International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(2): 2982-2987

Received: 19-01-2020
Accepted: 21-02-2020

Rajesh Kumar Yadav
Department of Plant Pathology, S.K.N. College of Agriculture, (Sri Karan Narendra Agriculture University Jobner, Jaipur, Rajasthan, India

RP Ghasolia
Department of Plant Pathology, S.K.N. College of Agriculture, (Sri Karan Narendra Agriculture University Jobner, Jaipur, Rajasthan, India

Roshan Kumar Yadav
Department of Plant Pathology, S.K.N. College of Agriculture, (Sri Karan Narendra Agriculture University Jobner, Jaipur, Rajasthan, India

Corresponding Author:
Rajesh Kumar Yadav
Department of Plant Pathology, S.K.N. College of Agriculture, (Sri Karan Narendra Agriculture University Jobner, Jaipur, Rajasthan, India

Management of *Rhizoctonia solani* of okra (*Abelmoschus esculentus* L. Moench) through plant extracts and fungicides *in vitro* and field conditions

Rajesh Kumar Yadav, RP Ghasolia and Roshan Kumar Yadav

DOI: https://doi.org/10.22271/chemi.2020.v8.i2at.9206

Abstract
The experiment was conducted at Department of Plant Pathology, S.K.N. College of Agriculture, Jobner (Rajasthan). Rhizoctonia root rot of okra caused by *rhizcotonia solani* is an important disease An attempt was more find out the efficacy of different plant extracts and fungicides were against in *Rhizoctonia solani in vitro* and *in vivo* conditions. Among five Plant extracts garlic clove was found most effective followed by neem and among five fungicides carbendazim was found most effective followed by propiconazole against *Rhizoctonia solani in vitro* conditions. In potted plant minimum disease severity were obtained in garlic and carbendazim and followed by neem and propiconazole.
Garlic and carbendazim were found effective in management of root rot of okra caused by *Rhizoctonia solani in vitro and in vivo* conditions.

Keywords: Okra, rhizoctonia root rot, rhizoctonia solani, plant extract and fungicides

Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] is a member of the family *Malvaceae*. Earlier, its botanical name was *Hibiscus esculentus* (L.) Moench under the section Abelmoschus of Hibischus, established by Linnaeus in 1737.It is an important summer/rainy season vegetable crop, extensively used globally for its nutritional and health benefits. Okra seeds are good sources of quality edible oil and proteins (Berry *et al*., 1988) [4]. The okra plants are used for controlling diseases like stone in kidney, leucorrhoea, backache and goitre in human beings. Mucilage extract of stem and roots of okra is used for clarifying sugarcane juice for making jaggery (Gur). The fruits of okra contain carbohydrate (6.4%), protein (1.9%), fat (0.2%), fibre (1.2%), minerals (0.7%) and moisture (89.6%). (Anonymous, 2013) [2]. Okra is cultivated throughout the country for its immature tender fruits, occupying an area over 532.66 thousand hectares with an annual production of 6346.37 thousand metric tonnes. Major okra growing states are Andhra Pradesh, West Bengal, Bihar, Gujarat, Odisha, Uttar Pradesh, Haryana and Rajasthan. In Rajasthan, it is grown in an area of 3.95 thousand hectares with an annual production of 12.27 thousand metric tonnes (Anonymous, 2014) [3]. This crop suffers severely from the vagary of diseases caused by fungi, bacteria, viruses and nematodes in the field. Okra is attacked by several fungal pathogens, which not only reduces the potency of seed, but also degrades the health beneficial and nutritional quality components. Root rot (Rhizoctonia solani) is major destructive fungal diseases (Anonymous, 2003) [1]. The genus Rhizoctonia was described by De Candolle (1815) [6], now, it is a well known saprophyte, notorious soil inhabiting plant pathogen, capable of attacking a tremendous range of host plants throughout the world, causing seed decay, damping-off, stem cankers, root rots, fruit decay and foliage diseases. Young culture of R. Solani shows profuse mycelia growth and dirty white sclerotia while older ones are abundantly branched with constriction at the point of origin and dark brown sclerotia with variable shape and size (Verma *et al*., 2006) [17]. Crop losses by root rot of okra (*Rhizoctonia solani*) is ranged from negligible to 50 per cent depending on the extent of severity and different stages of crop (Safiuddin *et al*., 2014) [12]. Kamangar *et al*. (2014) [8] evaluated ethanol extracts of five plant species viz., hermel (*Peganum harmala*), thyme (*Thymus kotschyanus*), yarrow (*Achillea wilhelmsii*), pennyroyal (*Mentha pulegium*) and garlic

(*Allium sativum*) on mycelial growth of *R. solani* at four levels (100, 250, 500 and 1000 ppm), against bean root rot pathogen (Rhizoctonia solani) under green house conditions. Extract of thyme and pennyroyal (both at the level of 1000 ppm) had the most inhibitory effect against the pathogen. Safiuddin *et al*. (2014) [12] tested *Trichoderma viride* and *Azotobacter chrococcum* individually and concomitantly against Rhizoctonia solani of okra. Satija and Hooda (1989) [13] evaluated some fungicides for protection of tomato and chilli seeds in soil inoculated with *R. Solani* and *R. Bataticola.* They found that Bavistin, Brassicol and Topsin-M were most effective in controlling damping-off of tomato due to *R. solani* while mancozeb and thiram were the best for chilli seeds.

Materials and Methods

Efficacy of plant extracts against Rhizoctonia root rot of okra *in vitro*

In recent years, many phyto-extracts are being used as fungitoxicants for the management of various plant diseases. The present investigation was carried out using following five natural phyto-extracts to see their antimycotic behaviour on the growth of *Rhizoctonia solani* following Poisoned Food Technique (Nene and Thapliyal 1993) [11].

Common name of plant	Botanical name	Plant part used	Concentration (%)
Garlic	*Allium sativum*	Clove	5, 10
Onion	*Allium cepa*	Bulb	5, 10
Eucalyptus	*Eucalyptus spp*	Leaf	5, 10
Ginger	*Zingiber officinale*	Rhizome	5, 10
Neem	*Azadirachta indica*	Leaf	5, 10
Control	-	-	-

The effect of each plant extract was tested at two different concentrations (5 & 10%) following the method suggested by Singh and Majumdar (2001) with slight modifications. To get these, the required plant part was thoroughly washed with sterilized water and ground separately in electric grinder using equal amount of sterilized distilled water (i.e. 1:1 ratio, w/v). The mixture was squeezed with double layered sterilized cheese cloth. The extracts thus obtained were considered as of 100 per cent concentration. Required quantity of each plant extract (i.e. stock solution) was mixed thoroughly in melted PDA, to get desired concentration, just before pouring in sterilized 9 cm diameter glass Petridishes and was allowed to solidify for 12 hours. Each plate was inoculated with 5 mm disc of mycelial bit taken with the help of sterilized cork borer from the periphery of 7 days old culture of *R. solani* growing on PDA. The inoculated petridishes were incubated at 30±1ºC. Three petridishes were used for each treatment serving as three replications. A control was also maintained where medium was not supplemented with any plant extract. The experiment was conducted in completely Randomized Design (CRD). Colony diameter (two diagonals) was measured at 7th day of incubation. Per cent growth inhibition was calculated by Vincent's (1947) [18] formula as follows:

$$\text{Per cent growth inhibition} = \frac{C - T}{C} \times 100$$

Where,

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

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

Efficacy of fungicides against Rhizoctonia root rot of okra *in vitro*

Efficacy of five systemic and non-systemic fungicides carbendazim, propiconazole, hexaconazole, mancozeb and propineb against mycelial growth and sclerotia formation of *Rhizoctonia solani* were tested by Poisoned Food Technique (Schmitzs 1930) [14]. Three different concentrations *viz.,* 100, 300 and 500 ppm of each fungicide was evaluated. required quantity of each fungicide was added separately to sterilized medium, mixed thoroughly and poured in sterilized 9 cm diameter glass Petriplates and allowed to solidify. Three replications were maintained for each treatment. A control was also maintained where medium was not supplemented with any fungicides. Each plate was inoculated with 5 mm discs taken with the help of sterilized cork borer from the edge of the fungal culture and incubated at 30±1 ºC for 7 days. The linear growth of the test fungus was recorded and per cent growth inhibition was calculated by vincent's (1947) [18] formula.

Efficacy of plant extracts and fungicides *in vivo*

Plant extracts and fungicides, which proved efficacious *in vitro* were also evaluated by seed-cum-soil drenching (*in vivo*) in mini plots (1×1m). These mini plots were inoculated with inoculum, multiplied on sorghum grains @ 20 g/m row. Apparently healthy and surface sterilized okra seeds (S-51) were sown in mini plot with three replications. Soil inoculation was done as per 3.1.4.2. Observations were recorded at 40th and 60th day after sowing. Per cent disease incidence was calculated as 3.1.4.

Results and Discussion

Efficacy of plant extract against Rhizoctonia root rot of okra (*in vitro* condition)

The efficacy of five plant extracts (Table 1, Fig. 1) was tested *in vitro* at two concentrations viz., 5 and 10 per cent against *R. solani* on PDA by Poisoned Food Technique. Among five plant extracts, extract of garlic cloves was found most effective in inhibiting mycelial growth (50.33 and 66.66%) of *R. solani* at 5 and 10 per cent, respectively followed by neem (46.20 and 59.42%) over control. Extracts of onion (37.08 and 55.12%), ginger (32.33 and 52.66%) and eucalyptus (13.77 and 32.55%) were found least effective in inhibiting mycelial growth of *R. solani* over control. All the concentrations (5 and 10%) of all the tested plant extracts were found significantly superior with each other. Similar results have been reported by Khatik *et al*. (2005) [9] and Sehajpal *et al*. (2009) [15] while working with Rhizoctonia solani in vitro. Dutta *et al*. (2004), who reported that 10 per cent concentration of crude *Allium sativum* extract inhibited mycelial growth of *R. Solani*, causing sheath blight of rice.

Table 1: Fungitoxicity of plant extracts against *Rhizoctonia solani* by poisoned food technique after 7 days at 30 ± 1 ^{0}C

Common name of plant	Scientific name	Part used	Per cent mycelial growth inhibition at different concentrations*		
			5%	10%	Mean
Garlic	*Allium sativum*	Clove	50.33	64.66	57.50
			(45.19)	(53.52)	
Onion	*Allium cepa*	Bulb	37.08	55.12	46.10
			(37.51)	(47.94)	
Eucalyptus	*Eucalyptus sp.*	Leaf	13.77	32.55	23.16
			(21.78)	(34.79)	
Ginger	*Gingiber officinali*	Rhizome	32.33	52.66	42.50
			(34.65)	(46.52)	
Neem	*Azadirachta indica*	Leaf	46.20	59.42	52.81
			(42.82)	(50.43)	
Control	-	-	0.00	0.00	0.00
			(0.00)	(0.00)	
Mean			29.13	43.33	-
			SEm±	CD (p=0.05)	
	P	P	0.34	1.01	
	Con.	Con.	0.20	0.58	
	P x Con.	P x Con.	0.49	1.42	

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

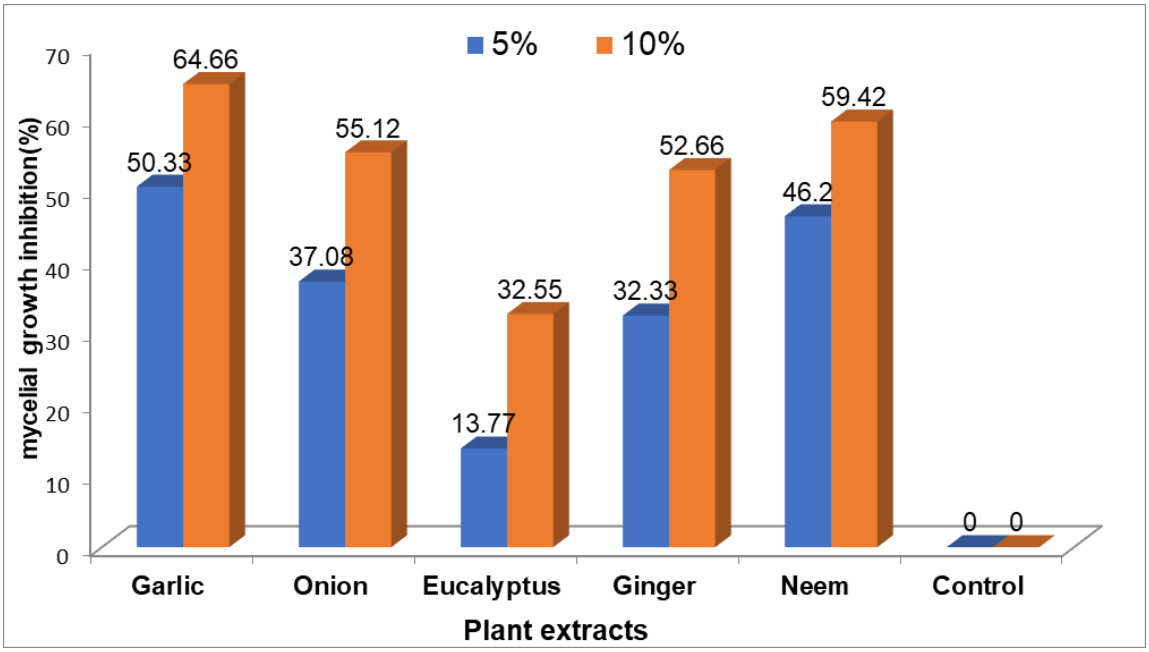
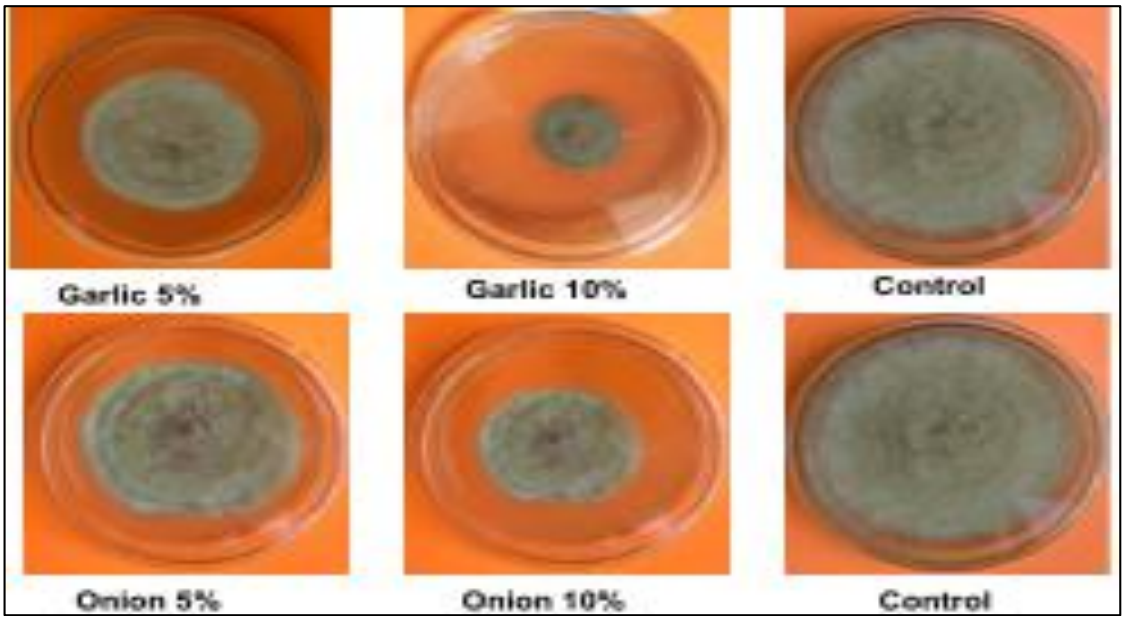


Fig 1: Funfitoxicity of plant extracts against *R. solani* by poisoned food technique after 7



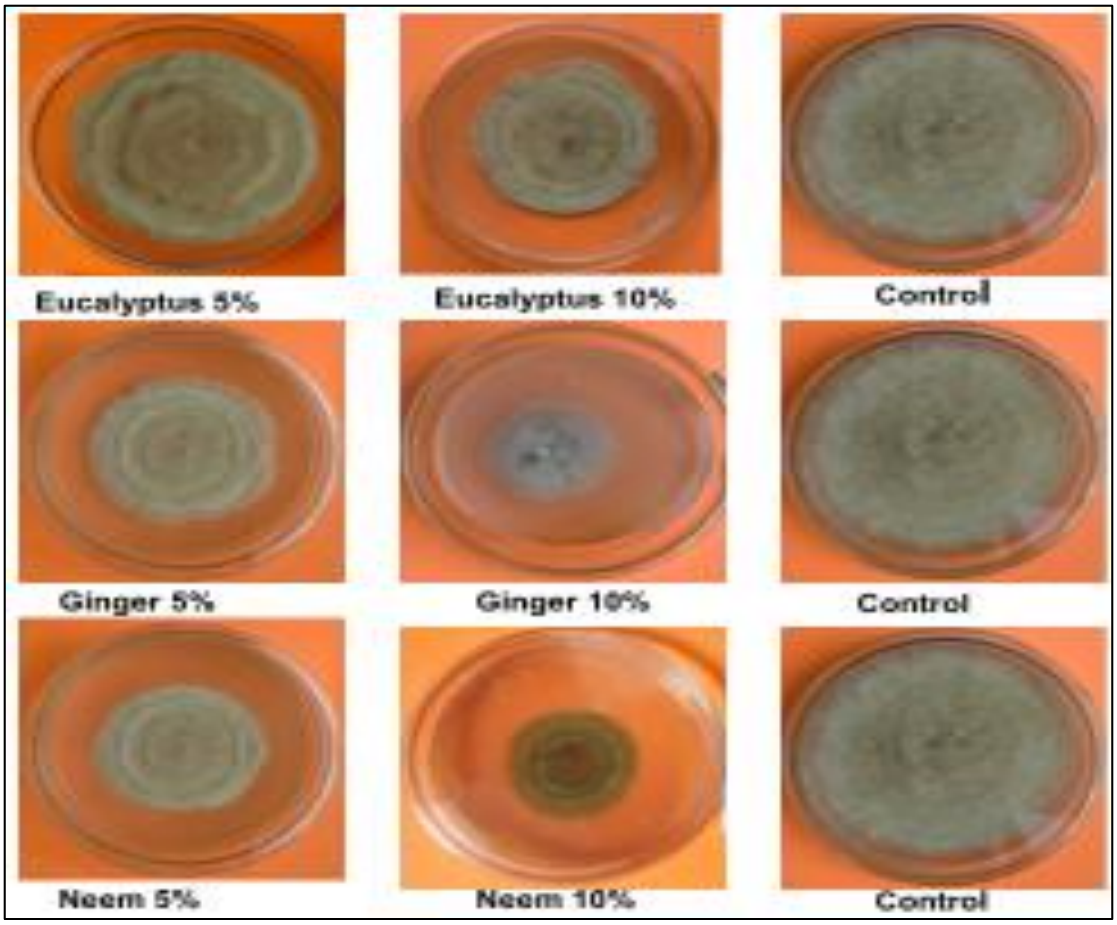


Plate 1: Fungitoxicity of plant extracts against *R. solani* by poisoned food technique after 7 days at 30 ± 1 ^{0}C

Efficacy of fungicides against mycelial growth of *Rhizoctonia solani* after 7 days of incubation at 30± 1*C (poisoned food technique)

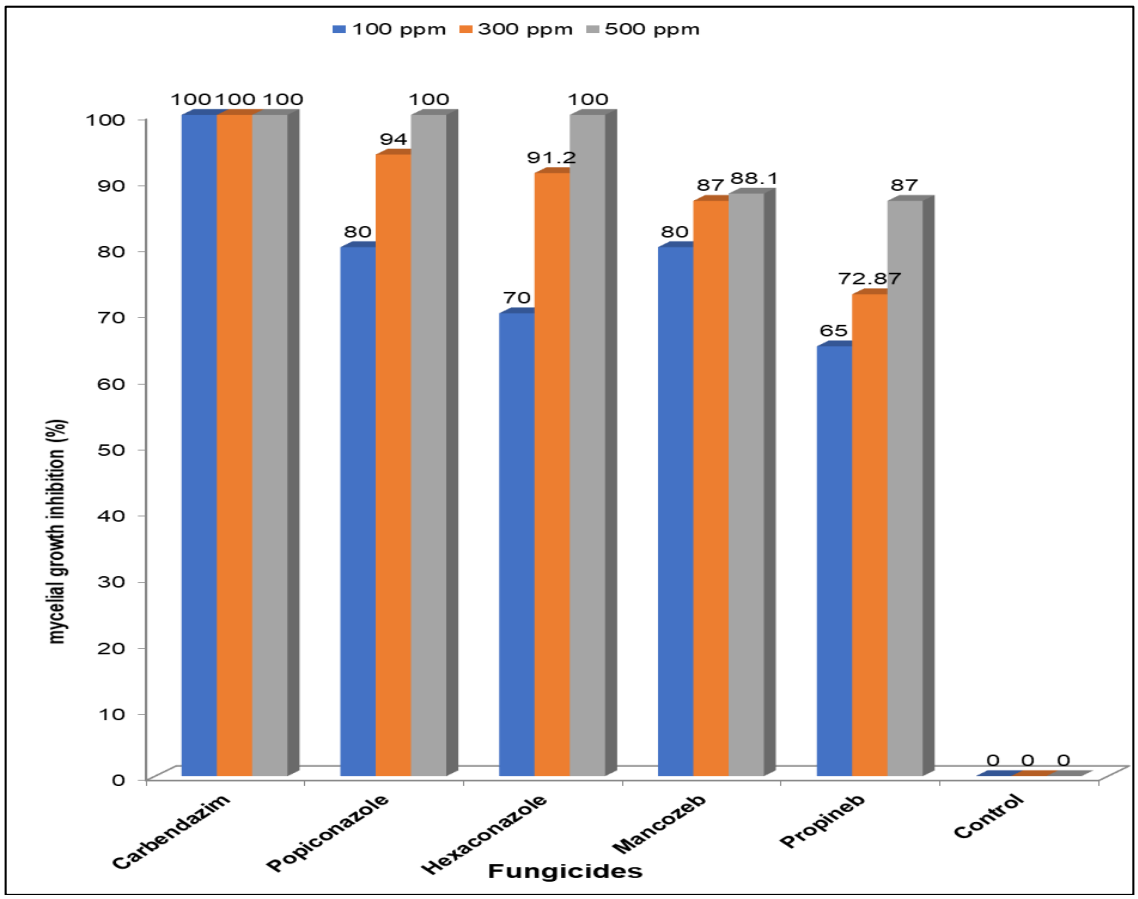
The efficacy of five fungicides (Table 2 and Plate: 1) were tested *in vitro* at three concentrations viz. 100, 300 and 500 ppm against *R. solani* on PDA by Poisoned Food Techinique. Among five fungicides, carbendazim was found most effective in inhibiting mycelial growth (100, 100 and 100%) of *R. solani* at 100, 300 and 500 ppm, respectively followed by propiconazole (80.00, 94.00 and 100%) and hexaconazole (70.00, 91.20 and 100%) over control. Fungicides like mancozeb (80.00, 87.00 and 88.10%) and propineb (65.11, 72.87 and 87.00%) were found least effective in inhibiting mycelial growth over control. All the concentrations (100, 300 and 500 ppm) of tested fungicides were found significantly superior with each other. Similar observations were also made by Dutta and Kalha (2011) [7] while working with Rhizoctonia solani in vitro. They have reported that carbendazim, propiconazole and hexaconazole had inhibited the mycelial growth of the pathogen.

Table 2: Efficacy of fungicides against *Rhizoctonia solani* by poisoned food technique after 7 days at 30 + 1 ^{0}C

Fungicide	Trade name	Per cent mycelial growth inhibition at various concentrations* (ppm)			
		100	300	500	Mean
Carbendazim	Bavistin	100.00	100.00	100.00	100.00
		(90.00)	(90.00)	(90.00)	
Propiconazole	Tilt	80.00	94.00	100.00	91.33
		(63.43)	(75.82)	(90.00)	
Hexaconazole	Sitara	70.00	91.20	100.00	89.97
		(56.79)	(72.74)	(90.00)	
Mancozeb	Indofil M-45	80.00	87.00	88.10	86.78
		(63.43)	(68.87)	(69.82)	
Propineb	Antracol	65.00	72.87	87.00	74.96
		(53.73)	(58.61)	(68.87)	
Control	-	0.00	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)	
				SEm±	CD (p=0.05)
			F	0.85	2.43
			C	0.60	1.72
			FxC	1.47	4.21

* Average of three replications

Figures given in parentheses are angular transformed values



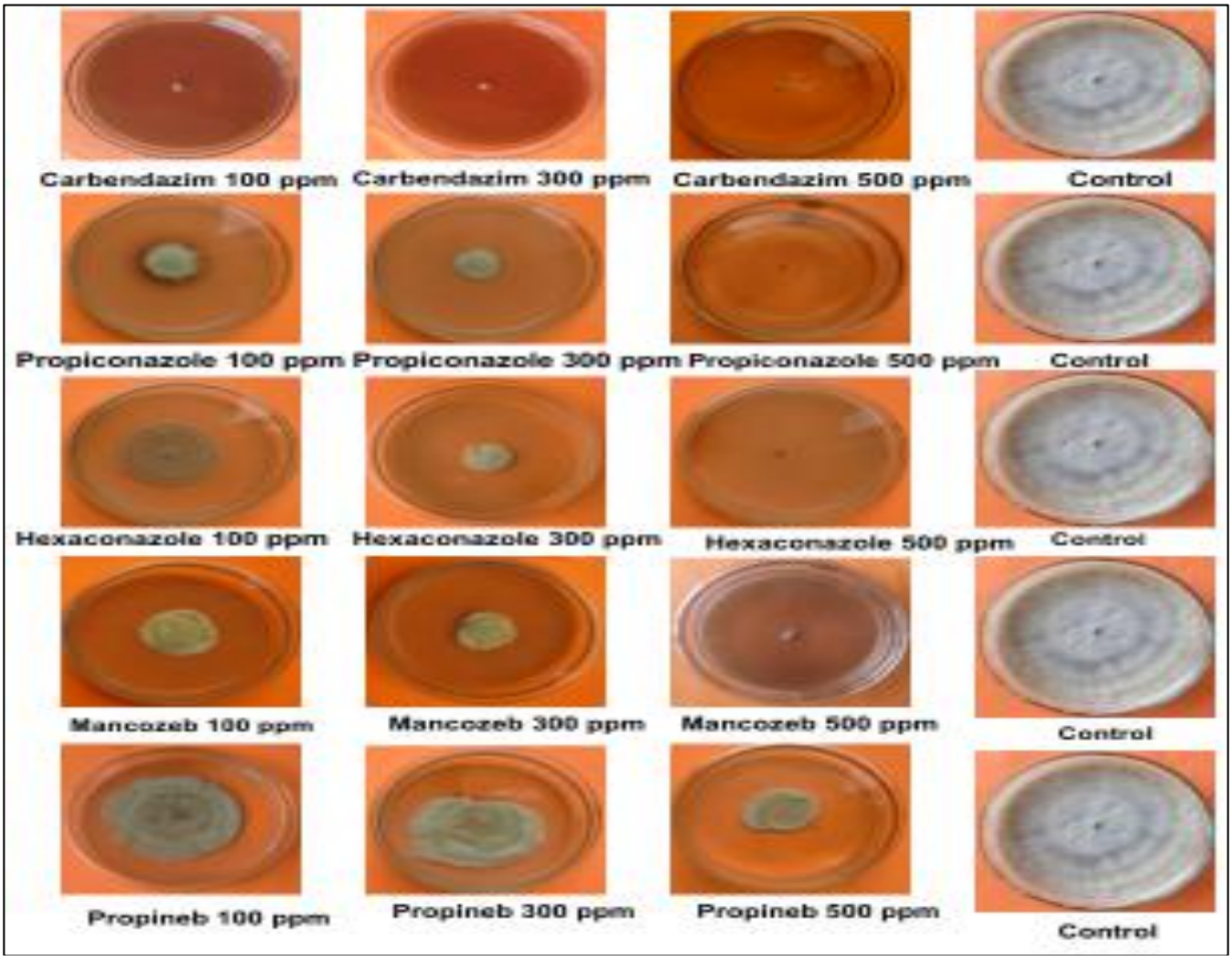


Plate 2: Efficacy of fungicides against *R. solani* by poisoned food technique after 7 days at 30 + 1 ^{0}C

Efficacy of plant extracts and fungicides (*in vivo)*

Plant extracts and fungicides were found effective in *in vitro* were also tested as seed-cum-soil drenching in mini plots against *R. solani* and these were garlic, neem,, carbendazim and propiconazole. The results depicted in Table 3 revealed that all plant extracts, and fungicides were found significantly superior over control in recuding per cent disease contol at 40 and 60 days after sowing. Minimum per cent disease incidence was recorded with carbendazim (12.75 and 14.75%) followed by propiconazole (14.56 and 17.85%),, garlic (27.25 and 36.57%) and neem (29.44 and 39.12%) over control (42.88 and 61.86%) at 40 and 60 days after sowing, respectively. Maximum disease control over check was recorded with carbendazim (70.27 and 76.16%), followed by propiconazole (66.04 and 71.14%), garlic (35.75 and 40.88%) and neem (31.34 and 36.76%) over control at 40 and 60 days after sowing, respectively. These observations are in line with those recorded by Mallesh *et al*. (2009) [10], They have reported the effectiveness of many plant extracts, and fungicides in controlling root rot of sage (Salvia officinallis) caused by *Rhizoctonia solani* and *Fusarium solani* in field as well as in laboratory. Chopra and Sharma (1986) [5] has also bee Rhizoctonia n worked with three formulations of carbendazim as seed treatment and found best in reducing of pre-and post-emergence mortality of cotton seedlings, caused by *Rhizoctonia solani*.

Table 3: Efficacy of plant extracts and fungicides against *R. solani* on okra applied through seed-cum-drenching

Treatments	Disease incidence (%)		Disease control (%)	
	40 DAS	60 DAS	40 DAS	60 DAS
Carbendazim	12.75	14.75	70.27	76.16
	(20.92)	(22.59)		
Propiconazole	14.56	17.85	66.04	71.14
	(22.43)	(24.99)		
Garlic	27.55	36.57	35.75	40.88
	(31.66)	(37.21)		
Neem	29.44	39.12	31.34	36.76
	(32.86)	(38.72)		
Control	42.88	61.86	-	-
	(40.91)	(51.86)		
SEm±	0.46	0.59		
CD (p=0.05)	1.41	1.81		

* Average of three replications

Figures given in parentheses are angular transformed values

References

1. Anonymous. Indian Agriculture. Vikas Singhal for Indian Economic Data Research Centre, Maya Puri, New Delhi, India. 2003, 271-2.
2. Anonymous. Okra: Area under cultivation. National Horticulture Board website: http://nhb.govt.in/bulletin-vegetables.html. 2013, 52-56.
3. Anonymous. Final area and production of horticultural crops. Indian Horticulture Database 2014. National Horticulture Board, 2014, 279-283.
4. Berry SK, Kalra CL, Schyal, RC. Quality characteristics of seeds of five okra (*A. esculentus* (L.) Moench) cultivars, J. Food Sci. Tech. 1988; (25):303.
5. Chopra BL, Sharma JR. Screen house studies on evaluation of cotton varieties and fungicides against seedling mortality caused by Rhizoctonia solani. Pl. Dis. Res. 1986; 1:83-85.
6. De Candolle AP. Memoire surles rhizoctones nouveau genre de champignons qui attaque les racines des plantes et en particulier celle de la luzerne cutivee. Mem. Mus. D' Hist. Nat. 1815; (2):209-216.
7. Dutta U, Kalha CS. In vitro evaluation of fungicides, botanicals and bioagents against *Rhizoctonia solani* causing sheath blight of rice and their integration for effective management of the disease under field conditions. Pl. Dis. Res. 2011; 26(1):14-19.
8. Kamangar H, Hemmati R, Yazdinejad A, Fazel MM. Study on antifungal effects of five plant species extract against *Fusarium solani* and *Rhizoctonia solani* on bean. Iranian J. Pl. Prot. Sci. 2014; 45(1):49-58.
9. Khatik SK, Mathur AC, Maharshi RP. Efficacy of plant extracts and bio-control agents against stem canker of tomato incited by *Rhizoctonia solani*. Udyanika. 2005; 11(2):80-83.
10. Mallesh SB, Narendrapp AT, Kumara. Management of root rot of sage (*Salvia officinallis*) caused by *Fusarium solani* and *Rhizoctonia solan*. International J. Pl. Prot. 2009; 2(2):261-264.
11. Nene YL, Thapliyal PN. Evaluation of fungicides. In: Fungicides in Plant Disease Control. (3rd Ed.). International Science Publisher, New York. 1993, 531.
12. Safiuddin SA, Tiyagi, RR, Mahmood, Irshad. Biological control of disease complex involving *Meloidogyne incognita* and *Rhizoctonia solani* on growth of okra through microbial inoculants. J Microbiol. Biotech. Re, 2014; 4(5):46-51.
13. Satija DV, Indra Hooda. A note on fungicidal control of damping-off of tomato and chilli caused by *Rhizoctonia solani* and *Rhizoctonia bataticola*. Haryana J Of Horti. Sci. 1989; 16:294-297.
14. Schmitz H. Poisoned Food Technique. Second Edn., Industry of Engineering and Chemical. London, U.S.A. pp. 1930; 333-361.
15. Sehajpal A, Arora S, Kaur P. Evaluation of plant extracts against *Rhizoctonia solani* causing sheath blight of rice. The J. Pl. Prot. Sci. 2009; 1(1):25-30.
16. Singh J, Majumdar VL. Efficacy of plant extracts against *Alternaria alternata*, the incitant of fruit rot of pomegranate (*Punica granatum* L.). J Mycol. Pl. Pathol. 2001; 31(3):346-349.
17. Verma OP, Singh N, Sharma P. First report of Rhizoctonia solani causing leaf spot of *Adhatoda vasica*. New Dis. Reports. First, 2006.
18. Vincent JM. The esters of 4-hydroxyl benzoic acid and related compound. Methods for the study of their fungistatic properties. J Sci. Indian. 1947; 16:749-755.