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RESEARCH ARTICLE

Management of basal bulb rot of onion (*Allium cepa* L.)

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ABSTRACT

Basal bulb rot of onion causes considerable damage. The causal organism was isolated from infected bulbs of onion. The fungus culture was identical as *Fusarium oxysporum* f.sp. *cepae* on the basis of morphological characters. In screening, it was observed that all onion genotypes were susceptible to highly susceptible to basal bulb rot of onion but none of the genotypes was found resistant to disease. It was observed that benomyl (0.1%), carbendazim (0.1%) and Bordeaux mixture (1%) alone and in combination, treatments benomyl + mancozeb (0.1 +0.2%) and carbendazim + mancozeb (0.1 + 0.2%) inhibited 100 per cent growth of the pathogen. Among the bioagent, *Trichoderma viride* inhibited maximum growth and was at par with *Trichoderma harzianum.*

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INTRODUCTION

Onion (*Allium cepa* L.) a bulbous, biennial herb, is one of the most important vegetable crops grown in India. In India onion is one of the most important among various Allium crops grown and comprises 772.8 ha area and 12,970.1 MT of production in 2010-11. In Maharashtra it occupied an area of about 170 ha and production 2800 M. tones (Anonymous, 2011).

Onion crop is attacked by many diseases, which cause loss in quality and quantity. Among these diseases basal bulb rot caused by *Fusarium oxysporum* f.sp. *cepae* is one of the most widespread and economically important diseases of onion. In India the occurrence of this disease was first reported from Rajasthan.

The disease is characterized by symptoms as wilting and rapid dying back of leaves from the tips of the plants near maturity. Infected plants can be pulled out easily because they have a retarded root system. Affected roots are dark brown, flattened, hollow and transparent. The present studies were undertaken to screen different varieties of onion for their resistance against basal rot in pots under glasshouse conditions and to evaluate the bioefficiency of available fungicides and bioagents against the pathogen *in vitro.*

MATERIAL AND METHODS

Varietal resistance :

With a view to screen genotypes of onion under artificial epiphytotic condition, pot culture experiment was conducted in glasshouse with three replications and ten genotypes of onion. Thirty days old pathogenic culture of *Fusarium oxysporum* f.sp. *cepae* was used for preparing sick soil. Culture was grown on potato dextrose agar medium and further multiplied on the sand maize medium for 15 days. This fungal growth was mixed with sterilized soil and FYM. The inoculated soil was stored in a sealed container for about a month with frequent stirrings and watering. The pots were filled with the inoculated soil.

Sowing of seeds of onion genotypes was done in the pots containing sterilized soil and FYM to raise the seedlings of onion of each genotype. Transplanting of onion seedlings into sick soil pots was done after two months. The pots were placed in the glasshouse and periodical observations on incidence of Fusarium rotting were recorded using the method described by Wellman (1939) and Harrison (1940). The observations were grouped as per the details given in Table A.

The wilt incidence was calculated using formula :

Table A : Observation		
Sr. No.	Reaction/grade	Percentage/Rating (%)
1.	Total resistance	0
2.	Highly resistance	1-10
3.	Moderately resistance	11-30
4.	Moderately susceptible	31-50
5.	Susceptible	51-70
6.	Highly susceptible	71-100

$$\text{Wilt incidence (\%)} = \frac{\text{Number of wilted plants}}{\text{Total number of plants}} \times 100$$

Evaluation of fungicides against *F. oxysporum* (*in vitro*):

In vitro studies were undertaken at Department of Plant Pathology, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri in completely randomized design with three replications and ten treatments. Seven fungicides were tested against *Fusarium oxysporum* f.sp. *cepae* by using poisoned food technique. Medium without fungicide served as control. The plates were incubated at room temperature (27 $\pm$ 1^{0}C). The observations on colony diameter and sporulation were recorded when Petriplates in control treatment was fully covered with mycelial growth after 7 days of inoculation. The per cent inhibition of growth of test fungus was calculated by using the formula given by Vincent (1947).

***In vitro* evaluation of bioagents against *Fusarium oxysporum* f.sp. *cepae* :**

In vitro effect of Trichoderma species **:**

The antagonistic activity of two species of *Trichoderma viz., T. harzianum* and *T. viride* were tested on PDA against *Fusarium oxysporum* f.sp. *cepae* by dual culture inoculation technique. Mycelial discs of 5 mm diameter were cut from the margin of 7 days old cultures of test pathogen and antagonistic agents respectively and placed opposite to each other on PDA in Petriplates having diameter of 90 mm. The discs were placed 30 mm away from each other. The Petriplates inoculated with discs of *Fusarium oxysporum* f.sp. *cepae* alone served as control. The inoculated plates were incubated in inverted position at 27 $\pm$ 1^{0}C in BOD for seven days. The radial growth of *Fusarium oxysporum* f.sp. *cepae* was measured to assess the antagonistic potential of *Trichoderma* spp. against pathogen. The per cent growth of test fungus was calculated by using the formula given by Upadhyay and Rai (1987).

In vitro effect of Pseudomonas fluorescens :

The antagonism of *Pseudomonas fluorescens* against fungal pathogen was tested *in vitro* by dual culture technique on potato dextrose agar (PDA) medium. *Fusarium oxysporum* f.sp.*cepae* culture was placed at the center of the Petriplate and after 48 hours streaks of bacterial isolates were made equidistantly at the periphery of agar plates. Then the inoculated Petriplates were incubated at 28^{0}C for 7 days and the diameters of inhibition zones were measured.

$$\text{Per cent growth inhibition} = \frac{\text{Colony growth in control plate} - \text{Colony growth in treatment plate}}{\text{Colony growth in control plate}} \times 100$$

RESULTS AND DISCUSSION

The results obtained from the present investigation are summarized below :

Screening of different genotypes of onion against basal rot in pots under glasshouse condition :

Ten genotypes of onion were evaluated for resistance to *Fusarium oxysporum* f.sp. *cepae* in glasshouse by sowing them in sick soil (sterilized artificially inoculated soil). The results of these studies carried out in pot culture are presented in Table 1. There appeared to be larger variability in respect of disease expression. The disease incidence was ranged from 60-100 % in ten genotypes of onion. Among the genotypes screeneded, the highest disease incidence was found in N-2-4-1 (100 %) followed by Bhima Shakti (90 %), Bhima Super

Table 1 : Per cent basal rot incidence on different genotypes of onion (30 days after transplanting)

Sr. No.	Variety	Pre cent disease incidence	Reaction
1.	Bhima Shweta	80	Highly susceptible
2.	Bhima Super	90	Highly susceptible
3.	Bhima Raj	80	Highly susceptible
4.	Bhima red	60	susceptible
5.	B-780	90	Highly susceptible
6.	Bhima Shakti	90	Highly susceptible
7.	Bhima Shubhra	90	Highly susceptible
8.	N-2-4-1	100	Highly susceptible
9.	Bhima Kiran	80	Highly susceptible
10.	Phule Smarth	90	Highly susceptible

(90%), Phule Smarth (90 %), B-780 (90 %) and Bhima Shubhra (90%).

The genotypes Bhima Kiran, Bhima Raj, Bhima Shweta exhibited 80 per cent disease incidence. However, lowest incidence was observed on Bhima red (60 %). It was observed from the data that all the onion genotypes were susceptible to highly susceptible to basal bulb rot of onion but none of the genotypes was found resistant to basal bulb rot disease.

In vitro Evaluation of fungicides against *Fusarium oxysporum f.sp. cepae* :

The results presented in Table 2 showed that, the fungicides carbendazim, benomyl and Bordeaux mixture of the given concentration were 100 per cent inhibition of mycelial growth of *F. oxysporum* f.sp. *cepae*. In combination treatments benomyl + mancozeb (0.1 + 0.2 %) and carbendazim + mancozeb (0.1 + 0.2 %) also inhibited 100 per cent growth of pathogen and haxaconazole +mancozeb was moderatly effective against *F. oxysporum* f.sp. *cepae*, inhibited 86.25 per cent growth of the pathogen.

However, the fungicides *viz.*, captan (0.25%), hexaconazole (0.1%), copper oxychloride (0.25 %) and mancozeb (0.25 %) and captan (0.25 %) alone inhibited 81.25, 77.50, 72.50 and 72.50 per cent growth of the pathogen respectively. This showed that mancozeb and hexaconazole were less effective when used alone but when mancozeb was used in combination with benomyl and carbendazim it showed significant result effectiveness.

Earlier workers have evaluated fungicides against *Fusarium oxysporum*. Naik and Burden (1981) observed, 28 per cent increase in plant establishment when onion seed was dusted with Granosan 200 (benomyl 15 % + mancozeb 60 %) before planting. They also observed that, benomyl decreased the basal rot and increased the yield. Ozer and Koycu (1998) evaluated different chemicals under *in vitro* against *Fusarium oxysporum* and they reported benomyl,

Table 2 : Evaluation of fungicides on growth and sporulation of *Fusarium oxysporum* f.sp. *cepae*

Sr. No.	Fungicides	Concentration (%) use	Mean colony diameter (mm*) after 7 days of inoculation	Sporulation	Per cent inhibition of growth
1.	Carbendazim	0.1	0.00	-	100.00
2.	Haxaconazole	0.1	18.30	++	77.50
3.	Copper oxychloride	0.25	22.00	+++	72.50
4.	Bordeaux mixture	1.0	0.00	-	100.00
5.	Mancozeb	0.25	22.00	++	72.50
6.	Captan	0.25	15.00	+	81.25
7.	Benomyl	0.1	0.00	-	100.00
8.	Carbendazim + mancozeb	0.1 + 0.2	0.00	+	100.00
9.	Benomyl + mancozeb	0.1 + 0.2	0.00	+	100.00
10.	Haxaconazole + mancozeb	0.1 + 0.2	11.00	++	86.25
11.	Control	-	88.00	+++	-
	S.E. ±		0.48		
	CD at 5 %	-	1.41		

- = No sporulation   * = Average of three replications
+ = Poor sporulation   ++ = Moderate sporulation
+++ = Good sporulation

Table 3 : *In vitro* evaluation of biocontrol agents against *Fusarium oxysporum* f.sp. *cepae*

Sr. No.	Biological agents	Mean colony diameter (mm)* (after 7 days)	Per cent inhibition
1.	*T. viride*	12.00	85.00
2.	*T. harzianum*	19.0	76.25
3.	*Pseudomonas fluorescens*	30.00	62.50
4.	Control	80.00	-
	S.E. ±	3.01	-
	CD at 5 %	9.82	-

carbendazim, carboxin, maneb, prochloraz, tebuconazole and thiram reduced the incidence of Fusarium basal rot in onion. Poddar *et al.* (2004) reported that carbendazim inhibited maximum growth of *Fusarium oxysporum in vitro*. Kishore and Kulkarni (2008) reported that carbendazim + mancozeb inhibited 98.88 per cent growth of *Fusarium oxysporum* f.sp. *dianthi.*

***In vitro* evaluation of biocontrol agents against *Fusarium oxysporum* f.sp. *cepae* :**

The results of inhibition of *Fusarium oxysporum* f.sp. *cepae* are given in Table 3. The results revealed that, all the antagonists showed inhibitory effect on growth of the test fungus and were effective in controlling the growth of the pathogen. Among the two species of *Trichoderma*, *Trichoderma viride* was found to be most effective in inhibiting the growth of *Fusarium oxysporum* f.sp.*cepae* which inhibited about 85 per cent growth of the test fungus which was at par with *Trichoderma harzainum* which inhibited 76.25 per cent growth of the test fungus.

The antagonistic activity of *Pseudomonas fluorescens* was examined on Potato dextrose agar plates by dual culture method. The results revealed that the bacterial species was found less effective against *F. oxysporum* f.sp. *cepae*. *P. fluorescens* inhibited 62.5 per cent growth of the pathogen.

Similar antagonistic effects of bioagents against *Fusarium oxysporum* f.sp. *cepae* causing basal bulb rot in onion were also documented by several research workers. Philippe and Claude (1991) reported biological control of *Fusarium* disease by *Pseudomonas fluorescens*. Muthuraman and Sekar (1998) reported inhibition of *Fusarium oxysporum* f.sp. *cepae* by *Trichoderma viride* and *T. harzianum*. Joon *et al.* (2000) reported the inhibitory effect by *Pseudomonas putida* and *Trichoderma harzianum* against basal rot pathogen. Coskuntuna and Ozer (2008) reported that *Trichoderma harzianum* strain KUEN-1585 controlled Fusarium basal rot of onion. Sudhasha *et al.* (2009) reported that *Trichoderma viride*, *T. harzianum* and *Bacillus subtilis* inhibited the growth of basal bulb rot pathogen in *in vitro*.

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