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Management of Root Rot (*Rhizoctonia solani*) of Clusterbean through Fungicides

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A B S T R A C T

Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] is popularly known as "*Guar*" or "*Guwar*" and belongs to family *Fabaceae* of kingdom *Plantae*.Root rot is the important disease of clusterbean caused by *Rhizoctonia solani* in Rajasthan and India. To manage the disease, efficacy of fungicides were tested *in vitro* and *iv vivo* against *Rhizoctonia solani*. Among fungicides carbendazim was found most effective in inhibiting mycelial growth (100 %) followed by carbendazim + mencozeb (85.27 %) at 100 ppm concentration. Maximum disease control was recorded with carbendazim (87.75 & 83.40) followed carbendazim+mencozeb (78.47%) up to 60 days after sowing by applying through seeds.

Introduction

Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] is popularly known as "*Guar*" or "*Guwar*" and belongs to family *Fabaceae* of kingdom *Plantae.* It is an important legume crop and mainly grown under rainfed conditions of arid and semi arid regions of tropical India during *Kharif* and *Zaid* seasons. It is considered as one of the most drought tolerant grain legumes and very valuable within crop rotation cycle as it lives in symbiotic association with nitrogen fixing bacteria. It is tolerant to drought, deep rooted and can be grown for different purposes viz., vegetable, green fodder, green manuring, production of seed and for endospermic gum (30-35 percent). Green pods of clusterbean are nutritionally rich in energy (16 kcal), moisture (81g), protein (3.2 g), fat (1.4 g) carbohydrate (10.8 g), vitamin-A (65.31 IU), vitamin-C (49 mg), calcium (57 mg) and iron (4.5 mg) per 100 g of edible portion (Kumar and Singh, 2002).It is well adapted to conditions prevailing in Rajasthan like hot desert areas (Jaisalmer, Barmer, Jodhpur etc.) and is being grown in areas receiving annual rainfall from 350 to 750 mm. Cultivation for vegetable purposes, it favors long days for growth and short days for producing flowers. In Rajasthan, clusterbean as a vegetable crop is cultivated throughout the state for its green

pods (immature pods) occupying an area 694 hectares with production of 976 metric tonnes (Anonymous, 2016). For seed production, it is grown in arid and semi-arid regions mainly during rainy season while, for vegetable purpose during *Zaid* and rainy seasons. As vegetable crop, it produces green pods continuously for a long time, thus it needs regular feeding along with much care from pests specially from diseases.

Root rot or charcoal rot caused by *Rhizoctonia* sp. is a serious disease of clusterbean (Prasad, 1944; Dhingra and Sinclair, 1978 and Lodha, 1993). Lodha *et al.*, (1986) observed 31.0 per cent root rot incidence of clusterbean with 32.11 per cent yield loss in arid regions of Rajasthan. *Fusarium solani* also recorded to cause root rot of clusterbean (Mathur and Shekhawat, 1987).

Among the initial symptoms of the disease, yellowing of leaves is a first symptom which in next 2 or 3 days leaves droop and wither off. Infected plants may wilt within a week after the appearance of first symptom. When stem is examined closely, dark lesions can be observed on the bark near ground level. If the plants are pulled from soil, the basal stem along with main root, may show symptoms of rotting. The tissues are weakened and break off easily in advanced cases and sclerotial bodies can be seen scattered on the affected roots. The pathogen invades the host both inter and intracellularly, it grows rather fast covering large areas of the host tissues and eventually killing them in short time. Pathogen produces numerous sclerotial bodies on host tissues, which measure about 110-130µm in diameter. Often the conidial or pycnidial stage is produced on the infected host tissues. 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).An association of *Fusarium equisetii*and *Macrophomina phaseolina* with black stem rot of clusterbean was also noticed by Satyaprasad *et al.*, (1983). Lodha (1998) recorded that dry root rot of clusterbean might occur at any stage of the crop from pre-emergence to maturity.

Materials and Methods

Efficacy of fungicides (*In vitro*)

Efficacy of five systemic and non-systemic fungicides (carbendazin, carboxin + thiram, hexaconazole, trifloxystrobin+ tebuconazole, and carbendazim + mancozeb) were evaluated against *Rhizoctonia solani* by Poisoned Food Technique (Schmitz, 1930). Three different concentrations *viz.*, 100, 300 and 500 ppm of each fungicide was tested. Required quantity of each fungicide was added separately to sterilized medium, mixed thoroughly and poured in sterilized 90 mm diameter glass Petri plates and allowed to solidify. Four replications were maintained for each treatment. A control was also maintained where medium was not supplemented with any fungicides. Each plate was inoculated with 5mm discs taken with the help of sterilized cork borer from the edge of the fungal culture and incubated at 30 ± 1 ˚C for 7 days. Per cent inhibition of mycelial growth was calculated as per formula given by Vincent (1947).

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

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 (*In vivo)*

Five fungicides (carbendazin, carboxin + thiram, hexaconazole, trifloxystrobin + tebuconazole and carbendazim + mancozeb) were also used as dry seed treatment. The required amount of seeds and chemical were taken in 250 ml Erlenmeyer flask and shaken thoroughly to give a uniform coating of respective chemical. Chemical treated as well as untreated seeds were sown separately in plots (2x1 m^2) with four replications. The inoculum multiplied on sorghum grains was added @ 20g/m row. Observations on disease incidence was recorded at 40 and 60 days after sowing. Per cent disease incidence (PDI) and disease control in various experiments were calculated as follows:

$$\text{Disease incidence (\%)} = \frac{\text{No. of diseased plants}}{\text{Total No. of plants}} \times 100$$

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

Results and Discussion

Through fungicides (*in vitro*)

Among five fungicides (Table 1), carbendazim was found most effective in complete inhibiting of mycelial growth of *Rhizoctonia solani*at all concentrations tested followed by carbendazim + mancozeb (85.27, 100 and 100%) and carboxin+thiram (76.11,86.94 and 100 %) at 100, 300 and 500 ppm, respectively.. Fungicides like tebuconazole+trifloxystrobin (57.77, 62.50, 78.70%) and hexaconazole (65.00, 79.44, and 85.83%) were found least effective in inhibiting mycelial growth over control.

Efficacy of fungicides (*In vivo*)

The results revealed that all fungicides (Table 2) were found significantly superior over control in reducing per cent disease incidence at 40 and 60 days after sowing. Minimum percent disease incidence was recorded by treating the seeds with carbendazim (6.40 and10.33 %) followed by carbendazim+mancozeb (8.37 and 13.40%) over control (52.25 and 62.25 %) at 40 and 60 days after sowing, respectively and statistically found at par to each other. Maximum diseasecontrol over check was recorded with carbendazim (87.75 and 83.40%), followed by carbendazim +mancozeb (83.98 and 78.47%) over control at 40 and 60 days after sowing, respectively. Per cent disease control was higher at 40 DAS but it was declined in next 20 days.

Minimum disease control was recorded with hexaconazole (72.72 and 67.34%) followed by tebuconazole+trifloxystrobin (76.32 and 71.66%) and carboxin+thiram (77.76 and 73.01%) at 40 and 60 days, respectively and found at par to each other. Control recorded maximum per cent disease (52.25 and 62.25%). In field conditions, seed treatment with carbendazim was found most effective followed by carbendazim+mancozeb against root rot pathogen. Similar observations were also made by Dutta and Kalha (2011) while working with *Rhizoctonia solani in vitro*. They have reported that carbendazim and carbendazim+mancozeb had inhibited the mycelial growth of the pathogen. However, efficacy of carbendazim at different concentrations has also been confirmed by Mishra and Sinha (1999) and Manibhushanrao *et al.*, (1979). Similar observations were also made by Sinha and Khare (1977) who found that carbendazim and thiram were highly effective against *Macrophomina phaseolina* in laboratory as well as in field conditions. Ramadoss and Sivaprakasam (1994) also observed that sclerotial production of *Macrophomina phaseolina* was completely inhibited by carbendazim and thiram, which again favour the present study.

Table.1 Efficacy of fungicides against *Rhizoctonia solani* by poisoned food technique after 7 days of incubation at 30°C

Fungicide	Per cent inhibition of mycelial growth at various concentrations* (ppm)			
	100	**300**	**500**	**Mean**
Carbendazim	100.00	100.00	100.00	100.00
	(90.00)	(90.00)	(90.00)	(90.00)
Carbendazim + Mancozeb	85.27 (67.43)	100.00 (90.00)	100.00 (90.00)	95.09 (82.48)
Carboxin + Thiram	76.11 (60.74)	86.94 (68.81)	100.00 (90.00)	87.68 (73.18)
Tebuconazole +Trifloxystrobin	57.77 (49.47)	62.50 (52.24)	78.70 (62.51)	66.32 (54.74)
Hexaconazole	65.00	79.44	85.83	76.76
	(53.73)	(63.04)	(67.89)	(61.55)
Control	0.00	0.00	0.00	0.00
	SEm±	**CD (p=0.05)**		
F	**0.44**	**1.23**		
C	**0.62**	**1.74**		
F x C	**1.08**	**3.01**		

*Average of four replications
Figures given in parentheses are angular transformed value

Table.2 Efficacy of fungicides against root rot of vegetable clusterbean applied through seeds

Fungicide	Dose	Per cent disease incidence*		Per cent disease control	
		40 DAS	**60 DAS**	**40 DAS**	**60 DAS**
Carbendazim	1 g/kg	6.40	10.33	87.75	**83.40**
		(14.65)	(18.75)		
Carbendazim + Mancozeb	2 g/kg	8.37 (16.82)	13.40 (21.47)	83.98	**78.47**
Carboxin + Thiram	2 g/kg	11.62	16.80	77.76	**73.01**
		(19.93)	(24.20)		
Tebuconazole + Trifloxytrobin	2 g/kg	12.37 (20.59)	17.64 (24.83)	76.32	**71.66**
Hexaconazole	2 g/kg	14.25	20.33	72.72	**67.34**
		(22.18)	(26.80)		
Control	-	52.25	62.25	0.00	**0.00**
		(46.29)	(52.09)		
SEm±		**0.79**	**0.93**		
CD (p=0.05)		**2.45**	**2.86**		

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

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