Eco-friendly management of Purple blotch (*Alternaria porri*) of onion (*Allium cepa* L.)

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ABSTRACT

Onion (*Allium cepa* L.) is one of the important commercial vegetable crops grown in India. Onion is attacked by many diseases, one of which is Purple blotch. This study aimed to evaluate the effect of organic manures and fungicides on Purple blotch disease of onion caused by *Alternaria porri.* The research work was undertaken at Central Research Farm (CRF) Sam Higginbottom University of Agriculture, Technology and Sciences, SHUATS, Naini, Prayagraj during *Rab*i in 2023-24. A randomized block design with seven treatments was employed including Untreated check T_0 (Control), T_1 (Vermicompost @100g/m^2 + *Lantana camara* @100g/m^2), T_2 (Biomix @100g/m^2 + *Lantana camara* @100g/m^2), T_3 (Cocopeat @100g/m^2 + *Lantana camara* @199g/m^2), T_4 (Vermicompost @50g/m^2 + Biomix @50g/m^2 + *Lantana camara* @100g/m^2), T_5 (Vermicompost @50g/m^2 + Cocopeat @50g/m^2 + Lantana camara @100g/m^2) and Treated check T_6 (Carbendazim @0.2%). The results revealed that among the organic manure T_{4}- Vermicompost @50g/m^2 + Biomix @50g/m^2 + *Lantana camara* @100g/m^2 minimum disease intensity (8.21%, 17.82% and 26.48%) at 30,60 and 90 DAT, respectively while maximum disease intensity was recorded in untreated T_{0}- Contro (12.07%, 26.54% and 39.17%) at 30, 60 and 90 DAT, respectively. Maximum plant height (17.34 cm, 29.56 cm and 38.18 cm) at 30, 60 and 90 DAT, number of leaves (4.53 per plant, 4.76 per plant and 6.66 per plant) at 30, 60 and 90 DAT, fresh weight of bulb (44.96 gm), bulb size (5.90 cm), yield (153.26 q/ha) and benefit-cost ratio (1:4.2) also highest yield 89.20 q/ha and benefit-cost ratio (1: 4.10) were found in T_{4}- Vermicompost @50g/m^2 + Biomix @50g/m^2 Lantana camara @ 100g/m^2 when compared to treated T_6- Carbendazim and untreated check T_0- Control.

Keywords: Onoin, Alternaria pori, organic manure, fungicide, purple blotch

INTRODUCTION

Onion (*Allium cepa* L.) is one of the important commercial vegetable crops grown in India. It is widely grown in different parts of the country mainly by small and marginal farmers. Onion is produced and consumed not only in India but also throughout the world. Onion is classified as a vegetable and has special qualities which add taste and flavour to food **(Palanisamy *et al*., 2022)**.

Onion bulbs are low in calories but rich in vitamins and minerals and are a good source of dietary fibre. Onions are also a good source of antioxidants and sulphur-containing compounds that may have health benefits. They have been proven to assist in reducing inflammation, lowering blood sugar, and enhancing heart health. However, it's important to note that onions may cause digestive discomfort in some people, particularly when consumed in large amounts **(Singh *et al*., 2023).**

India is the second-largest onion-growing country in the world. Indian onions are famous for their pungency and are available around the year. Onion is a temperate crop but can be grown under a wide range of climatic conditions such as temperate, tropical and subtropical climates. The best performance can be obtained in mild weather without the extremes of cold and heat and excessive rainfall. Maximum onion production takes place in Maharashtra (4905.0 thousand tons) state followed by Karnataka (2592.2 thousand tons), Gujarat (1514.1 thousand tons.), Bihar (1082.0 thousand tons.), Madhya Pradesh (1021.5 thousand tons.) There is a lot of demand of Indian onion in the world, the country has exported 15,78,016.59 MT of fresh onion to the world for the worth of Rs. 2,826.50 crores/ 378.49 USD Million during the year 2020-21(APEDA,2022). In India, the yield of onion is very low as compared to the world average yield of 19.1t ha-1 **(Bhoite and Backiyavathy, 2022)**.

The purple blotch of onion caused by *Alternaria porri* (Ellis) Cif. is one of the most serious fungal diseases that affect onions, causing heavy yield loss ranging from 2.5 to 87.8 per cent. The pathogen *Alternaria porri* destroys the leaf tissue which hinders the stimulus for bulb initiation and delay in bulbing and malnutrition. In severe attack on flowering, onion can completely girdle flower stalks with necrotic tissue, causing their collapse and total loss of seed production capacity **(Agale *et al*., 2014)**. The disease usually affects the leaves and bulbs of a plant, reducing their yield by up to 97% **(Dar *et al*. 2020)**.

Conidia were formed in large quantities on clusters of conidiophores in older areas. Bull's-eye-shaped brown lesions with reddish-purple edges were also observed. Infected leaves and stems die after turning a yellowish-white colour. Blight symptoms on the injected plant became apparent in 4 to 5 days **(Agale *et al*., 2014)**. *Alternaria porri* isolates recorded the morphological characters viz., conidial length, width, beak length and number of septa. The conidial dimensions were observed to be 141.28 ± 1.31 µm × 22.92 ± 0. 14 µm and a beak length of 43.61 ± 0.91 µm with 3 to 12 transverse septa and 0 to 5 longitudinal septa **(Shahnaz *et al*., 2013).**

The organic manure (Biomix, vermicompost), is eco-friendly, economically viable and ecologically sound that also played a significant role in soil biology, chemistry and physics. Interestingly, each human, livestock and crops produce approximately 38 billion metric tons of organic waste worldwide, which may be an efficient source of organic matter supply in soils. According to a conservative estimation, around 600 to 700 million tonnes (mt) of agricultural waste (including 272 million tonnes of crop residues) are available in India every year, but most of it remains unutilized. This huge quantity of waste can be converted into a nutrient-rich bio-fertilizer (vermicompost) for sustainable land restoration practices. In general, a great proportion of the crop nutrient input during cultivation returned in the form of plant residues.

Estimation showed that 30-35 % of applied N and P and 70- 80 % of K remained in the crop residues of food crops **(Suthar *et al*., 2009).**

For the management of Purple blotch Onion, nowadays increasing use of chemicals tremendously in agriculture has resulted in growing concern about both public health and environmental hazards thus emphasis is now on the use of indigenous sources for the management of the plant disease which is less costly and doesn't affect public health and environment. Many fungicides have been tested in onions against purple blotch disease and out of these mancozeb, propiconazole, azoxystrobin and thio phanate methyl were found effective in managing the disease **(Singh *et al*., 2018)**.

MATERIALS AND METHODS

The experiment was carried out in the research field of the Department of Plant Pathology located at Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, during the *Rabi* season of 2023-24. The field experiment was laid out in a Randomized Block Design with seven treatments having three replications.

Field Preparation

The field having good organic matter was well pulverized so that it would have a good drainage facility. The field is levelled, and cleaned, stubbles are removed, and previous crop residues and weeds are removed. Soil clods were broken down and plots were marked as per the layout after which the field is divided into sub-plots according to treatments.

Application of soil amendment

The application of soil amendment was done before the transplanting of the plants. The soil amendments vermicompost, biomix, cocopeat and *Lantana camara* were applied in the field.

Transplanting of seedlings:

The experimental plot was laid out as per Randomized Block Design and necessary marking of the hills was done for transplanting the seedling. The healthy seedlings of about 25-30 days old having uniform size were used for transplanting. Proper care should be taken while transplanting the seedlings. Transplanting was done in a row manually. The spacing adopted was 50cm x 15cm i.e., row to row spacing was 50cm and plant to plant was 15cm.

Isolation and identification of pathogen:

The leaves were collected from infected onion plants bearing characteristic symptoms of purple blotch. The leaves were thoroughly washed under running tap water. The symptoms on leaves after mounting on the slide were examined under a microscope to confirm the presence of *Alternaria* sp. The infected leaf parts along with the healthy portion were cut into small pieces under aseptic conditions and surface sterilized with 0.1% mercury chloride ($HgCl_2$) solution for 30 seconds and washed three times with sterile distilled water to remove any traces of mercury chloride ($HgCl_2$) adhered with leaf bits. Then they were placed on filter paper so that extra water could be absorbed. After that, 2-3 leaf bits were transferred on PDA media **(Tuite, 1969)** contained in sterilized petri plates with the help of forceps. To avoid bacterial contamination streptomycin @ 100 ppm was added in the medium at a lukewarm stage before pouring PDA into Petri plates. Then Petri plates were wrapped and incubated at 27±2°C in BOD, after 3 days mycelia growth was observed around leaf bits. With the help of cork borer from this colony growth a portion from the periphery having a single hyphal tip was separated and transferred to other petri plates having medium to get pure culture and identification of the pathogen was recorded by observing the morphological features of the colony, spore characteristics and referring the relevant literature **(Barnett *et al*., 1972).**

Symptomology:

The initial symptoms caused by *Alternaria porri* appeared as whitish chlorotic patches on the leaf surface and these patches immediately turned brown. The disease progressed in the form of large zonate lesions of purple colour. The margins of the lesions became purplish red and were surrounded by a yellowish-brown border (Figure 1). Under the conditions of high humidity, these spots assumed black colour followed by sporulation of the causal pathogen. In advanced stages, yellowingand wilting of the leaves took place. The leaves gradually died from the tip downwards. The above symptoms and progress of the disease have also been reported by differentworkers **(Neergaard,1938)**.

(a) **(b)**

Figure:1 (a) and (b) Symptoms of a purple blotch of onion

Morphology:

Alternaria porri is the largest section of the *Alternaria* species which are important plant pathogens **(Woudenberg *et al.,* 2014).**
The characteristic feature of the genus is the production of ovoid, obclavate or beaked, ellipsoid pigmented conidia (light to deep brown colour) with relatively thin transverse and longitudinal septa (muriform). The body of the conidium is oblong with its formal end protruding out and the terminal part tapered into a beak and is ±produced from bud formed by conidiophores. The pathogen Alternaria has septate, dark-coloured mycelium and produces short, simple, erect conidiophores that bear single and branched chains of conidia in acropetal chains. The conidiophores are solitary or found in groups and are purple when young and brown when old. The colonies of A. porri look velvety or cottony in appearance with regular to irregular margins, and the colony colour appears light to dark olivaceous with a greenish or brownish tinge **(Saharan *et al.,* 2003)**.

RESULTS AND DISCUSSION

Effect of Treatments on Disease Intensity (%) of Purple Blotch on Onion

The data presented in the table 1 revealed that the disease intensity (%) of purple blotch of onion significantly decreased in T_4- Vermicompost + Biomix + *Lantana camara* (26.48%) followed by T_5- Vermicompost + Cocopeat + *Lantana camara* (27.22%), T_1- Vermicompost + *Lantana camara* (28.74%), T_2- Biomix + *Lantana camara* (32.39%), T_3- Cocopeat + *Lantana camara* (34.16%) as compared to (Treated check) T_6- Carbendazim (21.45%) and (Untreated check) T_0- control (39.17%). Similarly, findings have been reported by **Suthar *et al*. (2009)**, **Akter *et al*. (2022)**, **Zacharia *et al*. (2023)** and **Prajapati *et al*. (2019)** The probable reason for this result may be due to the availability of higher nutrients and having the humus – like compounds, active micro-organisms, growth hormones and enzymes. Biomix contains nutrients and components like cow dung, rice husk ash, vegetable waste and neem cake. They showed that organic manure has suppression disease-promoting activity mat because of some biocontrol properties in the manure. *Lantana camara* produces various allelochemicals like carbohydrates, flavonoids and tannins.

Effect of Treatments on Plant Height (cm)

The data presented in the table 2 revealed that the plant height (cm) of onion significantly increased in treatment T_4- Vermicompost + Biomix + *Lantana camara* (38.18 cm) followed by T_5- Vermicompost + Cocopeat + *Lantana camara* (35.95 cm), T_1- Vermicompost + *Lantana camara* (35.00 cm), T_2- Biomix + *Lantana camara* (29.77 cm), T_3- Cocopeat + *Lantana camara* (27.64 cm) as compared to (Treated check) T_6- Carbendazim (43.78 cm) and (Untreated check) T_0- Control (23.83 cm). Therefore, the availability of a higher quantity of nutrients might be responsible for improvement in the physical properties of soil and increased activity of microbes with higher levels of organics might have helped in increasing plant height. Similar findings have been reported by **Rai *et al*. (2015).**

Effect of Treatments on Number of Leaves per plant

The data presented in the table 3 revealed that the number of leaves (per plant) of onion significantly increased in treatment T_4- Vermicompost + Biomix + *Lantana camara* (6.66 per plant) followed by T_5- Vermicompost + Cocopeat + *Lantana camara* (6.26 per plant), T_1- Vermicompost + *Lantana camara* (5.73 per plant), T_2- Biomix + *Lantana camara* (5.33 per plant), T_3- Cocopeat + *Lantana camara* (5.13 per plant) as compared to (Treated check) T_6- Carbendazim (7.93 per plant) and (Untreated check) T_0- Control (4.06 per plant). This result may be due to the availability of vermicompost, boimix and *Lantana camara*. The nutrients provide all essential nutrients to plants resulting in promoted vegetative growth of the plant. Similar findings have been reported by **Solanki *et al*. (2020).**

Effect of Treatments on Fresh Weight of Bulb (g)

The data presented in the table 4 revealed that the fresh weight of bulb (g) of onion significantly increased in treatment T_4- Vermicompost + Biomix + *Lantana camara* (44.96 g) followed by T_5- Vermicompost + Cocopeat + *Lantana camara* (40.60 g), T_1- Vermicompost + *Lantana camara* (38.76 g), T_2- Biomix + *Lantana camara* (33.30 g), T_3- Cocopeat + *Lantana camara* (32.90 g) as compared to (Treated check) T_6- Carbendazim (48.20 g) and (Untreated check) T_0- Control (25.96 g). This result could be due to the application of vermicompost, biomix, *Lantana camara*. Organic manure application in the soil enhances the biochemical potential of soil and consequently affects plant production. Similar findings have been reported by **Kumar *et al*. (2019).**

Effect of Treatments on bulb diameter (cm)

The data presented in Table 5 revealed that the bulb diameter (cm) of onion significantly increased in treatment T_4- Vermicompost + Biomix + *Lantana camara* (5.90 cm) followed by T_5- Vermicompost + Cocopeat + *Lantana camara* (5.13 cm), T_1- Vermicompost + *Lantana camara* (4.50 cm), T_2- Biomix + *Lantana camara* (4.30 cm), T_3- Cocopeat + *Lantana camara* (3.30 cm) as compared to (Treated check) T_6- Carbendazim (6.76 cm) and (Untreated check) T_0- Control (2.70 cm). This result could be due to the application of vermicompost, biomix, *Lantana camara*. Organic manures which provide major micronutrients resulted in increased photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the plants ultimately improving the diameter of the bulb. Similar findings have been reported by **Dhaker *et al*. (2017).**

Effect of Treatments on Yield of Onion (q/ha)

The data presented in the table 6 revealed that the yield of onion (q/ha) significantly increased in treatment T_4- Vermicompost + Biomix + *Lantana camara* (148.30 q/ha) followed by T_5- Vermicompost + Cocopeat + *Lantana camara* (136.16 q/ha), T_1- Vermicompost + *Lantana camara* (101.20 q/ha), T_2- Biomix + *Lantana camara* (90.13 q/ha), T_3- Cocopeat + *Lantana camara* (89.76 q/ha) as compared to (Treated check) T_6- Carbendazim (153.16 q/ha) and (Untreated check) T_0- Control (49.40 q/ha). This might be significantly increased by organic manure (vermicompost, biomix etc) and *Lantana camara*. The organic manure (vermicompost, biomix etc) may stimulate soil biological activity due to the enrichment of soil organic matter. Similarly, the addition of vermicompost could have improved the physical and biological properties of amended soil. The application of vermicompost can also lead to a significant increase in soil enzyme activities such as phosphatase, B-glucosidase, and dehydrogenase **(Srivastava *et al*., 2012).** The efficacy of the vermicompost is also linked to the earthworm's activities because , during vermicomposting, greater mineralization of organic nutrients occurs in the digestive tract of earthworms, which increases mineral content in the vermicompost. In addition, earthworms secret growth hormones and enzymes that promote plant growth (**Coulibaly *et al*., 2020).**

Table 1. Effect of treatments on disease intensity (%) of purple blotch of onion at 30, 60 and 90 DAT

Sr. No.	Treatments	30DAT	60DAT	90DAT
T_0	Control	12.07	26.54	39.17
T_1	Vermicompost (VC) + *Lantana camara* (*LC*)	9.82	19.82	28.74
T_2	Biomix (B) + *Lantana camara* (*LC*)	10.30	21.42	32.39
T_3	Cocopeat (C) + *Lantana camara* (*LC*)	10.78	23.90	34.16
T_4	VC + B + *LC*	8.21	17.82	26.48
T_5	VC + C +*LC*	9.31	18.39	27.22
T_6	Carbendazim	7.07	12.93	21.45
S.Em. (+)		0.35	0.37	0.53
C.D (5%		1.00	1.16	1.73

Table 2. Effect of treatments on plant height (cm) of onion at 30, 60 and 90 DAT

Sr. No.	Treatments	30DAT	60DAT	90DAT
T_0	Control	8.60	14.98	23.83
T_1	Vermicompost (VC) + *Lantana camara* (*LC*)	15.51	25.22	35.00
T_2	Biomix (B) + *Lantana camara* (*LC*)	12.60	21.34	29.77
T_3	Cocopeat (C) + *Lantana camara* (*LC*)	10.93	20.06	27.64
T_4	VC + B + *LC*	17.34	29.56	38.18
T_5	VC + C +*LC*	16.53	28.33	35.95
T_6	Carbendazim	22.46	34.73	43.78
S.Em. (+)		0.31	0.47	0.51
C.D (5%		1.02	1.45	0.98

Table 3. Effect of treatments on number of leaves per plant of onion at 30, 60 and 90 DAT

Sr. No.	Treatments	30DAT	60DAT	90DAT
T_0	Control	2.13	2.86	4.06
T_1	Vermicompost (VC) + *Lantana camara* (*LC*)	3.40	3.93	5.73
T_2	Biomix (B) + *Lantana camara* (*LC*)	3.20	3.80	5.33
T_3	Cocopeat (C) + *Lantana camara* (*LC*)	2.93	3.46	5.13
T_4	VC + B + *LC*	4.53	4.86	6.66
T_5	VC + C +*LC*	4.00	4.53	6.26
T_6	Carbendazim	5.00	6.06	7.93
S.Em. (+)		0.07	0.06	0.07
C.D (5%		0.23	0.20	0.22

Table 4. Effect of treatments on fresh weight of bulb (g) of onion

Sr. No.	Treatments	Fresh weight of bulb (g)
T_0	Control	25.96
T_1	Vermicompost (VC) + *Lantana camara* (*LC*)	38.76
T_2	Biomix (B) + *Lantana camara* (*LC*)	33.30
T_3	Cocopeat (C) + *Lantana camara* (*LC*)	32.90
T_4	VC + B + *LC*	44.96
T_5	VC + C +*LC*	40.60
T_6	Carbendazim	48.20
S.Em. (+)		0.18
C.D (5%		0.56

Table 5. Effect of treatments on bulb diameter (cm) on onion

Sr. No.	Treatments	Bulb diameter (cm)
T_0	Control	2.70
T_1	Vermicompost (VC) + *Lantana camara* (*LC*)	4.50
T_2	Biomix (B) + *Lantana camara* (*LC*)	4.30
T_3	Cocopeat (C) + *Lantana camara* (*LC*)	3.30
T_4	VC + B + *LC*	5.90
T_5	VC + C +*LC*	5.13
T_6	Carbendazim	6.76
S.Em. (+)		0.08
C.D (5%		0.25

Table 6 . Effect of treatments on yield of onion (q/ha)

Sr. No.	Treatments	Yield (q/ha)
T_0	Control	49.40
T_1	Vermicompost (VC) + *Lantana camara* (*LC*)	101.20
T_2	Biomix (B) + *Lantana camara* (*LC*)	90.13
T_3	Cocopeat (C) + *Lantana camara* (*LC*)	89.76
T_4	VC + B + *LC*	148.30
T_5	VC + C +*LC*	136.16
T_6	Carbendazim	153.16
S.Em. (+)		0.41
C.D (5%		1.28

4. CONCLUSION

From the present study, it can be concluded that the treatment T_4 – Vermicompost @50g/m^2 + Biomix @50g/m^2 + *Lantana camara* @100g/m^2 significantly reduced the disease intensity (%) of purple blotch of onion, and significantly increased plant height (cm) of onion, number of leaves per plant, fresh weight of bulb (g), bulb diameter (cm), yield (q/h) and benefit-cost ratio. Therefore, T_4 – Vermicompost + Biomix + *Lantana camara* is most effective against purple blotch of onion when compared with other treatments and untreated checks. Using Vermicompost, Biomix and *Lantana camara* may be economical, long-lasting, eco-friendly and free from residual side effects and can also be recommended to the farmers for the efficient management of disease. The present investigation was limited to one crop season (*Rabi*), under the climatic conditions of Prayagraj (U.P.) therefore, to substantiate the present result more such trials are required for further recommendation.

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