Management of root rot (*Rhizoctonia solani)* of okra through novel combined formulations of fungicides

Abstract

Lady's finger or okra [*Abelmoschus esculentus* (L.) Moench] is known as "*Bhindi*" in Hindi, is one of the most important summer vegetables of Rajasthan as well as India and belongs to the family *Malvaceae.*This crop suffers harshly from the vagary of diseases caused by fungi and important one is root rot caused by *Rhizoctonia solani*, which is an important constraint to the crop and causes significant economic losses and fungicides are the major tool to overcome the disease incidence. During investigation, seven systemic and non-systemic fungicides were evaluated *in vitro* and *in vivo* conditions for two consecutive years. All the tested fungicides showed highly inhibitory response at 100, 200 and 300 ppm concentrations. By treating the seeds with these fungicides, the highest disease reduction (85.91%), increased yield (30.65%) and maximum ICBR (1:215.89) was recorded withcaptan + hexaconazole (@ 0.2%) followed by tebuconazole + trifloxystrobin(81.59%, 30.10%, 1:140.55), penflufen+ trifloxystrobin(78.82%, 29.11%, 1:209.08), fluxapyroxad + pyraclostrobin(75.58%, 27.67%, 1:111.12),hexaconazole(73.80%, 26.32%, 1:197.84), azoxystrobin(71.68%, 24.52%, 1:180.36) and least effective was copper hydroxide (69.38%, 22.75%, 1:169.18, respectively) over control. It is concluded that the use of combined formulations of fungicides may be the most powerful tools in managing root rot of okra with economical yield returns.

Keyword: Okra,root rot,*Rhizoctonia solani*, fungicides, seed treatment.

Introduction

Okra or lady's finger [*Abelmoschus esculentus* (L.) Moench] which is known as "*Bhindi*" in Hindi, is one of the most important summer vegetables of Rajasthan as well as India and belongs to the family *Malvaceae*(Tindall, 1983). The genus *Hibiscus* created after the characteristics of the calyx, spathulate, with five short teeth, connate to the corolla and caducous after flowering (Kundu and Biswas, 1976). It was originated in tropical Africa, particularly in Ethiopia and spread throughout Middle East and North Africa (Lamont, 1999) and presently grown widely round the globe in the tropics, subtropical and warm region of the world (Singh *et al.*, 2014). The fruits are harvested at immature stage and eaten as a

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vegetable. The fruits of okra have reawakened beneficial interest in bringing this crop into commercial production (Priya *et al.*, 2014).

Due to delicious taste, liking as well as nutritional value, it plays an important role to meet the demand of vegetable in the market (Akinyele and Temikotan, 2007). In paper industries, the stem of okra plants is used for fiber purposes (Qayyum, 1990 and Mithal, 2006). Martin (1982) has suggested that its roasted and grinded seeds can used as a substitute for coffee.It is also good source of iodine which is useful in the treatment of simple goiter and source of other medically useful compound (Moanwarde*et al.*,1984). Tests conducted in China suggest that an alcohol extract of okra leaves can eliminate oxygen free radicals, alleviate renal tubular interstitial diseases, reduce protein urea, and improve renal function (Kumar *et al.*, 2009). The important diseases of okra areroot rot (*Rhizoctonia solani*Kuhn), powdery mildew (*Oidium* spp.),Fusariumwilt(*Fusariumoxysporum*), charcoal rot (*Macrophominaphaseolina*),Cercosporaleafspot(*Cercosporaabelemoschi*), damping off (*Pythium* spp.), root knot (*Meloidogyne* sp.) and yellow vein mosaic (*Bhindi Yellow Vein Mosaic Virus*)(Anon.,2003).

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Amongst these diseases, root rot caused by *Rhizoctonia solani*, is an important constraint to the crop and causes significant losses.The pathogen mainly attacks the root and underground parts, but it is also capable of infecting the other plant parts like the green foliage parts, the seeds and the hypocotyls (Acharya et al., 2014). Among the initial symptoms of the disease, yellowing of leaves is a firstsymptom which in next two or three days, leaves droop and wither off. Infected plantsmay wilt within a week after the appearance of first symptom. When stem isexamined closely, dark lesions can be observed on the bark near ground level. The roots of infected plants are poorly developed; finer roots are either not formed or rotted. Plants show stunted growth and can easily be pulled out. If the plants are pulled from soil, thebasalstemalongwithmainroot,mayshow symptoms of rotting. The tissues are weakened and break off easily inadvanced cases and sclerotial bodies can be seen scattered on the affectedroots. The fungus is mainly a soil dweller and spreads from plant to plant through irrigation water and implements and cultural operations. The sclerotia and pycniospores may also become air borne and cause further spread of the pathogen (Rangaswami and Mahadevan, 2008). Crop losses by root rot of okra (*Rhizoctonia solani)* is ranged fromnegligible to 50-60 per cent depending on the extent of severity and differentstagesofcrop(Safiuddin*etal.*,2014) and fungicides are the key tool to overcome this ailment. Crop losses by root rot of okra (*Rhizoctonia solani)* is ranged fromnegligible to 50-

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60 per cent depending on the extent of severity and differentstagesofcrop(Safiuddin*etal.*,2014). For managing root rot disease, earlier plant pathologists conducted several experiments including chemical control. Application of fungicides is the most effective and satisfactory method to manage root rot through tetra methyl thiram disulphide (TMTD), mancozeb, carbendazim, zineb and copper oxychloride. The most of these fungicides alter only one or perhaps two steps in genetically controlled events into the metabolism of the fungus. Therefore, the present investigation was carried out to evaluate noval and combined formulations of fungicides for managing root rot of okra.

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Materials and Methods

The laboratory experiment was carried out in the Department of Plant Pathology while field experiments were conducted at Instructional Farm, S.K.N. College of Agriculture, Jobner, Jaipur (Rajasthan) for two consecutive years. Jobner is situated at latitude 26°5’ N, longitude of 75°20’ E and altitude of 427 meters above MSL (mean sea level). The region falls under semi-arid eastern plain (Agro Climatic Zone- lll A) of Rajasthan.

The following seven systemic and non-systemic fungicides were evaluated against *R. solani* by poisoned food technique and seed treatment.

List 1 : Systemic and non-systemic fungicides and their doses

S. No.	**Common name**	**Dose**	
		***In vitro* (ppm)**	***In vivo* (%)**
1.	Azoxystrobin 22% SC	100, 200 & 300	0.1
2.	Copper hydroxide 53.8% DF	100, 200 & 300	0.2
3.	Hexaconazole 5% SC	100, 200 & 300	0.2
4.	Captan 70% + hexaconazole 5% WP	100, 200 & 300	0.2
5.	Penflufen13.28% w/w + trifloxystrobin13.28% WP	100, 200 & 300	0.2
6.	Tebuconazole 50% + trifloxystrobin 25% WG	100, 200 & 300	0.2
7.	Fluxapyroxad G/L% + pyraclostrobin 250G/LSC	100, 200 & 300	0.2
8.	Control	-	-

***In vitro* efficacy of fungicides:** Efficacy of above mentioned seven systemic and non-systemic fungicides was tested against mycelial growth of *R.solani* by Poisoned Food

Technique. Required quantity of each fungicide was added aseptically to 100 ml sterilized PDA medium in 150 ml flask so as to get concentration of 100, 200 and 300 ppm. Just before pouring in sterilized Petri plates, the flasks were shaken several times to ensure proper and uniform distribution of the fungicide. Poisoned medium was poured in sterilized Petri plates and allowed to solidify. Medium without fungicide served as control. Three replications were maintained for each treatment. Each plate was inoculated with 5 mm mycelial bit of the pathogen in the centre of plate. Inoculated plates were incubated at 28+1^{0}C for 7 days. The linear growth of test fungus was recorded and per cent growth inhibition was calculated by Vincent's (1947) formula:

$$\text{Per cent Growth Inhibition} = \frac{C - T}{C} \times 100$$

Whereas,

C =Diameter of the colony in check (average of both diagonals)

T = Diameter of colony in treatment (average of both diagonals)

***In vivo* efficacy of fungicides in disease management:** A field experiment was conducted during Zaid 2022 and 2023 at Instructional Farm, S.K.N. College of Agriculture, Jobner in randomized block design (RBD) with three replications in 1.8 m x 2.25 m plots, using Pusa Bhindi-5 as test variety, under artificial inoculation conditions (20 g inoculum per meter row, multiplied on sorghum grains). All the recommended agronomic practices were followed to raise the crop. Above mentioned seven fungicides were used as seed treatment. Fungicide treated as well as untreated seeds were sown separately in plots with three replications. Observations on disease incidence (75 DAS) and pod yield (up to harvest) were recorded.

Incremental cost benefit ratio (ICBR): ICBR over the control was worked out to identify and judge the cost effectiveness of the respective treatments, incremental cost benefit ratio (ICBR) *i.e.* the ratio between changes in return and change in cost over control treatment in absolute terms for the respective treatment combinations were computed subsequently.

ICBR= [Additional income received (from the particular treatment)/Additional cost incurred for the particular treatment]

Incremental Cost-Benefit ratio: This was calculated separately for each treatment as per following formulae

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$$\text{Incremental Cost-benefit ratio} = \frac{\text{Net Return}}{\text{Cost of Treatment}}$$

Statistical Analysis: The data obtained in different experiments was transferred using angular transformation wherever necessary and was statistically analyzed using Completely Randomized Block Design (CRD) as per the procedures suggested by Panse and Sukhatme (1978). Statistical analysis was carried out as per the procedures given by Panse and Sukhatme (1985). Actual data in percentage were converted to angular transformed values, before analysis according to the table given by Walter (1997). Fischer's method of analysis of variance was used for analysis and interpretation of the data as outlined by Gomez and Gomez (1984). The level of significance used in 'F' and 'T' tests was p=0.05. Critical differences were calculated wherever 'F' test was significant. Other statistical analysis *viz.,* calculation of correlation coefficients, regression equations *etc.* were done using MS-excel.

Calculation and Statistical Analysis: Percent disease incidence (PDI) and disease control in various experiments were calculated as follows:

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

$$\text{Disease control (\%)} = \frac{\text{Disease incidence in inoculated control (\%)} - \text{Disease incidence in treatment (\%)}}{\text{Disease incidence in inoculated control (\%)}} \times 100$$

$$\text{Increase in yield over check (\%)} = \frac{\text{Yield of plants in treatment (\%)} - \text{Yield of plants in inoculated control (\%)}}{\text{Yield of plants in inoculated control}} \times 100$$

Results and Discussion

Efficacy of fungicides (*in vitro*)

Seven systemic and non-systemic fungicides were evaluated against *R. solani*by poisoned food technique. All the tested fungicides showed significantly higher mycelial growth inhibition over control (Table-1, Plate-1 and Fig.-1). Among these fungicides, captan+

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hexaconazole was found the most effective in inhibiting mycelial growth (80.00, 89.00 and 98.00%) followed by tebuconazole + trifloxystrobin(70.00, 85.00 and 93.00%), penflufen+ trifloxystrobin (49.00, 80.00 and 89.00%), fluxapyroxad + pyraclostrobin (45.00, 73.00 and 86.00%)andhexaconazole(43.00, 70.00 and 82.00%) at 100, 200 and 300 ppm concentration, respectively.Copper hydroxide 53.8% DF was found least effective in inhibition of mycelial growth (40.00, 65.00 and 81.00%) at 100, 200 and 300 ppm concentration, respectively.The data presented in Table-1 also reflected that mean mycelial growth inhibition was also maximum in case of captan + hexaconazole(89.00%) followed by tebuconazole + trifloxystrobin(82.67%), penflufen+ trifloxystrobin(72.67%), fluxapyroxad + pyraclostrobin (68.00%), hexaconazole(65.00%), azoxystrobin(62.33%) andleast effective was copperhydroxide (59.67%).Our results are in agreement with the findings of Deepthi *et al.* (2014), Atia *et al.* (2015), Basandrai*et al.* (2016), Maruti *et al.* (2017) and Yadav *et al.* (2020) as they evaluated different fungicides under *in vitro* conditions against *M. phaseolina* in which carboxin + thiram and penflufen gave 100% inhibition at 500 ppm while tricyclazole gave 100 per cent inhibition at 1000 ppm. The seed treatment with Vitavax Power gave highest seed germination percentage and reduced seedling mortality, and lower yield losses. The Vitavax Power as seed treatment along with one foliar application of carbendazim was found most effective in increasing seed germination and reducing pre, post emergence mortality and lowering losses in yield of sesame.

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Table-1. ***In vitro* evaluation of fungicides against *Rhizoctonia solani* at three concentrations**

S. No.	Common name	Per cent inhibition of mycelial growth at various concentrations			
		100 ppm	**200ppm**	**300ppm**	**Mean**
1.	Azoxystrobin 22% SC	40.00 (39.23)	65.00 (53.73)	81.00 (64.90)	62.33 (52.14)
2.	Copper hydroxide 53.8% DF	38.00 (38.06)	63.00 (52.54)	78.00 (62.03)	59.67 (50.57)
3.	Hexaconazole 5% SC	43.00 (40.98)	70.00 (56.79)	82.00 (64.90)	65.00 (53.73)
4.	Captan 70%+hexaconazole5% WP	80.00 (63.43)	89.00 (70.63)	98.00 (81.87)	89.00 (70.63)
5.	Penflufen13.28% w/w + trifloxystrobin13.28% WP	49.00 (44.43)	80.00 (63.43)	89.00 (70.63)	72.67 (58.48)
6.	Tebuconazole 50% + trifloxystrobin 25% WG	70.00 (56.79)	85.00 (67.21)	93.00 (74.66)	82.67 (65.40)
7.	Fluxapyroxad G/L% + pyraclostrobin 250 G/LSC	45.00 (42.13)	73.00 (58.69)	86.00 (68.03)	68.00 (55.55)
8.	Control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
		SEm	**CD (p=0.05)**		
	F	0.60	1.66		
	C	0.91	2.53		
	F X C	1.58	4.38		

*Average of three replications. Figures in parentheses are angular transformed values

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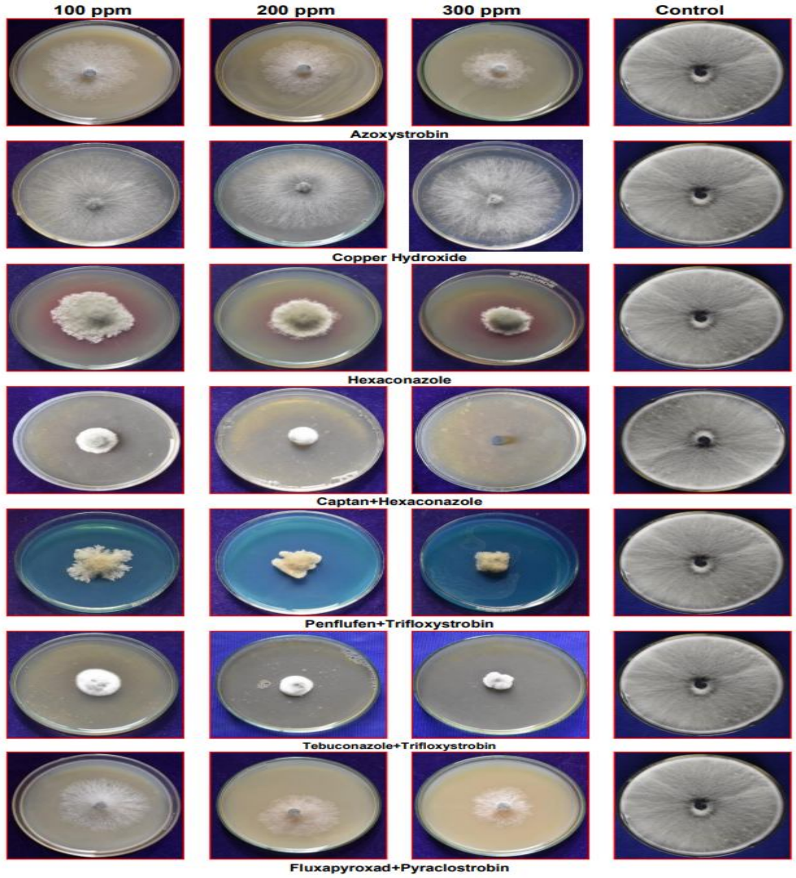

Plate-1. *In vitro* assessment of fungicides against *Rhizoctonia solani*

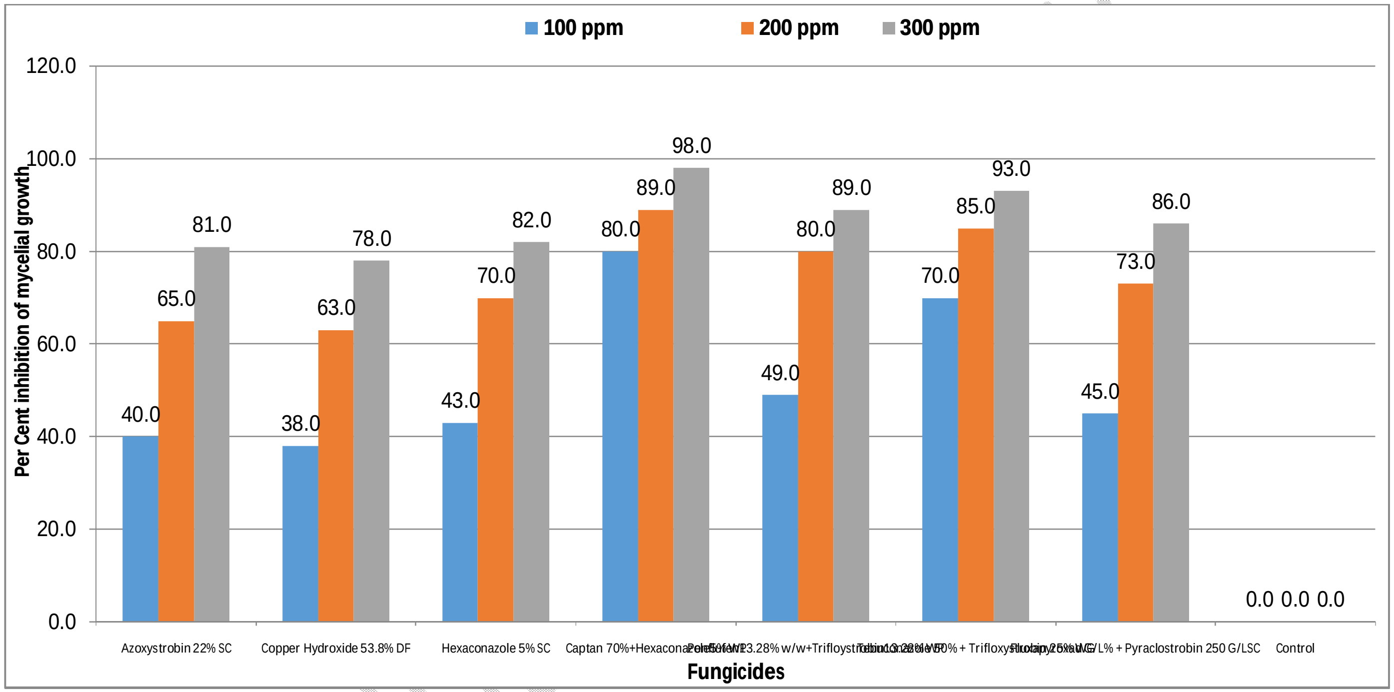

Fig.-1*In vitro* evaluation of fungicides against *Rhizoctoniasolani*

Efficacy of fungicides in field conditions (*In vivo*)

The results revealed that all fungicides tested significantly decreased the incidence of root rot of okra over control during both the years as well as pooled basis (Table-2 and Fig.-2). Among the tested fungicides, highest reduction in disease incidence (85.91%) was recorded by treating the seeds withcaptan + hexaconazole (@ 0.2%) followed by tebuconazole + trifloxystrobin(81.59%), penflufen+ trifloxystrobin(78.82%), fluxapyroxad + pyraclostrobin(75.58%),hexaconazole(73.80%), azoxystrobin(71.68%) and least effective was copperhydroxide(69.38%) over control.

It was evident from the result that all the fungicides used in present experiment were significantly enhanced the pod yield of okra over control during both the years as well as under pooled basis (Table-2 and Fig-2). Maximum increase in pod yield (30.65%) was observed by treating the seeds withcaptan + hexaconazole followed by tebuconazole + trifloxystrobin(30.10%), penflufen+ trifloxystrobin(29.11%), fluxapyroxad + pyraclostrobin(27.67%),hexaconazole(26.32%), azoxystrobin(24.52%) and lowest with copperhydroxide(22.75%) over check.

Incremental Cost-benefit ratio (ICBR)

Incremental cost benefit ratio (ICBR) was calculated to interpretate the economics of seven fungicides. The data presented in Table-2revealed that the highest ICBR was observed in captan + hexaconazole(1:215.89) followed by penflufen+ trifloxystrobin(1:209.08), hexaconazole(1:197.84),azoxystrobin(1:180.36), copperhydroxide(1:169.18) andtebuconazole + trifloxystrobin(1:140.55) whereas, lowest ICBR was recorded with fluxapyroxad + pyraclostrobin(1:111.12).

Our results are in agreement with the findings ofAtia *et al.* (2015) who evaluated nine fungicides *viz.*, tebuconazole + trifloxystrobin, propiconazole, fenamidone + mancozeb, carbendazim, tebuconazole and hexaconazole +

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zineb, mancozeb, captan and metalaxyl + mancozeb against *R. solani* causing root rot of tomato *in vitro* and *in vivo* conditions.The fungicides, propiconazole and trifloxystrobin + tebuconazole were found to be highly effective (100% inhibition) at 250, 500 and 1000 ppm concentration. They also tested these fungicides in field conditions through seed treatment and found that captan (44.73%), carbendazim (58.36%) and propiconazole (61.60%) were reduced root rot incidence as compared to untreated check. Maruti *et al.* (2017) tested combi fungicides against dry root rot of pigeon pea (*M. phaseolina*). Among combi products tested, carbendazim 12 per cent + mancozeb 63 per cent WP, trifloxystrobin 25 per cent + tebuconazole 50 per cent EC and carboxin 37.5 per cent + thiram 37.5 per cent WP showed total inhibition at 0.10, 0.20 and 0.30 per cent concentrations. Muhammad *et al.* (2017) conducted an experiment to manage sesame charcoal rot caused by *M. phaseolina* under field conditions and found that tebuconazole + trifloxystrobin was exhibited minimum mean disease incidence. Yadav *et al*. (2020) conducted an experiment to manage Rhizoctonia root rot of okra caused by *Rhizcotoniasolani* and recorded that carbendazim was found most effective followed by propiconazole.

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Table-2. Efficacy of fungicides on root rot of okra applied through seeds under field conditions

S. No	Common name	Dose *In vivo* (%)	PDI		Pooled	Disease reduction (%) over control	Yield (q/ha)		Pooled	Per cent increase in yield over check	Cost of treatment + Labour Charges (ha)	Gross return (ha)	ICBR ratio
			2022	2023			2022	2023					
1.	Azoxystrobin 22% SC	0.1	14.62 (22.48)	16.14 (23.69)	15.38 (23.09)	71.68	63.45	61.58	62.52	24.52	273	250080	1:180.36
2.	Copper hydroxide 53.8% DF	0.2	16.06 (23.63)	17.20 (24.50)	16.63 (24.07)	69.38	62.15	61.10	61.63	22.75	270	246520	1:169.18
3.	Hexaconazole 5% SC	0.2	13.10 (21.22)	15.36 (23.07)	14.23 (22.16)	73.80	64.35	62.49	63.42	26.32	267.08	253680	1:197.84
4.	Captan 70%+ hexaconazole5% WP	0.2	6.20 (14.42)	9.10 (17.56)	7.65 (16.06)	85.91	66.74	64.45	65.60	30.65	285.14	262400	1:215.89
5.	Penflufen13.28% w/w + trifloxystrobin13.28% WP	0.2	9.80 (18.24)	13.20 (21.30)	11.50 (19.82)	78.82	65.78	63.86	64.82	29.11	279.5	259280	1:209.08
6.	Tebuconazole 50% + trifloxystrobin 25% WG	0.2	8.86 (17.32)	11.13 (19.49)	10.00 (18.43)	81.59	66.33	64.30	65.32	30.10	430	261280	1:140.55
7.	Fluxapyroxad G/L% + pyraclostrobin 250G/LSC	0.2	11.86 (20.14)	14.66 (22.51)	13.26 (21.35)	75.58	65.02	63.17	64.10	27.67	500	256400	1:111.12
8.	Control	-	53.01 (46.73)	55.60 (48.22)	54.31 (47.47)	0.00	51.29	49.12	50.21	0.00	-	200840	-
	SEm±		0.58	0.65	0.41		3.07	2.96	1.85				
	CD (P=0.05)		1.76	1.97	1.23		9.24	8.92	5.56				
	CV (%)		4.38	4.51	2.95		9.46	9.41	6.92				

*Average of three replications. Figures in parentheses are angular transformed values

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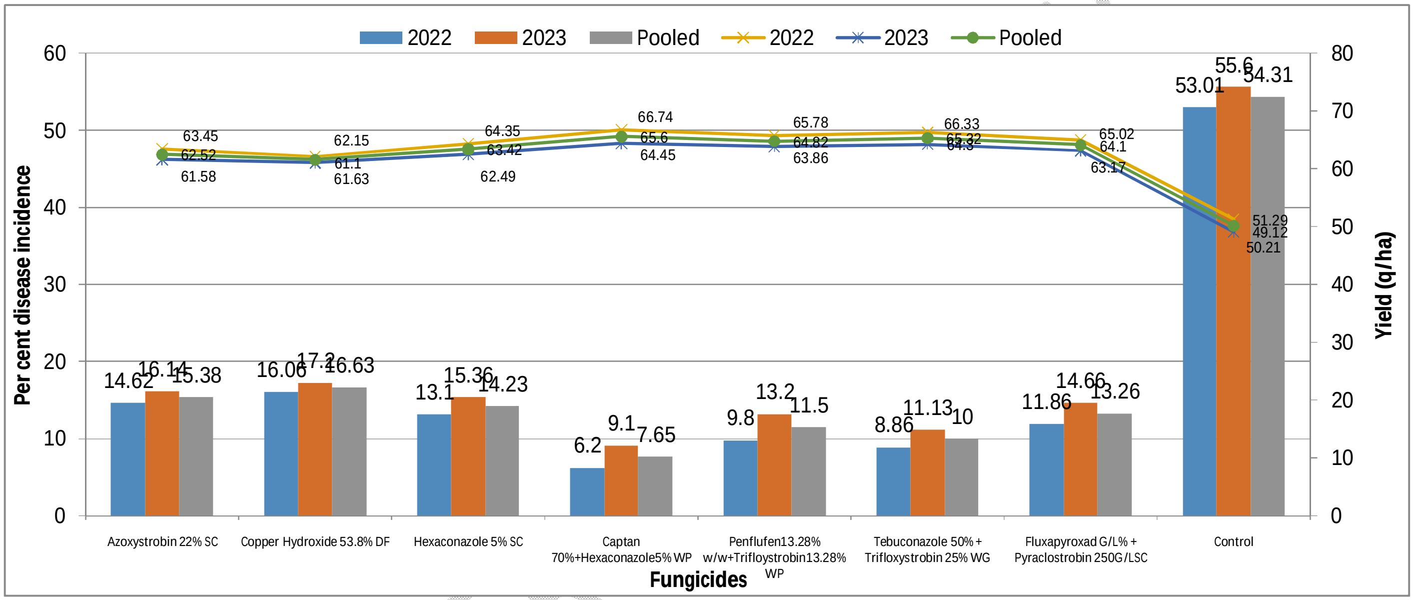

Fig.-2 Efficacy of fungicides on root rot of okra under field conditions

Conclusion

Conclusively, it is recommended that the use of combined formulations of fungicides viz. captan + hexaconazole (@0.2%) through seeds may be the most powerful tools in managing root rot of okra with economical yield returns.

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Reference

Acharya K, Chakraborty N, Chatterjee S and Basu SK (2014) Fungal diseases of fenugreek. American J Social Issues and Humanities 176

Akinyele BO and Temikotan T (2007) Effect of variation in soil texture on the vegetative and pod characteristics of okra (*Abelmoschuus esculents* (L.) Moench. International J Agril Res 2:165-169

Anonymous (2003) Indian Agriculture, Vikas Singhal for Indian Economies Data Research Centre, Maya Puri, New Delhi 271-272

Atia EA, Somasekhara YM and Gowda NCN (2015) Evaluation of new fungicide molecules for the management of tomato (*Solanum lycopersicum*Mill.) root rot (*Rhizoctonia solani*Kuhn). Mysore J Agri Sci 49 (4):693-697

Basandrai AK, Basandrai D and Sharma BK (2016) Fungicidal management of web blight of urdbean caused by *Rhizoctonia solani*.Legume Res 39 (6):1038-1042

Datta PC and Naug A (1968) A few strains of *Abelmoschus esculentus* (L.) Moench their karyological in relation to phylogeny and organ development. BeitrgezurBiologie der Pflanzen 45:113-126

Deepthi P, Shukla CS, Verma KP and Reddy ESS (2014) Identification of charcoal rot resistant lines of *Sesamum indicum* and chemical management of *Macrophominaphaseolina*Medicinal Plants. International J Phytomed Related Industries 6 (1):36-42

UNDER PEER REVIEW

Ford CE (1938) A contribution to a cytogenetical survey of the *Malvaceae*. Genetica 20:431-452

Gomez KA and Gomez AA (1984) Statistical procedures for agricultural research. John Wiley and Son's Publication, New York, p 680

Keijer J (1996) The initial steps of the infection process in *Rhizoctonia solani*. In *Rhizoctonia* Species taxonomy, molecular biology, ecology, Pathol Dis Control pp.149-162

Kumar R, Patil MB, Patil SR and Paschapur MS (2009) Evaluation of *Abelmoschus esculentus* mucilage as suspending agent in paracetamol suspension. International J Pharm Tech Res1:658-666

Kundu BC and Biswas C (1976) Anatomical characters for distinguishing *Abelmoschus* spp. and *Hibiscus* spp. Proc. Indian Sci Cong 60:295-298

Lamont W (1999) Okra a versatile vegetable crop. Horticultural Technology 9:179-184

Martin FW (1982) Okra, potential multiple-purpose crop for the temperate zones and tropics. Economic Bot 36:340-345

Maruti, Savitha AS, Gururaj Sunkad and Amaresh YS (2017) *In vitro* efficacy of fungicides and bioagents against dry root rot of pigeon pea caused by *Rhizoctonia bataticola*(Taub.) Butler. International J Pure Applied Biosci5 (6):1341-1347

Mithal MJ (2006) Low cost and pollution free technology against root rot of okra. Web source: www.pakissan.com.Moanward FG, Abdelwhab BM, Abdelnahun FM and Shehaya FW (1984) Annals of Agricultural Sci 21:603-613

Moanward FG, Abdelwhab BM, Abdelnahun FM and Shehaya FW (1984) Annals of Agricultural Sci 21:603-613

Muhammad RB, Abid M, Muhammad S, Muhammad AZ, Muhammad M, Qamar ATK and Faizan AT (2017) Exploitation of new chemistry

Comment [KK9]: Correct

UNDER PEER REVIEW

fungicides against charcoal rot of sesame caused by *Macrophominaphaseolina* In Pakistan. Pakistan J Phytopathol 29 (2):257-263

Panse VG and Sukhatme PV (1978) Statistical Methods for Agricultural Workers, Indian Council of Agricultural Research, New Delhi 136

Panse VG and Sukhatme PV (1985) Statistical Methods for Agricultural Workers, ICAR publications, New Delhi, India 359

Parmerter JR and Whitney HS (1970) Taxonomy and nomenclature of the imperfect state. In *Rhizoctonia Solani.* Biology and Pathology 225

Priya S, Varun C, Brahm KT, Shubhendra SC, Sobita S, Bilalc S and Abidia AB (2014) An overview on okra (*Abelmoschus esculentus*) and its importance as a nutritive vegetable in the world. International J Pharm Biological Sci 4 (2):227-233

Qayyum S (1990) A varietal trial on okra (*Hibiscus esculentus* L.) cultivars. Pakistan J Agri Res 7:55-78

Safiuddin SA, Tiyagi RR and Mahmood I (2014) Biological controlofdiseasecomplexinvolving*Meloidogyne incognita* and*Rhizoctoniasolani*ongrowthofokrathroughmicrobialinoculants.J MicrobioBiotech Res 4 (5):46-51

Singh HB and Bhatnagar A (1975) Chromosome number in an okra from Ghana. Indian J Gen Pl Breed 36:26-27

Singh PV, Chauhan BK, Tiwari SS, Chauhan S, Simon S, Bilal and Abidi AB (2014) An overview on okra (*Ablemoschus esculentus*) and its importance as a nutritive vegetable in the world. International J Pharmacy Biological Sci 4 (2):227-23

Sneh B, Jajabi-Hare S, Neate S and Dijst G (1996) *Rhizoctonia* species taxonomy, molecular biology, ecology, pathology and disease control. Dor-drecht: Kluwer Academic Publishers p 578

UNDER PEER REVIEW

Tindall HD (1983) Vegetables In The Tropics. Macmillan Press Limited, London 33:325-327

Vincent's JM (1947) The esters of 4-hydroxyl benzoic acid and related compounds, methods for the study of their fungistatic properties. J Appl Biosciences16:42-44

Walter PF (1997) Experimental Design Theory and Application, 3rd edition, New York 206

Yadav RK, Ghasolia RP and Yadav RK (2020) Management of *Rhizoctonia solani* of okra (*Abelmoschus esculentus* L. Moench) through fungicides *in vitro* and field conditions. International J Chem Studies 8 (2):2982-2987

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