Determination of Eco-Friendly management of maydis leaf blight (*Bipolaris maydis*) of maize

(*Zea mays* L.)

ABSTRACT: Maydis leaf blight is the destructive foliar fungal disease causes considerable losses in maize crop. Disease appears as young small and diamond shaped lesions, as they mature, they elongate. The present investigationwas carried out in *kharif*season in the year 2023-2024 under field conditions. Eight treatments were tested against maydis leaf light *viz.Trichoderma viride* @ 5g/ha (ST) + Turmeric rhizome extract @ 10% (FS), *T. viride* @ 5g/ha (ST) + Garlic clove extract @ 10% (FS), *T. viride* @ 5g/ha (ST) + Neem leaf extract @ 10% (FS), *T. viride* @ 5g/ha (ST) + Eucalyptus leaf extract @ 10% (FS), *T. viride* @ 5g/ha (ST) + Tulsi leaf extract @ 10% (FS), *T. viride* @ 5g/ha (ST) + Datura leaf extract @ 10% (FS), Propiconazole 25 EC @ 0.1% as treated check and untreated control in Randomize Block Design with three replications. Among all the treatments minimum disease intensity (%) was recorded in treatment *T.viride* @ 5g/kg + Garlic clove extract @ 10% (26.98%) followed by *T.viride* @ 5g/kg + Neem leaf extract @ 10% (28.90%), *T.viride* @ 5g/kg +Datura leaf extract @ 10% (31.44%), *T.viride* @ 5g/kg + Turmeric rhizome extract @ 10% (34.32%), *T.viride* @ 5g/kg + Eucalyptus leaf extract @ 10% (37.88), *T.viride* @ 5g/kg + Tulsi leaf extract @ 10% (38.90%) as compared to control and maximum plant height (cm) (168.40), number of leaves (19.46), cob length (cm) (18.92cm), yield (t/ha) (4.25t/ha) and cost benefit ratio (1:2.4) was recorded in treatment *T.viride* @ 5g/kg + Garlic clove extract @ 10% compared to control.

Keywords: *Bipolaris maydis*, Botanicals, Maize, Maydis leaf blight.

Introduction

"Maize (*Zea mays*) is one of the most important cereal crops of the world and contributes to food security in most of the developing countries. Maize is grown throughout the world under a wide range of climatic conditions. Maize is a member of grass family and domesticated in Mexico, about 10,000 years ago"**(Bharti *et al.*, 2020)."**In India, maize is emerging as third most important crop after rice and wheat. Its importance lies in the fact, that it is not only used for human food and animal feed but at the same time it is also widely used for corn starch industry, corn oil production, baby corns etc.It is cultivated in nearly 205 m ha with a production of 1210 m tonnes and productivity of 5878 kg/ha all over the world. India produced 33.62 million tonnes in an area of 10.04 million hectares in 2021-22, whereas in *kharif* 2022-23, maize production was 23.10 million tonnes in an area of 9.68 million hectares"**(PJTSAU 2023)**. "In 2022 the maize production of Uttar Pradesh was 2.21 million tonnes. In India, about 35 diseases are reported from different locations and predominantly of fungal and bacterial origin. The crop is affected by several fungal diseases like smut, rust, anthracnose, charcoal rot, curvularia leaf spot, downy mildews, maydis leaf blight, banded leaf and sheath blight, brown spot, etc. of which maydis leaf blight is a serious foliar disease of maize and can cause up to 40-70 per cent yield losses"**(Vanlalhruaia*et al.*, 2022)**. Maydis leaf blight caused by *Bipolaris maydis* was first discovered by Drechsler (1925), in United States, but it was first identified in India by Munjal and Kapoor (1960) in the Malda district of West Bengal. In 1970's an epidemic in USA was occured by this pathogen in maize with Texas male-sterile cytoplasm **(Chaudhary *et al.*, 2023)**. "The symptoms O strain of the fungus appears as young small and diamond shaped lesions. As they mature, they elongate. Growth is limited by adjacent veins, so final lesion shape is rectangular and 2 to 3 cm long. Lesions may coalesce, producing a complete burning of large areas of the leaves. The prevalence of the disease is in warm humid tropical to temperate region, where the temperature ranges between 20-30ºC during cropping period" **(Singh and Srivastava, 2012)**."As the pathogen is able to overwinter in infected corn debris as mycelium and spores on the surface of the soil or inside the seed, but failed to survive in debris which were buried at 5-20cm"**(Kumar *et al.*, 2021)**."Biological control offers an environment friendly approach to the management of plant disease and can be incorporated into cultural and physical strategies and limited chemical usage for an effective integrated disease management (IDM) system"**(Monte, 2001).** So eco-friendly management approaches are important mainly with the use of

botanicals which are plenty available in the nature, plant defence activators which can induce systemic resistance and biocontrol agents which are efficient with high antagonistic activity.

Materials and Methods

Isolation and Purification of *Bipolaris maydis*

Maize plants showing characteristic symptoms of maydis leaf blight were collected from the Central Research Farm, SHUATS, Prayagraj during *Kharif* season 2023.The infected samples were brought to the laboratory and washed with running tap water to remove dust and dirt. For isolation of the pathogen, infected leaf parts were cut into small pieces of 2-3mm dimension. Such leaf bits were surface sterilized with 1 per cent sodium hypochloride (NaOCl) solution for 1 minute and washed three times with sterile distilled water to remove any traces of sodium hypochloride adhered with leaf **(Rangaswami, 1972).** 3-5 leaf bits was transferred on PDA medium contained in petri plates aseptically with the help of sterilized forceps. These petri plates will be incubated at 25±2° C. After 3 days mycelia growth were observed around leaf bits, a bit of hyphal growth from growing tips was transferred aseptically to fresh PDA slants. The fungus was brought into a pure culture by employing single hyphal tip method **(Singh,1988)**. However, the culture is preserved by routinely transfer on PDA slants for further studies.

Effect of *Trichoderma viride* and selected botanical extracts against *Bipolaris maydis* under field conditions

The field trial against maydis leaf blight was conducted at central research farm, SHUATS, Prayagraj to evaluate the effect of *Trichoderma viride* and botanical extracts. The experiment was conducted in randomised block design comprising of 8 treatments including treated check and control with 3 replications. Plant to plant spacing was 70cm × 25cm and plot size was 2m ×1m. The 1st spray of botanical extracts was done after first appearance of the disease and second spray after 15 days of first spray. First appearance of disease and further progess of disease was recorded according to Disease rating scale given by **Saari and Prescott, 1975** that is shown in table 1 and per cent disease intensity was calculated by formula given by **Wheeler, 1969**.

$$\text{Disease intensity (\%)} = \frac{\textbf{Sumofalldiseaseratings}}{\textbf{Totalnumberofratings} \times \textbf{Maximumdiseasegrade}} \times \mathbf{100}$$

The benefit cost ratio from each treatment was determined by using the following formula given by **Reddy *et al.*, 2004**.

Gross Return Cost

C:B Ratio = ----------

Total Cost of Cultivation

Where, C: B is Benefit Cost Ratio

Table 1 Disease Rating Scale for Maydis leaf blight on 0-9 scale

Grade	Leaf area covered
0	No infection
1	10 % area of leaf blighted
2	11-20 % area of leaf blighted
3	21-30 % area of leaf blighted
4	31-40 % area of leaf blighted
5	41-50 % area of leaf blighted
6	51-60 % area of leaf blighted
7	61-70 % area of leaf blighted
8	71-80 % area of leaf blighted
9	>81 % area of leaf blighted

Results and Discussion

Effect of treatments on growth parameters against maydis leaf blight caused by *Bipolaris maydis*

The result (table-2) revealed that all the treatments were statistically significant over untreated check. Maximum plant height(cm) at 30, 60 and 90 DAS(52cm, 106.17cm and 168.40cm, respectively), number of leaves (7.8, 16.33 and 19.46, respectively), cob length(cm) (18.92cm)at90 DAS was recorded in treatment *Trichoderma viride* (ST) + Garlic clove extract (FS).Second next best treatment was *T. viride* (ST) + Neem leaf extract (FS) plant height (cm) (50.35cm, 105.52cm and 166.58cm, respectively), number of leaves (7.60, 15.46 and 18.73, respectively) and cob length (cm) (18.46cm) was recorded.

Table 2 Effect of treatments on growth parameters against maydis leaf blight caused by *Bipolaris maydis*

Treatments	Plant height (cm)			Number of leaves			Cob length (cm)
	30DAS	60DAS	90DAS	30DAS	60DAS	90DAS	90DAS
Control	40.14	100.21	161.08	5.60	11.60	14.40	15.11
Trichodermaviride(ST)+ Turmeric rhizome extract(FS)	48.73	103.51	164.16	6.86	13.73	17.46	17.52
Trichodermaviride(ST)+ Garlic clove extract(FS)	52.00	106.17	168.40	7.80	16.33	19.46	18.92
Trichoderma viride(ST)+ Neem leaf extract(FS)	50.35	105.52	166.58	7.60	15.46	18.73	18.46
Trichoderma viride(ST)+ Eucalyptus leaf extract(FS)	48.22	102.86	162.84	6.46	13.20	16.46	16.98
Trichoderma viride(ST)+ Tulsi leaf extract(FS)	47.07	101.51	162.66	6.20	12.73	15.53	16.16
Trichoderma viride(ST)+ Datura leaf extract(FS)	49.67	104.43	165.60	7.26	14.73	18.26	17.91
Propiconazole 25% EC	52.82	107.46	170.17	8.20	18.6	21.80	19.82
CD (0.05)	0.74	0.85	0.42	0.28	0.46	0.63	0.51
S.ED (±)	0.35	0.40	0.20	0.13	0.22	0.29	0.24

ST = Seed treatment, FS = Foliar spray, DAS = Days after sowing

Table 3 Effect of treatments on disease intensity (%), yield (t/ha) and cost benefit ratio

Treatments	Disease intensity (%)			Yield (t/ha)	C:B ratio
	30DAS	45DAS	60DAS		
Control	17.26	31.73	41.20	2.6	1:1.6
Trichodermaviride(ST)+ Turmeric rhizome extract(FS)	12.98	29.20	34.32	3.5	1:2.0
Trichodermaviride(ST)+ Garlic clove extract(FS)	9.41	24.26	26.98	4.2	1:2.4
Trichoderma viride(ST)+ Neem leaf extract(FS)	10.90	26.32	28.90	4.0	1:2.3
Trichoderma viride(ST)+ Eucalyptus leaf extract(FS)	14.98	29.94	37.88	3.3	1:1.9
Trichoderma viride(ST)+ Tulsi leaf extract(FS)	16.09	30.62	38.90	3.2	1:1.7

Trichoderma viride(ST)+ Datura leaf extract(FS)	12.77	28.02	31.44	3.8	1:2.1
Propiconazole 25% EC	6.96	19.95	23.60	4.2	1:2.7
CD (0.05)	1.03	0.71	1.51	0.02	
S.ED (±)	0.54	0.34	0.71	0.01	

ST = Seed treatment, FS = Foliar spray, DAS = Days after sowing, C:B = Cost benefit ratio

The result (table-3) revealed that all the treatments were statistically significant over untreated check. Minimum disease intensity (%)at 30, 45 and 60 DAS (9.41%, 24.46% and 26.98%, respectively) and maximum yield (t/ha) (4.2t/ha), cost benefit ratio (1:2.4) was recorded in treatment *Trichoderma viride* (ST) + Garlic clove extract (FS).Second best treatment was *T.viride* (ST) + Neem leaf extract (FS) disease intensity (%) at 30, 45 and 60 DAS (10.90%, 26.32% and 28.90%, respectively) and yield (t/ha) (4.0t/ha), cost benefit ratio (1:2.3).*Trichoderma viride* suppress the growth and development of fungal pathogen and promote growth of plants and stimulate expression of defense genes when challenged by the pathogen. *T. viride* generally penetrates the host fungus by degrading the cell wall and utilizing their cellular contents. It is achieved with the help of some lytic enzymes including chitinase, glucanases and proteases **(Sarma*et al.*, 2014)**. Garlic clove extract consist antimicrobial agents interfere chemically with the synthesis of the function of vital components of microorganism in different ways. Inhibitors of cell wall synthesis, inhibitors of cell membrane, inhibitors of bio synthesis. Such components enhances growth and yield of different crops **(Rehman and Mairaj, 2013)**.Further it has been reported by **Baron and Tansley (1997)** that allicin converts into disulphide compounds that disrupt fungal cell wall metabolism due to the oxidation of proteins.

Conclusion: Among the treatments minimum disease intensity (26.98%), and maximum plant height (168.40cm), number of leaves (19.46), cob length (18.92cm), cost benefit ratio (1:2.4) were observed in treatment *Trichoderma viride* @ 5g/kg + Garlic clove extract @ 10% followed by *Trichoderma viride* @ 5g/kg + Neem leaf extract @ 10% disease intensity (28.90%) and plant height (166.58cm), number of leaves (18.73), cob length (18.46cm), cost benefit ratio (1:2.3). However, the present study is limited to one crop season (*kharif*) Prayagraj agroclimatic conditions, for substantiation of current results, more such trails should be conducted in future.

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