T_3: carbandazim 12% + mancozeb 63% 75 WP, 0.133%, b.Treatment T_8:Control

to draw the conclusion that the ready-mix fungicide carbandazim (12%) + mancozeb (63%) 75 WP greatly decreased foliar diseases in the mungbean crop and broke the chain of pathogen resistance development. This fungicide could be used as a component of a programme for disease control to reduce disease risk.

Discussion

Apply the ready-to-use fungicides carbandazim (12%) + mancozeb (63%) 75 WP, 0.133% (18 g/10 l of water) twice to leaves, once at the start of the disease and once 15 days later, for effective treatment of the anthracnose disease. According to Patel *et al*. (2021), the combination of *Trichoderma herzianum* (10 g/kg seed) and carbendazim (3 g/kg seed) was more effective at improving germination and lowering the percentage of chickpeas that died from *Sclerotium rolfsii* Sacc-related sickness and mortality. Maurya *et al*. (2021) noticed in 2021 the inhibitory effects of botanicals and bioagents against *Ustilaginoidea virens* (Cooke) Takah, which results in false smut of rice. Following *Pseudomonas fluorescence* (41.87%), *Trichoderma viride* (40.35%), and *Trichoderma harzianum* (36.29%) in an *in vitro* context, *Bacillus subtilis* had the highest percentage of bioagent inhibition (53.55%). Kulkarni (2009) discovered that between 21.36 and 58.97 and 24.67 to 60.07%, respectively, the severity of the anthracnose on green gramme during the *kharif* of 2006 and 2007.

The least severe cases of the disease were those that

Table 1. Efficacy of different ready-mix fungicides on anthracnose disease of mungbean (Pooled data; 2020-21 and 2021-22)

Treatments	Before spray	PDI at 7 days after			Disease	Yield
		I spray	**II spray**	**Pooled**	Control (%)	(Kg/ha)
T_1	13.95(5.81)	31.73b(27.66)	32.29b(28.54)	32.00b(28.08)	30.56	632
T_2	14.41(6.19)	27.37c(21.14)	27.06cd(20.70)	27.22c(20.92)	48.27	603
T_3	14.60(6.35)	20.28d(12.61)	19.99e(11.69)	20.13d(11.84)	70.72	758
T_4	14.21(6.03)	31.56b(27.39)	31.68b(27.58)	31.62b (27.49)	32.02	551
T_5	13.99(5.84)	31.13b(26.73)	31.24bc(26.90)	31.18b(26.80)	33.73	658
T_6	14.79(6.52)	25.45c(18.47)	23.90de(16.41)	24.68c(17.43)	56.90	699
T_7	14.49(6.26)	26.50c(19.91)	26.84d(20.39)	26.67c(20.15)	50.17	646
T_8	14.47(6.24)	39.22a(39.98)	39.76a(40.91)	39.49a(40.44)	—	401
S.Em. ± T	0.212	0.950	1.177	0.888	—	31.07
Y	—	—	—	—	—	—
TxY	—	—	—	—	—	—
C.D.@ 5% T	NS	Sig.	Sig.	Sig.	—	89.29
Y	—	—	—	—	—	—
YxT	—	—	—	—	—	—
C.V.%	—	8.36	10.05	9.04	—	12.79

Table 2 Economics of fungicides evaluated against anthracnose disease of mungbean

Treatments	Quantity of fungicide required for 2 sprays (kg or litre/ha)	Price of fungicide (./litre or kg)	Total cost of fungicides (./ha)	Labour cost (./ha)	Total cost of plant protection (./ha)	Grain yield (kg/ha)	Net gain over control (kg/ha)	Realization (./ha)	ICBR
T_1	0.900	960	864	2464	3328	632	231	13860	1:4.16
T_2	1.300	960	1248	2464	3712	603	202	12120	1:3.27
T_3	1.800	960	1728	2464	4192	758	357	21420	1:5.11
T_4	2.200	2120	4664	2464	7128	551	150	9000	1:1.26
T_5	3.400	2120	7208	2464	9672	658	257	15420	1:1.59
T_6	4.500	2120	9540	2464	12004	699	298	17880	1:1.49
T_7	3.000	2181.3	6544	2464	9008	646	245	14700	1:1.63
T_8	-	-	-	0	0	401	-	-	-

received Azotobacter seed treatment, two sprays of zinc at the CRI and booting stages, and soil applications of *Tirchoderma* through FYM, according to Husain *et al*. (2021) .'s analysis of the impact of integrated diseases management (IDM) modules for the control of stripe rust of wheat. The conidia survived for 120 days in a glasshouse environment, compared to 210 days in a room environment, according to Kulkarni (2009). When protected from the sun by trees, conidia continued to exist for 240 days. It took spores a maximum of 360 days to become viable under freezing temperatures. Under field circumstances, conidial viability was at its lowest (90 days). The control of the mungbean anthracnose disease was discovered by Chaudhari and Gohel (2016) to be impacted by the new generation of fungicides known as strobilurins (i.e. azoxystrobin and trifloxystrobin). The Strobilurins work by preventing the fungi's mitochondria from respiring. The ability of Strobilurins to suppress fungi from all four plant pathogen groups- Ascomycota, Basidiomycota, Deuteromycota, and Oomycota-is one of the main factors in their success. Anthracnose of mungbean caused an average loss of 40.18 percent in seed output and 46.90 percent in stalk yield (Kulkarni, 2009).

According to Hammia and Bouatrous's evaluation of Ruta chalepensis L.'s essential oil's antifungal potential against Mauginiella scaettae, the fungus that causes date palm (Phoenix dactylifera L.) inflorescence rot, the yield of essential oil produced by hydrodistilling *R. chalepensis*' aerial part was 0.41 0.02%. Shovan *et al*. (2008) assessed the efficacy of five fungicides at concentrations of 100, 200, and 400 ppm against the *C. dematium* that causes soybean anthracnose. These fungicides included propiconazole 25 EC, Carboxin-200, iprodione 50 WP, mancozeb, and cupravit. At all of the studied concentrations, propiconazole 25 EC was found to totally suppress the fungus that causes anthracnose. Carbendazim was discovered by Tasiwal *et al*., 2009 to be the chemical that was most effective at preventing the mycelial growth of *C. gloeosporioides* at three different concentrations (0.05, 0.1, and 0.15%) out of all those that were tested. Using nine fungicides, Jagtap *et al.* (2013) tested them in vitro against *C. truncatum*, the organism that causes soybean anthracnose/pod blight. The researchers found that mancozeb had the highest mean colony diameter (10.38 mm) and the lowest mycelial growth inhibition when compared to the untreated control, whereas carbendazim had the lowest mean colony diameter (7.52 mm) and the highest mycelial growth inhibition (91.63%). Consequently, the findings of prior studies are in agreement with those of the current one. Kumbhar and More (2013) investigated how well five fungicides from the Triazole group, including Tebuconazole 25.9 EC, Difenconazole 25 EC, Hexaconazole 5 SC, Tricyclazole 75 WP, and Propiconazole 25 EC, worked against the chilli fruit rot disease. When compared to the other fungicides tested, tebuconazole was shown to be the most effective, reducing fruit rot incidence and intensity by 69.96% and 73.56%, respectively, when compared to an unsprayed control. In vitro evaluation of new molecule fungicides against Rhizoctonia solani Kuhn causing sheath blight disease in rice, found that complete inhibition was recorded under treatment Propineb, Propiconazole, Hexaconazole, and Carbendazim while, in Kresoxim methyl (89.04%, 94.16%), Tebuconazole + Trifloxystrobin (93.70%).

Conclusion

According to the results of this study, foliar sprays of Carbandazim (12%) + Mancozeb (63%) 75 WP, 0.133% (1.8 ml l^{-1} of water) were found to be more effective in managing anthracnose diseases in mungbean and demonstrated good seed yield along with the highest 1:5.11 ICBR. The first spray was applied at the onset of the disease, or 30 DAP. The second spray was applied at a 15-day interval this treatment might be used more extensively as a part of disease management.

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References

Anonymous, 2004. Recommended dietary allowance for Indians. *Survey of Indian Agriculture*, Pub . *The Hindu*, pp. 54.

Anonymous, 2012. FAO *Bull. Stat*, Statistics Division of Economics and Social Department, 2: 54.

Arora, P.P. 1989. Genetic divergence studies and scope for improvement in chickpea. *Nation. Symp.On few frontlines in Pulse Res*. 32-36.

Chaudhari, K.A. and Gohel , N.M. 2016. Management of anthracnose disease of mungbean through new fungicidal formulations. *Journal of Pure and Applied Microbiology.* 10(1) : 691-696.

Hammia, H. and Bouatrous Y. 2021. Evaluation of antifungal potential of *Ruta chalepensis* L. essential oil against *Mauginiella scaettae*, fungus responsible for the inflorescence rot of date palm (*Phoenix dactylifera*L.) *Ann. Phytomed*. 10(2): 442 - 447.

Husain, A., Biswas, S.K., Khan, J.B., Kumar, S. and Salman, M. 2021. Effect of integrated diseases management (IDM) modules for the management of stripe rust of wheat. *Ann. Phytomed*. 10(2): 521 - 529.

Jagtap, G.P. Gavate, D.C. and Dev, U. 2013. Management of *Colletotrichum truncatum* causing anthracnose/ pod blight of soybean by fungicides. *Indian Phytopath.* 66(2): 177-181.

John, M.P. 1991. *The Mung Bean*, Oxford and IBH Publishing Co. Pvt. Ltd., pp. 375.

Kulkarni, S. A. 2009. *Epidemiology and integrated management of anthracnose of green gram.* M.Sc. (Agri.) Thesis submitted to UAS, Dharwad, Karnataka.

Kumbhar, C.T. and More, S.M. 2013. Efficacy of triazole fungicides in controlling fruit rot of chilli. *Int. J. Pl. Prof.* 6(2): 257-261.

Laxman, R. 2006. Studies on leaf spot of green gram caused by *Colletotrichum truncatum* (Schw.)

Majid, S. 1953. Annu. Reptr. Dept. Agric., Assam for year ending 31st March 1950. II. *The Grow More Food Campaign* 11: 107.

Maurya, 2021. Inhibitory effect of botanicals and bioagents against *Ustilaginoidea virens* (Cooke) Takah. causing false smut of rice. *Phytomed*. 10(2): 515 - 520.

Mayee, C.D. and Datar, V.V. 1986. Phytopathometry Technical Bulletin-I, Marathawada Agricultural University, Parbhani, India, pp. 146.

Patel, S.K., Rahul, S.N. and Singh, S.K. 2021. Effect of botanicals on collar rot of chickpea caused by *Sclerotium rolfsii* Sacc. in combination with *Trichoderma harzianum Ann. Phytomed.* 10(2): 502 - 506, 2021.

Shovan, L.R., Bhuiyan, M. K.A., Begum, J.A. and Pervez, Z. 2008. *In vitro* control of *Colletotrichum dematium* causing anthracnose of soybean by fungicides, plant extracts and *Trichoderma harzianum*. *Int. J. Sustain. Crop Prod.* 3(3): 10-17.

Singh, D.P. 1995. Breeding for resistance to diseases in pulse crops. In: *Genetic Research and Education*: *Current Trends and Fifty Years*, B. Sharma (Ed.) Indian Society of Genetics and Plant Breeding, New Delhi. pp. 339-420,

Singh, V. and Singh, B. 1992. Tropical grain legume as important human foods. *Eco Bot*, 1646: 310-321.

Tasiwal, V., Benagi, V.I., Hegde, Y.R., Kamanna, B.C. and Naik, K.R. 2009. *In vitro* evaluation of botanicals, bioagents and fungicides against anthracnose of papaya caused by *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc. *Karnataka J. Agric. Sci*. 22(4): 803-806.

Wheeler, B.E.J. 1969. *An Introduction to Plant Disease*, John Wiley and Sons Ltd., London, p.301.