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Efficacy of different fungicides against *Macrophomina phaseolina* (Tassi) Goid causing castor root rot

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Abstract
Different systemic and non-systemic fungicides at three different concentration were evaluated *in vitro* against castor root rot pathogen *Macrophomina phaseolina.* Among the different contact (non-systemic) fungicides evaluated, maximum mean mycelial growth inhibition was observed in propineb and mancozeb (99.97%) followed by captan (85.63 %). Sclerotial formation was also absent in all this three treatments. Out of six systemic fungicides tested, carbendazim found best with 95.23 % mycelial growth inhibition followed by difenoconazole (75.47%) and thiophanate methyl (69.49%). Carbendazim showed maximum inhibition of mycelial growth (99.97%) of the test fungus at 250 ppm and 500 ppm concentration. Sclerotial formation was totally absent in all systemic fungicides treatments at 300 ppm concentration except hexaconazole which was also found poor in growth inhibition.

Keywords: Fungicides, *Macrophomina phaseolina,* root rot, castor.

Introduction
Castor (*Ricinus communis* L.) is an important non-edible annual oilseed crops. This crop is mainly grown in tropical, subtropical as well as temperate regions of different countries on commercial scale. It is significant source of income, making India the world's single largest producer and exporter to the USA, UK, Canada, Saudi Arabia, Singapore, Malaysia, Germany and many more countries across the world.

Castor is affected by many diseases like as wilt, collar rot, seedling blight, cercospora leaf spot, alternaria leaf spot, powdery mildew etc. Among all diseases, root rot caused by *Macrophomina phaseolina* is a major problem in India and it has now become a limiting factor in stepping up the castor seed yield. This disease appears at different growth stages of crops and hence, it is named differently as named as spike blight, stem blight, twig blight, collar rot and root rot (Moses and Reddy, 1987) [12]. The infected plants at seedling stage exhibited the symptoms similar to water shortage or moisture stress followed by dark black discolouration appeared at the collar region. All the secondary roots of the infected plants decayed and root bark shredded off easily. Brown discolourations with black dot like sclerotial bodies produce on infected roots. The attacked plants in most of the cases die within a very short time (Maiti and Raoof, 1984) [11].

Economic yield losses caused by the disease are 20 to 60% (Savalia *et al.*, 2003) [14]. Several workers have attempted to control *Macrophomina phaseolina* by use of different systemic fungicides (Bhatia *et al.* 1997, Chaudhari and Sharma 1998, lambhate *et al.* 2002, Jaiman and Jain 2010, khalikar *et al.* 2011 and Rekha *et al.* 2012) [3, 5, 10, 8, 9, 13] and contact fungicides (Dubey 2003 and Abdul *et al.* 2015) [7, 1]. The main objective of this study was to evaluate the different fungicides at different concentrations for testing their efficacy against mycelial growth inhibition and sclerotial formation of *Macrophomina phaseolina* under *in vitro* condition.

Materials and methods
Isolation and Pathogenicity of the Pathogen
The disease causing fungus was isolated by using tissue segment method. The fungus *Macrophomina phaseolina* was frequently isolated from the root rot affected castor plant and pathogenicity was proved by the method described by Bhaliya and Jadeja (2013) [4]. The cultures were purified by hyphal tip method (Dasgupta, 1988) [6].

In vitro evaluation of fungicides

Different concentrations of systemic and non-systemic fungicides were tested for the growth inhibition and sclerotial formation of *M. phaseolina* by using poisoned food technique (Sinclair and Dhingra 1985) [15]. The required quantity of each chemical was incorporated aseptically in 100 ml of PDA in 250 ml flasks to make various concentrations fungicides. The medium was shaken well to give uniform dispersal of the chemical and then 20 ml of medium was poured aseptically to each plate with three replications. After solidification, the plates were inoculated with mycelial discs of 4 mm diameter of five days old culture. The mycelium disc which was placed in the center of the plates, in an inverted position to make a direct contact with the poisoned medium which was incubated at 28 ± 1 ^{0}C for seven days. The linear growth of the fungal colonies was measured from two different angels in millimeter (mm) and the average values were calculated.

The per cent inhibition of growth of the fungus in each treatment was calculated by using the following formula described by Vincent (1947) [17].

$$I = \frac{C - T}{C} X\ 100$$

Where, I= Per cent inhibition
C= Colony diameter in control (mm)
T= Colony diameter in respective treatment (mm)

Sclerotial formations were counted in fungal culture suspensions under the microscope at low power (10X). The fungal culture suspension was prepared by vigorously shaking the 4 mm mycelial disc of the fungus in 10 ml sterilized distilled water. The relative degree of formation of sclerotia was recorded as per Table 1.

Table 1: Relative degree of sclerotial formation

No. of sclerotia per microscopic field (10X)	Grade	Sign
0	Absent	-
1-4	Scanty	+
5-8	Moderate	++
9-15	Good	+++
>15	Abundant	++++

Result and Discussion

The growth inhibition and sclerotial formation of *M. phaseolina* causing root rot in castor has been tested at various concentration of systemic and non-systemic fungicides *in vitro* recorded in Table 2 and 3.

The perusal of results showed that (Table 2) among all the systemic fungicides tested, carbendazim gave cent per cent inhibition of growth of the fungus at 250 and 500 concentrations which was found significantly superior over rest of systemic fungicides. More than 70 per cent inhibition observed in carbendazim at 100 ppm, fluzilazole at 500 ppm, tebuconazole at 250 and 500 ppm, difenoconazole at 250 and 500 ppm and thiophanate methyl at 500 ppm. Where as, fluzilazole 100 ppm (36.65%), tebuconazole 100 ppm (40.98%) and hexaconazole 100 ppm (40.29%) which were found least effective among all systemic fungicides.

The effect of different concentrations of systemic fungicide on sclerotial formation was found negatively correlated with the inhibition of growth. Within the concentration of each fungicide, except carbendazim and hexaconazole at 250 and 300 ppm were significantly differ from each other in growth inhibition of *M. phaseolina*. In case of concentration mean maximum growth inhibition was recorded at 300 ppm (82.28 %) and lowest was at 100 ppm (55.10 %). In present investigation, carbendazim found most effective fungicide in inhibition of radial growth and sclerotial formation. This finding is also in consonance with the results of Bhatia *et al.* (1997) [3], Chaudhari and Sharma (1998) [5], Lambhate *et al.* (2002) [10]. Similarly; the effectiveness of carbendazim towards *M. phaseolina* has been also recorded by Jaiman and Jain (2010) [8], Khalikar *et al.* (2011) [9] and Rekha *et al.* (2012) [13].

Similarly; non systemic fungicides mancozeb and propineb proved to be the best and inhibited cent per cent mycelia growth at all concentrations. Whereas, captan gave 83.47, 85.75 and 87.67 per cent inhibition, thiram gave 69.12, 82.31 and 85.47 per cent inhibition, copper hydroxide gave 73.25, 74.70 and 80.16 per cent inhibition and copper oxychloride gave 66.18, 71.79 and 82.31 per cent inhibition at 2000, 2500 and 3000 ppm concentrations, respectively (Table 3). The effect of different concentrations of non systemic fungicide on sclerotial formation was found negatively correlated with the inhibition of growth. The sclerotial formation was not observed in all concentrations of mancozeb, propineb and captan. Within the concentration of each fungicide, except propineb and mancozeb at all concentrations and copper hydroxide at 2000 and 2500 ppm; were significantly differ from each other in growth inhibition of *M. phaseolina*. In case of concentration mean maximum growth inhibition was recorded at 3000 ppm (89.26 %) and lowest was at 2000 ppm (81.99 %). These results are supported by finding of Dubey (2003) [7] and Suryawanshi *et al*. (2008) [16]. They recorded that mancozeb proved to be the best for the growth inhibition of *M. phaseolina.* Ahmed *et al*. (1991) [2] and Abdul *et al.* (2015) [1] also achieved effective control of *M. phaseolina* by using propineb.

The present results indicates that carbendazim, mancozeb and propineb were quite effective in controlling castor root rot pathogen. The alternate application of these chemicals reduced the risk of development of resistant in pathogen. Such information will be helpful in formulation of schedule for management of disease.

Table 2: Growth inhibition and sclerotial formation of *M. phaseolina* at different concentrations of various systemic fungicides after seven days incubation at 28 ± 1 ^{0}C

Fungicide	Concentration (ppm) and sclerotial formation			Mean growth inhibition (%)
	100	250	500	
Carbendazim 50% WP	67.86 (85.75)	89.01 (99.97)	89.01 (99.97)	81.96 (95.23)
	-	-	-	
Difenoconazole 25% SC	54.86 (66.83)	61.35 (76.99)	65.36 (82.59)	60.52 (75.47)
	+	-	-	
Thiophanate methyl 70% WP	50.82 (60.08)	55.43 (67.80)	63.88 (80.58)	56.71 (69.49)
	+	+	-	
Tebuconazole 2% DS	39.79 (40.98)	57.82 (71.61)	65.91 (83.27)	54.51 (65.28)

	+++	+	-	
Fluzilazole 40 % EC	37.25 (36.65)	54.94 (66.99)	64.19 (80.98)	52.13 (61.54)
	+++	+	-	
Hexaconazole 5% SC	39.40 (40.29)	53.09 (63.91)	54.51 (66.28)	49.00 (56.83)
	+++	+	+	
Concentration Mean	48.33 (55.10)	61.94 (74.55)	67.14 (82.28)	-
	Fungicide (F)	Conc. (C)	F x C	
S.Em. ±	0.78	0.55	1.35	
CD at 5%	2.32	1.64	4.01	
CV %	3.96			

Data were arcsine transformed before analysis; Numerals in parentheses are re-transformed value.

Table 3: Growth inhibition and sclerotial formation of *M. phaseolina* at different concentrations of various non-systemic fungicides after seven days incubation at 28 ± 1 ^{0}C

Fungicide	Concentration (ppm) and sclerotial formation			Mean growth inhibition (%)
	2000	2500	3000	
Propineb 70% WP	89.01(99.97)	89.01(99.97)	89.01(99.97)	89.01(99.97)
	-	-	-	
Mancozeb 75% WP	89.01(99.97)	89.01(99.97)	89.01(99.97)	89.01(99.97)
	-	-	-	
Captan 75% WP	66.04(83.47)	67.85(85.75)	69.46(87.67)	67.78(85.63)
	-	-	-	
Thiram 75% WP	56.25(69.12)	62.32(82.31)	67.63(85.47)	62.06(78.79)
	++	-	-	
Copper hydroxide 77% WP	58.91(73.25)	59.81(74.70)	63.56(80.16)	60.77(76.03)
	+	+	-	
Copper oxychloride 50% WP	54.46(66.18)	57.93(71.79)	66.94(82.31)	59.75(73.04)
	++	+	-	
Concentration Mean (%)	68.95(81.99)	70.99(85.75)	74.27(89.26)	-
	Fungicide (F)	Conc. (C)	F x C	
S.Em. ±	0.65	0.46	1.12	
CD at 5%	1.92	1.36	3.33	
CV %	2.72			

Data were arcsine transformed before analysis; Numerals in parentheses are re-transformed value.

References

1. Abdul R, Mohammad I, Saira M, Nasir A, Waqar A, Kashif Riaz. Etiology, Pathogenicity and Management of Collar Rot in Cockscomb (*Celosia argentea*). Int. J. Agri. Biol. 2015; 17(1):9-14.
2. Ahmed M, Khan MA, Haq R, Sahi ST, Bajwa MN. Chemical control of Charcoal Rot of Soybean Caused By *Macrophomina Phaseolina* (Tassi) Goid. Pak. J. Agri. Sci. 1991; 28(2):186-190.
3. Bhatia JN, Gangopadhyay S, Satish Kumar. Evaluation of disease control potentiality of certain fungicides in controlling charcoal rot of sunflower. Indian J. Agric. Res. 1997; 31(1): 33-38.
4. Bhaliya CM, Jadeja KB. Antagonistic effect of rhizospheric mycoflora against *Fusarium solani* causing coriander (*Coriandrum sativum)* root rot. Trends in Biosciences. 2013; 6(6):801-802.
5. Chaudhari KC, Sharma YR. *In vitro* evaluation of some fungicides against two soil pathogens. Pesticides. 1998; 22(10):23-25.
6. Dasgupta MK. Principles of Plant Pathology. Allied Publishers Pvt. Ltd., Banglore, 1988, 1140.
7. Dubey SC. Integrated management of web blight of urd/mung bean bybio-seed treatment. Indian Phytopath. 2003; 56:34-38.
8. Jaiman RK, Jain SC. Effect of fungicides on root rot of cluster bean caused by *Macrophomina phaseolina*. Environment and Ecology. 2010; 28(2A):1138-1140.
9. Khalikar PV, Gholve VM, Adsul AK. *In vitro* Management of *Macrophomina phaseolina* by chemicals. Int. J. of. Plant. Prot. 2011; 4(1):201-203.
10. Lambhate SS, Chaudhari GK, Mehetre SS, Zanjare SR. *In vitro* evaluation of chemicals against root rot of cotton caused by *M. phaseolina.* J. Maharashtra Agric. Uni. 2002; 27(1):99-100.
11. Maiti S, Raoof MA. Aerial infection of *Macrophomina phaseolina* on castor. J. Oilseeds Res. 1984; 1:236-237.
12. Moses GJ, Reddy RR. Disease syndrome caused by *M. phaseolina* in castor. J. Oilseeds Res. 1987; 4:295-296.
13. Rekha, Shekhawat KS, Renu G, Khokhar MK. Integrated management against root-rot of mungbean [*Vignaradiata* (L.)] incited by *Macrophomina phaseolina* (Tassi) Goid. J. Pl. Patho. Microb. 2012; 3:5.
14. Savalia RL, Khandhar RR, Moradia AM. Screening of castor germplasm against root rot caused by *Macrophomina phaseolina* under sick plot. *ISOR* National Seminar: Stress Management in Oilseeds, 2003.
15. Sinclair JB, Dhingra OD. Basic Plant Pathology Methods. Published by CRC Press. Inc. corporate Buld, M. W. Boca Raton, Florida, 1985, 285-315.
16. Suryawanshi AP, Gore DD, Gawande DB, Pawar AK, Wadje AG. Efficacy of fungicides against *Macrophomina blight* of mung bean. J. Pl. Dis. Sci. 2008; 3(1):40-42.
17. Vincent JM. Distortion of fungal hyphae in the presence of certain inhibitor. Nature, 1947, 159-850.