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Evaluation of potentiality of different Fungitoxicants against *M. phaseolina*, causing stem and root rot disease of sesame

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Abstract
Stem and root rot disease caused by *Macrophomina phaseolina* is the serious soil-borne disease which affects sesame production. To know the best fungicides to manage it, fifteen chemicals were screened *in vitro* at four concentrations such as 100 ppm, 250 ppm, 500 ppm and 1000 ppm employing poison food technique. Experiment revealed that all the fungicides were strongly inhibited the growth of *Macrophomina phaseolina* and there was a significant decrease in mycelial growth with an increase in concentration of fungicides. Carbendazim 63%w/w + Mancozeb 12% w/w recorded maximum mycelium inhibition (70.10%) at 100 ppm followed by Thiophanate methyl 70% WP. At 250 ppm, Carbendazim 63%w/w + Mancozeb 12% w/w registered maximum inhibition (86.27%) followed by Thiophenate methyl 70% WP (84.61%) and Tebuconazole + Trifloxystrobin (84.61%). The complete inhibition (100%) of *M. phaseolina* mycelium at 500 ppm was observed in Carbendazim 50% WP, Carbendazim 63%w/w + Mancozeb 12% w/w, Hexaconazole 5% EC, Propiconazole 25% EC, Thiophenate methyl 70% WP and Carboxin 37.5%WP+ Thiram 37.5% followed by Tebuconazole + Trifloxystrobin(99.60%). At 1000ppm all the fungicides gave more than 90% inhibition where as Carbendazim 50% Wp, Carbendazim 63%w/w + Mancozeb 12% w/w, Hexaconazole 5% EC, Propiconazole 25% EC, Thiophanate methyl 70% WP and Carboxin 37.5%WP+ Thiram 37.5%, Propineb 70% WP, Tebuconazole + Trifloxystrobin and Tebuconazole 25% w/w gave complete inhibition.

Keywords: Fungicide, *Macrophomina phaseolina,* sesame, stem and root rot

Introduction

Sesame (*Sesamum indicum* L.) is the oldest cultivated oilseed crop in tropical and subtropical areas of Asia, Africa, South and Central America. India produces a wide variety of sesame seeds varying in color from white to red to black with oil content from 40 to 50 %. It is a quality food, nutrition, edible oil, bio-medicine and health care, all in one. It is known as "queen of oilseed crop" because of its high oil yield, mildness, high nutritive values and pleasant taste. It is mostly grown in hotter and drier areas of tropical and subtropical regions. Around 60-65 countries of the world produces sesame seed. China, India, Sudan, Myanmar, Uganda, Nigeria, Bangladesh, Pakistan, Tanzania, Mexico, Thailand and Egypt are major producer of sesame. India is the world leader with the maximum (25.8%) production from the largest (29.8%) area and highest (40%) export in the world. India produces 870 thousand metric tons in fiscal year 2015-2016. Sesame is largely cultivated in the western, southern and eastern parts of India with productivity of 413 kg/ha (Annual report,2016-17, Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture & Farmers Welfare, Government of India) [2]. Being a drought-tolerant, short duration crop, it is adapted to many cropping system. There is a large yield gap and farm loss exists in sesame crop because of knowledge gap, poor crop management practices and disease pest infestation. Out of all these constraints, disease prevalence is most important. The diseases of sesame include several fungal leaf spots, Fusarium wilt, stem and root rot, powdery mildew, bacterial leaf blight, phyllody and Phytophthora root rot. Macrophomina stem and root rot is one of major constraint in sesame production causing 22.5 to 38.5 per cent economic loss depending upon locality (Choudhary *et al*., 2005) [3]. At present chemical fungicides are the first choice for the farmers to combat diseases because of their easy adaptability and immediate therapy. Therefore, it is necessary to screen different fungicides to know their efficacy against *Macrophomina phaseolina*, which will help in devising suitable and effective management practices.

Present investigation was carried out to know efficacy of different fungi toxicant at different concentration against the test pathogen *in vitro*.

Materials and methods

Pathogen culture

The pathogen inciting stem and root rot disease was isolated from diseased plant sample and identified as *Macrophomina phaseolina* which was further confirmed by ITCC, IARI, New Delhi with ID No. 9811.15. Pathogen was grown in potato dextrose agar media and 5days old fresh culture was used for the studies.

Chemicals used fifteen fungicides were selected for the study which are systemic as well as contact in nature.

Fungicidal bioassay

The efficacy of different chemicals against *Macrophomina phaseolina* was tested employing poison food technique (Nene and Thapliyal, 1973) [10]. Fifteen chemicals were selected for the study and tested at 100 ppm, 500 ppm, 1000 ppm and 1500 ppm to standardize its effectiveness against test pathogen *in vitro.* For each concentration, required amount of chemical was added in melted, cooled PDA and plated. The experiment was laid in Completely Randomized Design. Each treatment was replicated thrice. One treatment without chemical was maintained which serve as control. All the plates were inoculated with 7 mm mycelia disc from the periphery of 5 days old culture of pathogen and incubated at room temperature of 25 ± 2^0C till the control plate fully covers. Diameters of each treatment were measured and per cent growth inhibition was calculated using Vincent formulae (Vincent, 1947) [12].

$$I = \frac{(C-T)}{C} x100$$

I = Per cent inhibition of mycelium
C = Growth of mycelium in control
T = Growth of mycelium in treatment

Result and discussion

Efficacy of fifteen chemicals were tested *in vitro* against *Macrophomina phaseolina* at four different concentrations *viz.*, 100 ppm, 250 ppm, 500ppm and 1000ppm by employing poisoned food technique. Observations on colony diameter of the fungus were recorded after five days of inoculation. The per cent inhibition of *M. phaseolina* mycelium at different concentrations was calculated and presented in the table1. All the fungicides inhibited the radial growth of *M. phaseolina*. There was a significant decrease in mycelial growth with an increase in concentration of fungicides. All the fungicides strongly inhibited the growth of the test fungus.

Table 1: Evaluation of potentiality of fungitoxicant against *M. phaseolina in vitro*

Sl. no	Treatments	Trade name	Systemic / contact	Mean per cent of mycelia inhibition			
				100 ppm	250 ppm	500 ppm	1000 ppm
1	Carbendazim 50% WP	Dhanustin 50% WP	Systemic	64.00 (53.11)	82.23 (65.04)	100.00 (90.00)	100.00 (90.00)
2	Carbendazim 63%w/w + Mancozeb 12% w/w	Saaf	Systemic & contact	70.10 (56.83)	86.27 (68.22)	100.00 (90.00)	100.00 (90.00)
3	Validamycin 3L	Sheathmar 3L	Systemic	45.27 (42.27)	64.50 (53.41)	80.72 (63.94)	94.78 (77.03)
4	Azoxystrobin 23 SC	One star	Systemic	34.83 (36.16)	46.27 (42.84)	61.04 (51.38)	92.57 (74.19)
5	Hexaconazole 5% EC	Contaf 5E	Systemic	45.03 (42.13)	78.49 (62.35)	100.00 (90.00)	100.00 (90.00)
6	Difenconazole 25 EC	Score	Systemic	54.63 (47.64)	72.70 (58.48)	96.58 (79.33)	99.60 (87.88)
7	Propiconazole 25% EC	Tilt	Systemic	66.80 (54.79)	80.56 (63.82)	100.00 (90.00)	100.00 (90.00)
8	Thiophenate methyl 70% WP	Roko	Systemic	70.00 (56.77)	84.61 (66.88)	100.00 (90.00)	100.00 (90.00)
9	Propineb 70% WP	Antracol	Contact	44.83 (42.02)	76.57 (61.03)	98.79 (86.33)	100.00 (90.00)
10	Chlorothalonil	Kavach	Contact	54.43 (47.52)	68.49 (55.83)	94.78 (76.89)	95.18 (77.56)
11	Carboxin 37.5%WP+ Thiram 37.5%	Vitavax power	Systemic & contact	65.33 (53.90)	72.65 (58.44)	100.00 (90.00)	100.00 (90.00)
12	Tebuconazole + Trifloxystrobin	Nativo 75 WG	Systemic	54.63 (47.64)	84.61 (66.88)	99.60 (87.88)	100.00 (90.00)
13	Cyamoxanil 8% + Mancozeb 64%	Curzate M8	Systemic & contact	42.63 (40.74)	62.63 (52.30)	93.17 (77.67)	99.60 (87.88)
14	Fenamidon + Mancozeb	Sectin 60WG	Systemic & contact	42.57 (40.71)	72.88 (58.60)	89.16 (70.76)	89.96 (71.50)
15	Tebuconazole 25% W/W	Folicure	Systemic	62.65 (52.30)	75.00 (59.98)	99.20 (87.01)	100.00 (90.00)
16	Control	-	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SE(m)± CD(0.01)			0.221 0.640	0.364 1.054	2.138 6.187	1.041 3.013

Carbendazim 63%w/w + Mancozeb 12% w/w recorded maximum mycelium inhibition (70.10%) at 100 ppm followed by Thiophanate methyl 70% WP (70.00%) which were at par with each other. The next best of merit was Propiconazole

25% EC (66%) followed by Carboxin 37.5%WP+ Thiram 37.5% (65.33%) and Carbendazim 50% WP (64%). Least inhibition was recorded by Azoxystrobin 23 SC (34.83%). All the fungicide witnessed more than 30% growth inhibition at 100 ppm concentration.

At 250 ppm, Carbendazim 63%w/w + Mancozeb 12% w/w recorded best inhibition (86.27%) followed by Thiophenate methyl 70% WP and Tebuconazole + Trifloxystrobin registering 84.61% mycelia inhibition of test fungus. Carbendazim 50% WP and Propiconazole 25% EC gave more than 80% of growth inhibition recording 82.23% and 80.56% growth inhibition respectively. All fungicides recorded more than 60 % growth inhibition except Azoxystrobin 23 SC (46.27%).

The complete inhibition (100%) of *M. phaseolina* mycelium at 500 ppm was observed in Carbendazim 50% WP, Carbendazim 63%w/w + Mancozeb 12% w/w, Hexaconazole 5% EC, Propiconazole 25% EC, Thiophenate methyl 70% WP and Carboxin 37.5%WP+ Thiram 37.5%. The next best in order of merit was Tebuconazole + Trifloxystrobin (99.60%) followed by Tebuconazole 25% W/W (99.20%), Propineb 70% WP (98.79%) and Difenconazole 25 EC (96.58%), Chlorothalonil (94.78%) and Cymoxanil 8% + Mancozeb 64% (93.17%) which were at par with each other witnessing more than 90% mycelia growth inhibition. All the fungicides inhibited the growth of *M. phaseolina* more than 80% at 500ppm except Azoxystrobin 23 SC which gave 61.04% mycelia inhibition.

At 1000ppm, all the fungicides gave more than 90% inhibition where as Carbendazim 50% Wp, Carbendazim 63%w/w + Mancozeb 12% w/w, Hexaconazole 5% EC, Propiconazole 25% EC, Thiophanate methyl 70% WP and Carboxin 37.5%WP+ Thiram 37.5%, Propineb 70% WP, Tebuconazole + Trifloxystrobin and Tebuconazole 25% w/w gave complete inhibition. Cymoxanil 8% + Mancozeb 64% and Difenconazole 25EC recorded 99.60% growth inhibition followed by Chlorothalonil (95.18%), Validamycin 3L (94.78%) and Azoxystrobin 23 SC (92.57%).

From the experiment, it is seen that all the fungicides inhibited the radial growth of *M. phaseolina*. It is dose dependent. Carbendazim 63%w/w + Mancozeb 12% w/w can be consider good as it inhibited the test pathogen at low concentrations. Many other chemicals also found at par with it. Similar results do exist in literature which provides ample support to present findings.

The efficacy of carboxin + thiram was observed by Daftari and verma (1975) [6], Dubey and Kumar (2003). Dubey and Kumar (2003) [7] found at 30 ppm the growth of the pathogen was completely inhibited by azadirachtin and carbendazim, whereas mancozeb inhibited the growth by 87.3%. Ammajamma *et al*. (2009) [1] reported systemic fungicide hexaconazole and metalaxyl have given cent per cent inhibition. Thiram and thiram + carboxin was also proved effective. Effectiveness of bavistin, captan, thiram, Indofil M-45 and vitavax against root rot was recorded by Kumari *et al* (2012) [9]. Sangeetha and Jahagirdar (2013) [11] observed combo-product carbendazim + mancozeb and carboxin + thiram were effective against *R. bataticola in vitro*. Choudhary *et al.* (2014) [5] Seed treatment with a mixture of carbendazim 50 WP (0.1%) and thiram 75 WP (0.15%) recorded minimum PDI of 11.15 per cent and 9.91 per cent and highest seed yield of 637 kg/ha and 646 kg/ha. Kumar *et al*. (2016) [8] reported nano form, a commercial composition at Trifloxystrobin 25% + Tebuconazole 50% (75 WG) proved effective at 10 ppm exerting hyphal abnormality, hyphal lysis and abnormality of sclerotial formation on *M. phaseolina in vitro*. The findings of earlier workers are in the line of corroboration to the present work.

All the chemicals have good control over mycelial growth of test pathogen. Screening of fungicides against *M. phaseolina* at different concentration *in vitro* is a preliminary work. Fungicides giving good result *in vitro* should be tested in field condition to know their effectiveness. Chemicals can be a good option for management of stem and root rot of sesame easily and immediately.

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