"Efficacy of *Trichoderma viride* and leaf extracts against southern corn leaf blight (*Bipolaris maydis*) of maize (*Zea mays* L.)"

ABSTRACT: Southern corn leaf blight is one of the most serious disease-causing damage in entire country, the disease caused by *Bipolaris maydis* by producing lengthy, cigar structured ovoid and greyish lesions on lower leaf parts. The present investigation on "Evaluation of *Trichoderma viride* and leaf extracts on southern corn leaf blight (*B. maydis*) of maize (*Zea mays* L.)" was carried out at seven treatments were tested under field condition namely *T. viride* @ 5g/kg (ST) + Neem leaf extract @ 10% (FS), *T.viride* @ 5g/kg (ST) + Eucalyptus leaf extra @ 10% (FS), *T. viride* @ 5g/kg (ST) +*Lantana camara* @ 10% (FS) *T.viride* @ 5g/kg (ST) + Datura leaf extract @ 10% (FS), *T. viride* @5g/kg (ST) + Ashwagandha leaf extract @ 10% (FS), Propiconazole 25 EC @ 0.1%and untreated control in Randomized Block Design with three replications. Among all the treatments *T. viride* @ 5g/kg (ST) + Datura leaf extract @ 10% (FS) recorded minimum % disease intensity (25.2%) followed by *T. viride* @ 5g/kg (ST) + Neem leaf extract @ 10% (FS) (29.96%) , *T.viride* @ 5g/kg (ST) + Ashwagandha leaf extract @ 10% (FS) (31.24%), *T. viride* @ 5g/kg (ST) + Eucalyptus leaf extract @ 10% (FS) (34.62%), *T. viride* @ 5g/kg (ST) +*Lantana camara* @ 10% (FS) (38.14%) as compare to treated Propiconazole 25 EC @ 0.1% (23.4%) and untreated control (41.52%). *T. viride* + Datura leaf extract recorded significantly maximum plant height (168.54cm), number of leaves
(21.33), cob length (18.46cm) and yield (38q/ha). Maximum cost benefit ratio was recorded in *T. viride* + Datura leaf extract (1:2.3) followed by *T. viride* + Neem leaf extract (1:2.2) as compared to treated check Propiconazole 25 EC (1:2.8) and untreated Control (1:1.7).

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Key words: *Bipolaris maydis*, Maize, Leaf extracts, *Trichoderma viride*.

INTRODUCTION

Maize (*Zea mays* L.) is an important crop belongs to *Gramineae* family and is grown in 166 countries worldwide **(Mihalcea and Amariei, 2022; Mir *et al*., 2019)**. It is also known as

"queen of cereals" because of its highest genetic yield potential among the cereals. Its ranks third after wheat and rice in the world food grain production. Maize is staple food for human being and quality feed for animals, maize serves as a basic raw material to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package, paper industries etc. In India maize sector has several opportunities in all its sub-sectors like seed, non-seed inputs, farm mechanisation, processed foods, industrial products, market-related infrastructure, storage, processing etc. It has also enormous potential to provide food security, feed security, nutritional security and enhanced income to maize growers **(indiastat.com)**. In the country, more than three-fourths of the maize is grown in Madhya Pradesh, Karnataka, Maharashtra, Rajasthan, Bihar, Uttar Pradesh, and Andhra Pradesh. 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. Maize is attacked by several different fungal diseases viz; smut, rust, anthracnose stalk rot, charcoal rot, curvularia leaf spot, downy mildews, brown spot, blended leaf and sheath blight, as well as southern corn leaf blight which affect at all stage of the crop **(Ashwani *et al.*, 2002)**. *Bipolaris maydis* disease appear on leaves as dead cinnamon buff or lesions surrounded by brownish colour margins, longitudinally elongated and forming dead portions between single vesicular regions. The *B. maydis* morphological character as colonies were effuse, grey to blackish brown or grey stromata sometimes formed in culture, erect, straight, cylindrical and black hyphae of *B. maydis* were pale to mild brown, smooth, septate and about 1-3 um thick .The conidia were straight, ellipsoida, oblong or cylindrical, round at the ends, pale to mild brown **(Bugnicourt, 1955)**. The fungus *B. maydis* over winters on crop debris, primarily on the soil surface as mycelium, and conidiospores **(Wang and Wu, 1987)**. It also survives on seeds **(Boothroyd, 1971; Kulik, 1971)**. The disease is most serious in wet and warm regions, and caused yield losses upto 70% **(Shah *et al.*, 2023)**.

MATERIALS AND MATHODS

Isolation and purification of pathogen *Bipolaris maydis*

During the *Kharif* season of 2023, maize plants that showed the symptoms of southern leaf blight were collected in paper bag from the central research farm, SHUATS, Prayagraj India. The infected samples were brought to laboratory and washed with water to remove the impurities. The sample were cut into approximately 2-3mm size pieces and surface steriled with 0.1% mercuric chloride solution for 30 seconds followed by a subsequent washing with sterilized water. These samples were placed on PDA plates using sterilized needles. After six days the initial inoculation, fungus growth was appeared in the plates that placed in incubator at 25±2°C. From this colony growth, a portion fron the periphery having single hyphal tip were separated and transfer to other petri plates having medium to get pure culture and identification of the pathogen was confirmed by observing the morphological feature of colony, spore characterstics and referring the relevant **(Nisikado and Miyake, 1926)**. Pure culture was stored in refrigerator for further processing.

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

The field trial was conducted at central research farm, SHUATS, prayagraj India. Experimental design employed was a Randomized Block Design (RBD) with three replications and and five treatment with one check. The plot size was 2m×1m and treatments were assigned randomly. The plot were sprayed with different treatment twice at 15 days intervals at 40-45 days after sowing (DAS). Five plants randomly selected from each treatment to record disease intensity (DI). Disease intensity (DI) was recorded according to the formula given below and data was recorded by using the scale given in Table1.

$$\text{Disease intensity (\%)} = \frac{\text{sum of all disease rating} \times 100}{\text{Total number of rating} \times \text{maximum disease grade}}$$

The healthy marketable yield from different treatments were collected separately and weighed. There were two sprays throughout the research period and the treatment cost and common cost of cultivation per hectare was calculated. Total income was realised by multiplying the total yield per hectare by the prevailing market price; while the net benefit

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was obtained by subtracting the total cost of plant protection from total income. The C: B was calculated by the following formula:

Cost benefit ratio= Gross Return Cost

Total Cost of Cultivation

Table No. 1 Observation on the intensity of disease was recorded on 0-9 scale (Sarri and Prescott, 1975)

Scale	Disease infection
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

Evaluation of *Trichoderma viride* and leaf extracts against southern corn leaf blight (*Bipolaris maydis*) on growth parameters of maize

The data presented in table-3 indicated that all the treatments were significantly effective in increasing the plant height when compared to untreated check. *Trichoderma viride* (ST) + Datura leaf extracts (FS) was found to be statically most effective treatment and recorded maximum plant height (cm) at 30, 60 and 90 DAS (52.10, 106.14 and 168.54 cm respectively), number of leaves (8.2, 17.4 and 21.33 respectively), cob length (cm) (18.46 cm) at 90 DAS followed by *Trichoderma viride* (ST) + Neem leaf extracts (FS) which was the next best treatment and recorded plant height (cm) at 30, 60, and 90 DAS (51.28, 105.05 and 166.85 cm respectively) , number of leaves (7.8, 16.6 and 20.66 respectively) , cob length (cm) (18cm) reported that *Trichoderma viride* (ST) +Datura leaf extracts (FS) was highly effective against southern corn leaf blight caused by *Bipolaris maydis.*

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Table 2 Effect of *Trichoderma viride* and leaf extracts on growth parameters of maize

Treatments	Plant height (cm)			Number of leaves			Cob length
	30 DAS	60DAS	90DAS	30DAS	60DAS	90DAS	90
Control	47.39	100.15	161.05	5.6	11.53	15.66	15.58
Trichoderma viride (ST) + Neem leaf extract (FS)	51.28	105.05	166.85	7.8	16.6	20.66	18
Trichoderma viride (ST) + Eucalyptus leaf extract	49.69	101.46	163.73	7.4	14.3	19.40	17.27
Trichoderma viride (ST) + *Lantana camara* (FS)	48.96	101.14	163.3	7.13	13.6	18.40	17.09
Trichoderma viride (ST) + Datura leaf extract (FS)	52.10	106.14	168.54	8.2	17.4	21.33	18.46
Trichoderma viride (ST) + Ashwagandha leaf extracts (FS)	50.26	103.38	165.27	7.6	15.4	20.33	17.63
Popiconzale (Tilt 25 EC)	53.12	107.56	170	8.7	18.6	21.86	19.04

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S.Ed(±)	0.25	0.10	0.21	0.15	0.32	0.23	0.14
CD at 5%	0.57	0.36	0.45	0.32	0.70	0.49	0.31

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

Evaluation of *Trichoderma viride* and leaf extracts against PDI in southern corn leaf blight (*Bipolaris maydis*)

The data presented in table-4 indicated that all the treatments were significantly effective in reducing the disease intensity (%) when compared to untreated check. *Trichoderma viride* (ST) + Datura leaf extracts (FS) was found to be most effective treatment in reducing the disease intensity at 45,60 and 75 DAS (8.9, 22.78 and 25.2% respectively), yield (38 q/ha) and cost benefit ratio (1:2.3) followed by *T. viride* (ST) + Neem leaf extracts (FS) which was the next best treatment in controlling disease intensity (11.29, 25.28 and 29.96% respectively), yield (35) and cost benefit ratio (1:2.2) reported that *T. viride* (ST) +Datura leaf extracts (FS) was highly effective against southern corn leaf blight caused by *Bipolaris maydis. Trichoderma viride* mechanism to control pathogen may be by attacking and binding the pathogenic organism by sugar linkage and secretion of extracellular protease and lipase **(Cal *et al.*, 2004)**. *Trichoderma* spp. are known to grow over the pathogenic fungal hyphae, coiled around them and degrade the cell walls. The action of parasitism restricts the development and activity of pathogenic fungi. Additionally, or together with mycoparasitism, *Trichoderma* species release antibiotic gliovirin, gliotoxin, viridin, pyrones and peptaibols **(Harman 2006)**. Datura have presence of antifungal compound such as, diterpenoida, alkaloids, saponins, flavonoids, tannins, glycosides, phenols, steroids and terpenoids **(Mishra *et al.*,2020)**. Saponin has been reported to have antifungal capacities **(Sparg *et al.*, 2004)**. Flavonoids have been proven for use against fungal pathogens since they have the ability to inhibit spore germination of plant pathogens **(Cushnie and Lamb, 2005)**.

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Table 3 Effect of *Trichoderma viride* and leaf extracts on PDI of southern corn leaf blight (*Bipolaris maydis*) of maize

Treatments	Disease intensity (%)			Yield (q/ha)	C:B ratio
	45DAS	60DAS	75DAS		
Control	17.33	31.28	41.52	25	1:1.7
Trichoderma viride (ST) + Neem leaf extract (FS)	11.29	25.28	29.96	35	1:2.2
Trichoderma viride (ST) + Eucalyptus leaf extract	13.22	28.23	34.62	31.1	1:2.0
Trichoderma viride (ST) + *Lantana camara* (FS)	15.32	29.51	38.14	30.83	1:1.9
Trichoderma viride (ST) + Datura leaf extract (FS)	8.9	22.78	25.2	38	1:2.3
Trichoderma viride (ST) + Ashwagandha leaf extracts (FS)	11.97	27.19	31.24	34.33	1:2.1
Popiconzale (Tilt 25 EC)	6.67	20.41	23.4	43	1:2.8
S.Ed(±)	0.32	0.67	0.75	0.01	
CD at 5%	0.69	1.45	1.64	0.031	

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

CONCLUSION: Among the treatment *Trichoderma viride* @ 5g/kg as seed treatment used in the combination with Datura leaf extract @ 10% as foliar spray recorded minimum disease intensity (%) of southern leaf blight of maize and maximum plant height (cm), number of leaves , cob length (cm), yield (q/ha) of maize. Cost benefit ratio was superiorly recorded in *Trichoderma viride* + Datura leaf extract. The present investigation was limited to one crop season (*kharif* 2023-2024) from August to November under Prayagraj agroclimatic conditions. As such to validate the finding more such trails should be carried out in future.

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