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Evaluation of Fungicides and Plant extracts against stem rot of mustard Caused by (*Sclerotinia sclerotiorum*) *In-Vitro* and *In-Vivo* condition

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ABSTRACT

Mustard group of crops are important oil seed crops of the world. The stem rot of mustard incited by *Sclerotinia scletiorum* (Lib.) de Bery, is a new emerging drastic disease. The pathogen was tested with 12 Fungicides and 03 Plant extract *In-Vitro*.*In-Vivo* condition 9 fungicides and 01 plant extract were tested in the year of 2019-20 and 2020-21. Among the tested fungicides namely Mancozeb, Chlorothalonil, and Vitvax were found most effective which inhibited the growth of the pathogen completely and inhibition exhibited 100%. Vapum was the least effective fungicide which showed 88.03mm fungal growth with 2.18 per cent inhibition over control. *In-Vivo* condition Chlorothalonil and Mancozeb was most effective fungicides which was showed mean minimum disease incidence (06.52% and 08.87%) and maximum mean yield 6.55 and 5.75q/ha. respectively. Next order of superiorly fungicides were Kitazin, Bavisin and Vitavax, which were showed the mean disease incidence 11.68, 13.65, 15.56 and yield 5.20, 4.70 and 4.30q/ha. respectively. Among the tested fungicide Zineb was least effective which was showed the maximum mean incidence of disease (30.03) with respect to minimum mean yield (2.67q/ha). Among the plant extract Nimbidinwas least effective which showed 33.14 per cent mean disease incidence and minimum (2.32q/ha) grain yield.

Keywords: Evaluation, Fungicides, Plant Extract, *Sclerotinia sclerotiorum*, Mustard.

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INTRODUCTION

Mustard (*Brassica juncia* L.) is a most important oil seed crop in all over India. Mustard is a third important oil seed crop in the world after Soya bean and palm (Shekhawat *et al*., 2012). Its belonging to family of Cruciferae (Bressicaceae).The cruciferous crop are grown in Tropical as well as Temperate zone moist cool weather during growing period and dry weather during harvesting. The oil contains usually 38-57% of Uric acid, 4.7-30% of Linoleic acid and 20% of Oleic acid which are the high nutritive value require to human health (Kumar *et al*., 2014). Mustard is a predominantly cultivated in Rajsthan, U.P., M.P. and Gujarat. Mustard crop is known to suffer from a number of fungal and bacterial diseases. More than 30 diseases are known to occur on mustard crop in India (Saharan *et al*., 2005). Among the fungal disease is stem rot caused by *Sclerotinia sclerotiorum* (Lib.) de Bary.

Stem rot of mustard are considered as a minor problem in India but it has become a threat by the wide spread, destructive and serious problem not only India but throught the world most mustard growing area. Large number of sclerotia are formed in soil on dead organic matter, on root and inside the pith of the stem in mustard crop, that is serve as source of primary inoculum for the next season. In India (Shaw and Ajrekar, 1915)the reported this disease first time from Pusa, Bihar.

MATERIALS AND METHODS

Screening of fungicides *In-Vitro*

The efficacy of fungicides and plant extracts against the pathogen *In-Vitro* was tested by "Poison Food Technique" as suggested by Schmitz (1930) using PDA medium. The fungicides namely *Viz*., Mancozeb, Chlorothalonil, Vitavax (0.15%), Bavistin, Kitazin, Captafal, Topsin-M (0.15%), Captan, Vapam, Zineb, Streptomycin, Ridomil (0.25%), Garlic extract, Nimbidin and Sadabahar(0.05%) were tested *In-Vitro* condition with C.R.D. design with 3 replication and without fungicides plate was mention as control.

Plant extracts of the botanicals, Garlic extracts (*Allium sativam*), Nimbidin (*Azadirachta indica*) and Sadabahar (*Catharanthus roseus*) were prepared by crushing their leaves and bulb (100g each) in 100ml of sterilized distilled water. The extracts were then filtered through a muslin cloth and centrifuged for 30 minute at 5000 rpm. The extract were sterilized by passing them through a Millipore filter (0.22um pore size) using a swimmy filter adopter. The materials were dried at room temperature (25±2^{0}C) for 6 hours to remove the traces of water. Subsequently 0.25% concentration of the extracts of each botanical was used for bio-assay test by poison food technique. The radial growth of *S. sclerotiorum* in four replications with CRD design were recorded separately and their average were taken. The per cent inhibition over contral was calculated by the formula (Bliss, 1934) as given below:

$$\text{Percent inhibtion over control} = \frac{C - T}{C} \times 100$$

Where,
C= Growth of fungus in control
T= Growth of fungus in treatment

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Screening of fungicides *In-Vivo*

In order to find out a suitable fungicide and plant extract which was found effective *In-Vitro* condition. The effective fungicides, and plant extracts were assessed in field trail during *Rabi* season 2019-20 and 2020-21.A highly susceptible field with known history of Sclerotinia rot of Mustard was selected. The mustard variety (Varuna)was sowing in 5X5m plot size in Randomized Blok Design with four replications. The nine fungicides *Viz,* Chlorothalonil, Mancozeb, Kitazin, Bavistin, Vitavax, Captafal, Topsin-M, Captan, Zineb and one plant extract Nimbidin were used as spray. For recording the disease incidence, forty randomly selected plants per plot were examined and the disease incidence in percentage was transformed in to angles and analysed statistically. Yield was estimated on plot basis without the border rows in the q/ha.

STATISTICALANALYSIS

The effect of different fungicide on disease incidence and yield against stem rot of mustard was calculated in term of percent disease incidence and yield (q/h) as per formula given and the data was analyzed by using the OPSTAT statistical program by Sheoran (2006).

RESULTS AND DISCUSSION

Major symptom of the Stem rot of Mustard

Stem rot are observed throughout the growing season and may vary in size, shape and colour depending on the environmental conditions, age of the rots, and the degree of susceptibility of the mustard variety. The stem of the mustard plants show the symptoms of the early, as the stem is the primary target of *Scleotinia sclerotiorum*. The disease appears as elongated water-shocked area. Later on this water-soaked areas are covered with a cottony mycelial growth of the fungus. The affected area become white and tends to shred and numerous greyish-white to black sclerotia of various forms and sizes appear on the surface of the lesions and also inside the pith(Fig. 1a&b) (Pandey *et al.*, 2002).

The stem rot of mustard caused by *Sclerotinia sclerotiorum* is a soil borne disease and mode of dissemination are many such as infected plant debris and sclerotia as culture (Fig.2a), mycelium , sclerotia (Fig.2b), Sclerotia germination (Fig.2c)and most commonly as apothecia (Fig. 2d), (Singh,*et al.*, 1998 and Adams and Ayers, 1981).

Fig. 1a: Infected field of Mustard

Fig. 1b: Sclerotia formation inside the stem

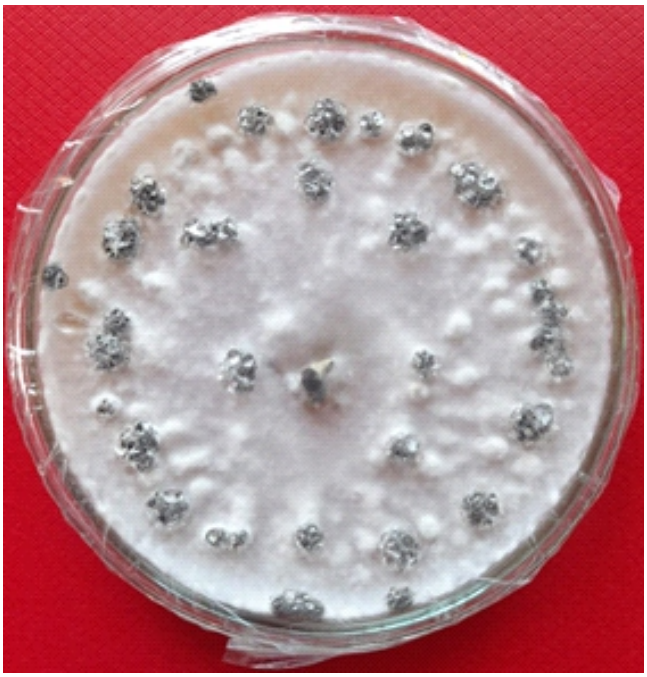

Fig. 2a: Pure culture of the pathogen

The result are presented in Table1, corresponding histogram (Fig. 3 and 4) indicate that all the fungicides and plant extracts were significantly superior over control in inhibition the growth of pathogen*In-Vitro*. Among the tested fungicides Mancozeb (0.00mm), Chlorothalonil (0.00mm) and Vitavax (0.00mm) were the most effective fungicides and they completely inhibited growth of pathogen (100.00%). The Bavistin (0.90mm) and Kitazin (01.00mm) were found to be the next best effective fungicide in inhibiting the growth of pathogen. Both the fungicide was statistically at par which sowing (99.00 and 98.88) per cent inhibition over control respectively. The next effective fungicide Captafal (02.13mm)

Fig. 2b: Sclerotia

Fig. 2c: Sclerotia germination

Fig. 2d: Apothecia formation

followed by Topsin-M (09.24mm), Captan (14.03mm), Nimbidine (24.07mm), Zineb (52.04mm), Streptomycin (70.01mm) and Ridomil (75.02mm). All the fungicide were statistically at different from each other. The least effective fungicide was Vapum with average fungal growth (88.03mm) and per cent inhibition ove control (02.18) per cent. Other fungicides and plant extract was also reduced the growth of pathogen. This finding are in close agreement with the observation of Moore and Atkins(1977) and Singh *et al.*(2003) on different crop affected by *Sclerotinia scletiorum*.

Table 1: Effect of fungicides and Plant extracts on colony growth of *S. sclerotiorum* on P.D.A. medium after 7 days

Name of fungicides	Dose %	Average fungal growth (mm)	Per cent inhibition over control
Mancozeb	0.25	00.00	100.00
Chlorothalonil	0.25	00.00	100.00
Vitavax	0.15	00.00	100.00
Bavistin	0.25	0.90	99.00
Kitazin	0.25	1.00	98.88
Captafal	0.25	2.13	97.63
Topsin-M	0.15	9.24	89.73
Captan	0.25	14.03	84.41
Nimbidine	0.25	24.07	73.25
Zineb	0.25	52.04	42.17
Streptomycin	0.25	70.01	22.21
Ridomil	0.25	75.02	16.64
Garlic Extracts	0.5	78.00	13.26
Sadabahar	0.5	85.07	05.47
Vapum	0.5	88.03	02.18
Control	…..	90.00	…..
C.D.		2.16	

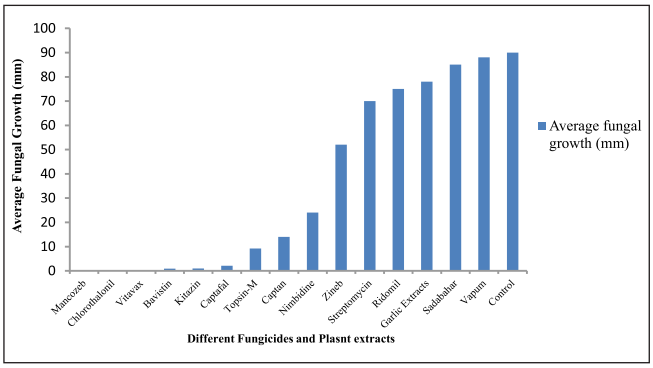

Fig. 3: Effect of different fungicisdes and plant extracts under In-Vitro 2019-20

The results are presented in Table 2 and corresponding histogram (Fig. 5) of field trail with nine fungicides and one plant extract indicate their effectiveness in managing the disease. In the year 2019-20 spraying of fungicide Chlorothalonil (6.07%) at the interval of 15 days was most effective in minimizing the disease incidence and increasing the yield (6.00q/h). The next effective fungicide was Mancozeb and Kitazin which showed (09.33 and 11.02) per cent disease incidence and (5.10 and 4.60q/h) yield, and these were statistically at par with each other. The next order of

Fig. 4: Effect on Different fungicides and Plant extracts against *Sclerotinia sclerotiorum* under *In-Vitro* condition

superiorty fungicides Bavistin (12.23%), Vitavax (15.01%), Captafol (18.34%), Topsin-M (22.12%), Captan (27.06%) and Zineb (28.02) per cent disease incidence and yield was (4.20, 3.90, 3.65, 3.20, 2.90, 2.65) q/h respectively. The Nimbidine provide to be least effective plant extract which showed (32.16mm) disease incidence and decreasing the yield (2.25q/h). The Zineb and Capton proved numerically better than Nimbidine but was at different statisticallyshowed disease incidence was (28.02 and 27.06%) and yield (2.65 and 2.90) q/h.

Table 2: Efficacy of different fungicides and plant extracts against Sclerotinia stem rot of Mustard under In-Vivo condition

Name of fungicides	Dose %	Per cent disease incidence			Yield q/h		
		Year		Mean	Year		Mean
		2019-20	2020-21		2019-20	2020-21	
Chlorothalonil	0.25	06.07 (15.00)*	06.97 (15.23)	6.52 (14.77)	6.00 (14.18)	7.10 (15.45)	6.55 (14.77)
Mancozeb	0.25	09.33 (17.76)	08.42 (16.85)	8.87 (17.26)	5.10 (13.05)	6.40 (14.65)	5.75 (13.81)
Kitazin	0.25	11.02 (19.55)	12.34 (20.53)	11.68 (19.91)	4.60 (12.39)	5.80 (13.94)	5.20 (13.18)
Bavistin	0.25	12.23 (20.44)	15.07 (22.79)	13.65 (21.64)	4.20 (11.83)	5.20 (13.18)	4.70 (12.52)
Vitavax	0.15	15.01 (22.87)	16.12 (23.66)	15.56 (23.19)	3.90 (11.39)	4.70 (12.52)	4.30 (11.97)
Catafal	0.25	18.34 (25.33)	19.07 (25.84)	18.70 (25.62)	3.65 (10.94)	4.00 (11.54)	3.82 (11.24)
Topsin -M	0.15	22.12 (28.04)	23.04 (28.66)	22.58 (28.32)	3.20 (10.31)	3.60 (10.94)	3.40 (10.63)
Capatn	0.25	27.06 (31.69)	28.11 (32.01)	27.58 (31.63)	2.90 (9.80)	3.00 (9.98)	2.95 (9.80)
Zineb	0.25	28.02 (32.08)	32.04 (34.45)	30.03 (33.21)	2.65 (9.28)	2.70 (9.46)	2.67 (9.28)
Nimbidine	0.5	32.16 (34.51)	34.13 (35.73)	33.14 (35.12)	2.25 (8.53)	2.40 (8.91)	2.32 (8.72)
Control	….	36.00 (87.00)	36.00 (87.00)	36.00 (87.00)	2.05 (8.13)	2.25 (8.53)	2.15 (8.33)
C.D.		**2.56**	**3.21**		**3.55**	**1.43**	

* Figures in parenthesis are angular transformed value.

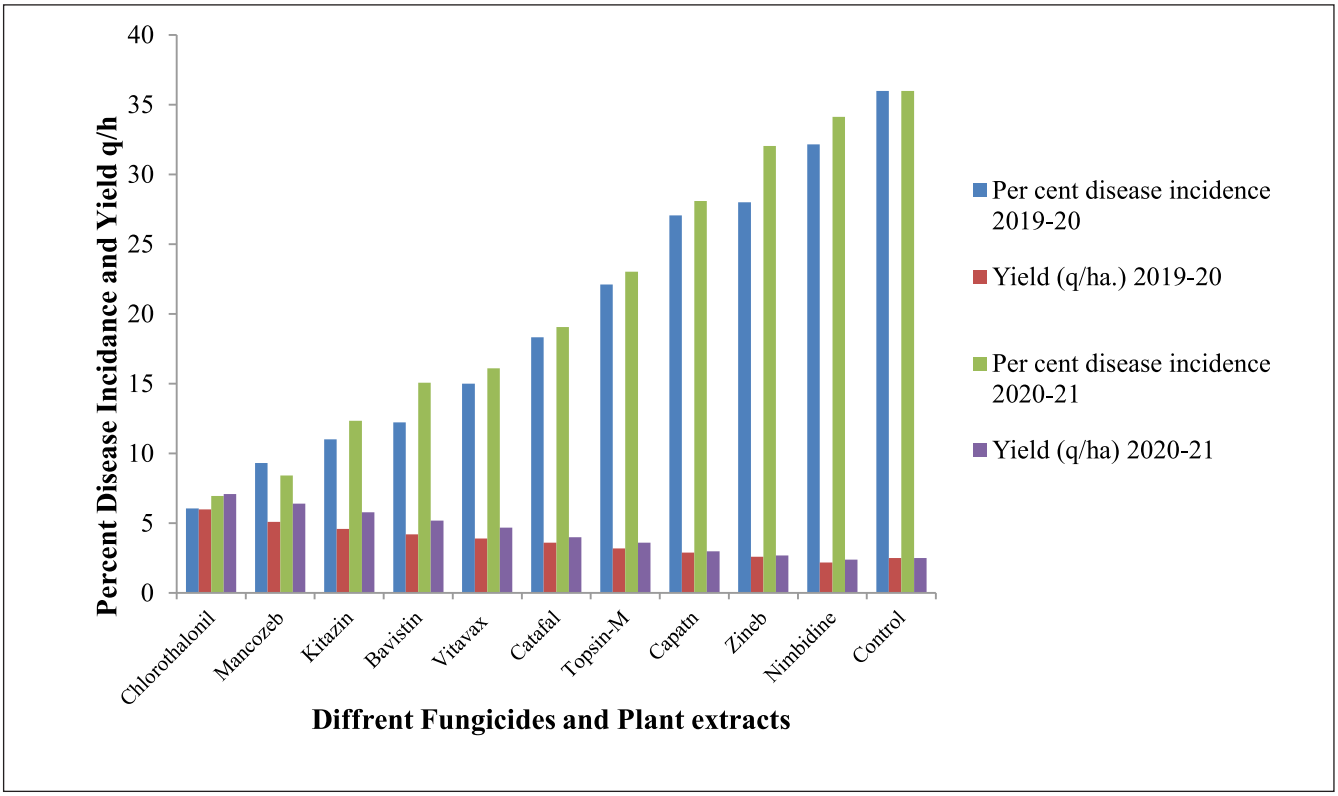

Fig. 5:Effect of diffrent fungicides, Plant extracts on PDI and Yield under In-Vivo condition during 2019-20 and 2020-21

In the year 2020-21 Chlorothalonil was most effective fungicide which showed (06.97) percent disease incidence and (7.10q/h) yield.The next best effective fungicide was Mancozeb and Kitazin (08.42 and 12.34%) disease incidence and (6.40 and 5.80q/h) yield and both the fungicide were statistically at par with each other. Next order of superiority fungicide Bavistin (5.20), Vitavax (4.70), Captafol (4.00), Topsin-M (3.60), Captan (3.00) and Zineb (2.70) per cent disease incidence and yield (5.20, 4.70, 4.00, 3.60, 3.00 and 2.70) q/ha. respectively. The least effective plant extract Nimbidine was (43.13%) disease incidence and yield was (2.40q/h). All the fungicides ware also reduced the disease incidence.The present finding is close agreement with the finding of Singh *et al.* (2019) on Sclerotinia stem rot of mustard and Singh*et al*.(1994) suggested that the Sclerotinia stem rot of mustard could be managed by spraying of Vitavax and Topsin-M which was reduced the per cent disease incidence and increasing the yield of mustard. Singh *et al.* (2008) recorded the effect of different fungicides and plant extract against Sclerotinia stem rot of brinjal.

CONCLUSION

The present study demonstrated that the safest chemical are used for the managing the disease of stem rot of mustard *In-Vivo* condition. The minimum average disease incidence 6.52 with maximum average yield 6.55 q/ha. was recorded with the application of Chlorothionil, followed by Mancozeb and Kitazin which showed 8.87 and 11.68 mean average disease incidence with the corresponding yield was 5.75 and 5.20 q/ha. Among the tested plant extract Nimbidine was also effective which showed the 33.14 mean average disease incidence with minimum average mean yield 2.32 q/ha. was recorded.

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