

Original Research Article

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## Evaluation of Fungicides and Bioagents against *Alternaria* Leaf Spot (*Alternaria cucumerina* (Ellis and Everh.) Elliott) Disease in Bottle Gourd [*Lagenaria siceraria* (Mol.) Standl.] under Field Conditions

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### ABSTRACT

#### Keywords

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A field experiment was conducted during *kharif* 2019 in medium red soil under irrigated conditions in order to find out the effective fungicide for control of the *Alternaria* leaf spot of bottle gourd caused by *A. cucumerina*. Among the six fungicides and one bioagent tested viz, Mancozeb, Propineb, Hexaconazole, Propiconazole, Tebuconazole, Captan + hexaconazole, *Trichoderma harzianum*, hexaconazole @ 0.1 % recorded least PDI (23.60) followed by propiconazole @ 0.05 % (24.84). With respect to per cent disease reduction over control, maximum disease reduction was recorded by hexaconazole @ 0.1 % (55.21 %) followed by propiconazole @ 0.05 % (52.86 %). The least PDI was noticed in *Trichoderma harzianum* @ 0.5 % (34.81%). The data with respect to yield revealed that maximum yield (15.78t/ha) was also recorded in case of propiconazole @ 0.05 per cent, with the B C ratio 2.38 followed by hexaconazole @ 0.1 per cent (14.23t/ha) with B C ratio 2.06.

### Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] is one of the important cucurbitaceous vegetable crops, which belongs to the family *Cucurbitaceae* having the chromosome number  $2n=22$ . It is a warm season crop, monoecious climber and propagated through seeds. In India, it is cultivated in an area of 149 thousand hectare with production of 2458 thousand metric tonnes (Anon, 2017). In Karnataka, bottle gourd is cultivated in an area of 0.65 thousand hectare with production of 8.36 thousand metric tonnes and (Anon, 2017). The fruits harvested at mature stage are used for making a wide

range of articles of common use, including bowls, bottles, containers and musical instruments (Thamburaj and Singh, 2001). As per nutrient data base of USDA 100g of bottle gourd consists water (96%), carbohydrate (2.9%), protein (0.2%), fat (0.5%), mineral matter (0.5%), 20 mg calcium, 10 mg phosphorous, 11 mg of vitamin C per 100 g fresh weight and traces of vitamin A and vitamin B with a calorific value of 1.2 cal.

The crop is affected by various fungal, bacterial and viral diseases. Among them *Alternaria* leaf spot caused by *Alternaria* sp. is more destructive and prevalent in major bottle gourd growing areas. Losses caused by them are

always considered to be a limiting factor for yield in bottle gourd (Maheshwari *et al.*, 2017). Ill effects of the diseases are observed on foliage as well on fruits (Seebold, 2010).

*Alternaria* leaf blight alone reported to cause 100% yield loss in cucurbits caused by *Alternaria cucumerina* (Watt, 2004). Bhargava and Singh (1985) reported that in bottle gourd plant infected by *A. cucumerina*, initial infection was yellow to brown spots, with yellow hallow.

Since the disease is prevalent in Karnataka and causes huge losses in the yield, there exists a need to find out the fungicidal molecules, which can be effective in managing the diseases. Few of the biocontrol agents like *Trichoderma* are also potentially capable of suppressing the pathogen multiplication. Thus these bio control agents can also be included in disease management programme. Keeping all these points in view, the present research work was undertaken on Management of bottle gourd leaf spot caused by *Alternaria cucumerina*

## Materials and Methods

A field experiment was conducted during *kharif* 2019 in medium red soil under irrigated conditions in order to find out the effective fungicide for control of the *Alternaria* leaf spot of bottle gourd caused by *A. cucumerina*. A total of eight treatments having six fungicides and one bio control agent which were proved effective under *in vitro* along with one untreated control were evaluated against leaf spot disease.

All the treatments were replicated three times following the randomized block design. Two sprays were given at 40 and 50 days after sowing were given. The per cent disease index was calculated.

## Details of Experimentation

Lay out : RBD

Plot size : 4.6 x 6 mt

Treatment : 08

Replication : 03

Spacing : 3 x 0.9 m

Date of sowing : 29/05/2019

Date of treatment imposed : 09/07/2019

Variety : Varad

Observations were made on disease severity following 0-5 scale given by Mahee and Datar (1986), for *Alternaria* leaf spot, five plants were selected randomly and tagged in each treatments. Further recorded grades were used to calculate Per cent Disease Index.

## Details of scale:- For *Alternaria* leaf spot

Per cent disease index was calculated by using the formula given by Wheeler (1969).

$$PDI = \frac{\text{Sum of disease ratings}}{\text{Total number of observations} \times \text{Highest disease grade}} \times 100$$

## Results and Discussion

Table1 reveals that treatments differ with respect to per cent disease index (PDI) and yield (t/ha). After 1<sup>st</sup> spray, hexaconazole @ 0.1 % recorded (25.06) least disease PDI which was on par with propiconazole @ 0.05 % (27.24), followed by tebuconazole @ 0.05 % (29.44) and Captan 70% + hexaconazole 5 % @ 0.2% (31.48) which were on par with each other. The untreated control (water sprayed) recorded maximum PDI (41.66). With respect to per cent disease reduction over control after 1<sup>st</sup> spray, maximum disease reduction was recorded by hexaconazole @ 0.1 % (39.84 %) followed by propiconazole @ 0.05 % (34.61%). The least was noticed in *Trichoderma harzianum* @ 0.5 % (13.58 %).

The data obtained after 2<sup>nd</sup> spray revealed that there is a significant difference between the treatments, hexaconazole @ 0.1 % recorded least PDI (23.60) which was on par with propiconazole @ 0.05 % (24.84), followed by tebuconazole @ 0.05 % (26.22) and captan + hexaconazole @ 0.2% (28.43) which were on par with each other. The untreated control (water sprayed) recorded maximum PDI (52.70). With respect to per cent disease reduction over control after 2<sup>nd</sup> spray, maximum disease reduction was recorded by hexaconazole @ 0.1 % (55.21 %) followed by propiconazole @ 0.05 % (52.86 %). The least was noticed in *Trichoderma harzianum* @ 0.5 % (34.81%). The data with respect to yield revealed that maximum yield (15.78t/ha) was also

recorded in case of propiconazole @ 0.05 per cent, followed by hexaconazole @ 0.1 per cent (14.23t/ha). Six fungicides and one biocontrol agent were evaluated, found effective and significantly reduced the disease severity of leaf spot as compared to control under field conditions. The PDI varied from 24.84 to 34.35 in different treated plots as compared to 52.70 PDI in control.

Two foliar sprays of hexaconazole @ 0.1 per cent resulted in highest disease control with least PDI (23.60) followed by propiconazole 0.05% (24.84 PDI), tebuconazole @ 0.05 % with 26.22 PDI and Captan + hexaconazole @ 0.2% with PDI of 28.43 percent. *Trichoderma harzianum* @ 0.5 per cent found least effectively in controlling the disease. Maximum yield (12.86 t/ha) was also recorded in case of propiconazole @ 0.05 per cent with highest net return of 88,882.5/ha, with BC ratio 2.38. These results are in agreement with the findings of Arun kumar (2008) who reported that hexaconazole (0.1%) effectively controlled the disease with less Per cent Disease Index (4.49) and recorded

highest yield of 76.25 q/ha with an incremental benefit cost ratio of 7.16. Identical results were obtained by Patel (2008) and Sinha (2014) who had reported the foliar sprays of hexaconazole at 0.1 per cent recorded minimum disease intensity (18.5 %) and highest yield of 184.4 q/ha and maximum disease reduction over control (54.32 %), as well recorded with highest C:B (1:19.29). The present findings showed that hexaconazole and propiconazole can be exploited for better management of *Alternaria* leaf spot in bottle gourd.

The results of the field evaluation of fungicides and bio agents against *Alternaria* leaf spot disease indicated that, two foliar sprays of hexaconazole @ 0.1 per cent resulted in highest disease control with least PDI (23.60) followed by propiconazole 0.05% (24.84 PDI), tebuconazole @ 0.05 % with 26.22 PDI and Captan + hexaconazole @ 0.2% with 28.43 PDI. *Trichoderma harzianum* @ 0.5 per cent found least effectively in controlling the disease. Maximum yield (15.78t/ha) was also recorded in case of propiconazole @ 0.05 per cent with highest net return of 88,882.5 /ha, with BC ratio of 2.38

**Table.1** Treatment Details

Treatment	Common name	Trade name	Concentration
T <sub>1</sub>	Mancozeb	Indofil M 45	0.2 %
T <sub>2</sub>	Propineb	Anthracol	0.25%
T <sub>3</sub>	Hexaconazole	Contaf	0.1%
T <sub>4</sub>	Propiconazole	Tilt	0.05%
T <sub>5</sub>	Tebuconazole	Folicur	0.05%
T <sub>6</sub>	Captan + hexaconazole	Taqat	0.2%
T <sub>7</sub>	<i>Trichoderma harzianum</i>	UHSB product	0.5%
T <sub>8</sub>	Control	-	-

**Table.2** Details of scale:- For *Alternaria* leaf spot

Grade	Disease severity (%)	Details
0	0	No disease symptoms
1	1-10	A few spots towards tip of the leaf area
2	11-25	Several dark brown patches
3	26-50	Several patches with paler outer zone
4	51-75	Leaf blight or breaking of the leaves from center
5	76-100	Complete drying of the leaves or breaking of the leaves from center

**Table.3** Management of *Alternaria* leaf spot in bottle gourd using fungicides and bioagent in field condition

Sl. No	Treatments	PDI		Reduction over control (%)	PDI	Reduction over control (%)	Yield t/ha
		Before spray	After 1 <sup>st</sup> spray		After 2 <sup>nd</sup> spray		
1.	Mancozeb 75 WP @ 0.2%	40.33 (39.23) *	34.42 (35.90)	17.37	32.51 (34.74)	38.31	10.62
2.	Propineb 70 WP @ 0.25%	37.36 (37.66)	32.08 (34.46)	22.99	30.97 (33.80)	41.23	11.12
3.	Hexaconazole 5 EC @ 0.1%	38.30 (38.21)	25.06 (30.02)	39.84	23.60 (29.04)	55.21	14.23
4.	Propiconazole 25 EC @ 0.05%	39.29 (38.80)	27.24 (31.44)	34.61	24.84 (29.88)	52.86	15.78
5.	Tebuconazole 250 EC @ 0.05%	38.33 (38.23)	29.44 (33.05)	29.33	26.22 (30.74)	50.24	13.14
6.	Captan 70 % + Hexaconazole 5 % @ 0.2%	37.32 (37.63)	31.48 (33.89)	24.43	28.43 (32.21)	46.05	11.84
7.	<i>Trichoderma harzianum</i> @ 0.5%	40.03 (39.23)	36.00 (36.85)	13.58	34.35 (35.86)	34.81	10.12
8.	Control	38.29 (38.21)	41.66 (40.18)	-	52.70 (46.57)	-	9.85
	<b>SEm±</b>	<b>0.55</b>	<b>0.89</b>		<b>0.69</b>		<b>2.89</b>
	<b>CD @ 5 %</b>	<b>1.70</b>	<b>2.74</b>		<b>2.11</b>		<b>0.94</b>

\* Figures presented in parenthesis are arc sine transformed values

**Table.4** Economic analysis for management of *Alternaria* leaf spot in bottle gourd.

Sl. No.	Treatments	Yield (t/ha)	Cost of cultivation (Rs/ha)	Cost of fungicides (Rs/ha)	Total cost /ha (Rs/ha)	Gross Returns/ha (Rs/ha)	Net returns/ha (Rs/ha)	B:C
1	Mancozeb 75 WP @ 0.2%	10.62	36,723	606	37,329	84,960	47,631	1.27
2	Propineb 70 WP @ 0.25%	11.12	36,723	1264	37,987	88,960	50,973	1.34
3	Hexaconazole 5 EC @ 0.1%	14.23	36,723	472.5	37,195.5	1,13,840	76,644.5	2.06
4	Propiconazole 25 EC @ 0.05%	15.78	36,723	634.5	37,357.5	1,26,240	88,882.5	2.38
5	Tebuconazole 250 EC @ 0.05%	13.14	36,723	870	37,593	1,05,120	67,527	1.79
6	Captan 70% + Hexaconazole 5 % @ 0.2%	11.84	36,723	2430	39,153	94,720	55,567	1.41
7	<i>Trichoderma harzianum</i> @ 0.5%	10.12	36,723	375	37,098	80,960	43,862	1.18
8	Control	9.85	36,723	-	36,723	78,800	42,077	1.14

Note: Average price of bottle gourd fruits- Rs. 8 / kg

## Author Contribution

Aishwarya S. Kammar: Investigation, formal analysis, writing—original draft. M. P. Basavarajappa: Validation, methodology, writing—reviewing. R. K. Mesta:— Formal analysis, writing—review and editing. S. H. Ramangouda: Investigation, writing—reviewing. Shashikanth Evoor: Resources, investigation writing—reviewing.

## Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

**Ethical Approval:** Not applicable.

**Consent to Participate:** Not applicable.

**Consent to Publish:** Not applicable.

**Conflict of Interest:** The authors declare no competing interests.

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