MANAGEMENT STUDIES ON ROOT ROT OF *PROSOPIS CINERARIA* CAUSED BY *FUSARIUM SOLANI*

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SHARMA, S., PAL, R., GUPTA, P. P. & KAUSHIK, J. C. 2004. Management studies on root rot of *Prosopis cineraria* caused by *Fusarium solani*. Screening of seven systemic and non-systemic fungicides in *in vitro* studies revealed the superiority of all the fungicides in controlling mycelial growth of *Fusarium solani* which causes root rot of *Prosopis cineraria*, though their efficacy varied Topsin-M showed 11% inhibition at 50 ppm whereas Emisan and Bavistin did so at 100 ppm concentration Bavistin and Topsin-M also retained their supremacy in seed treatment and pre sowing drenching Soil amendments with crop residues or oil cakes indicated mustard cake amendment as most effective followed by cotton cake and saw dust Biological antagonist *Trichoderma viride* controlled the disease to 50% under *in vivo* condition

Key words *P cineraria* – *F solani* – root rot – seed treatment – soil drenching – soil amendments

SHARMA, S., PAL, R., GUPTA, P. P. & KAUSHIK, J. C. 2004. Kajian pengurusan reput akar *Prosopis cineraria* akibat *Fusarium solani*. Saringan tujuh racun kulat sistemik dan tak sistemik dalam kajian *in vitro* menunjukkan keberkesanan semua racun kulat dalam mengawal pertumbuhan miselium *Fusarium solani* yang menyebabkan reput akar *Prosopis cineraria*, walaupun terdapat perbezaan dalam keberkesanan racun tersebut Topsin-M menunjukkan perencatan sebanyak 11% pada kepekatan 50 ppm sementara Emisan dan Bavistin menunjukkan keberkesanan yang sama pada kepekatan 100 ppm Biji benih yang disalut atau dibasahkan dengan Bavistin dan Topsin-M turut menunjukkan keberkesanan dalam mengawal racun kulat Meminda komposisi tanih dengan menggunakan sisa tanaman ataupun kerak minyak menunjukkan bahawa kerak biji sawi paling berkesan diikuti dengan kerak biji kapas dan habuk gergaji *Trichoderma viride* iaitu sejenis antagonis biologi mengawal penyakit tersebut sehingga 50% di bawah keadaan *in vivo*

Introduction

Prosopis cineraria, commonly known as khejri, has been recognised worldwide as one of the most important agroforestry tree species (Anonymous 1983). Due to its poor regeneration in dry areas, planting of artificially raised seedlings is preferred but its growth at the early stage of planting is very poor due to biotic and abiotic stresses (Chand & Arora 1970). Among the biotic stresses, root rot caused by *Fusarium solani* (Figures 1 & 2) causes heavy damage in nurseries (Sharma *et al.* 1997). This disease has only been reported in 1997 and thus, not much literature on its management is available. With this in view, the present study was undertaken to find out some suitable chemical control measures to inhibit *F solani*.

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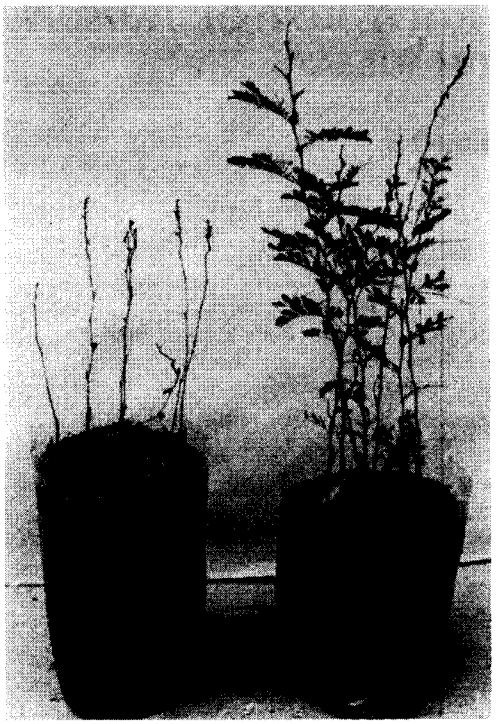

Figure 1 Healthy (right) and infected (left) seedlings of *Prosopis cineraria*

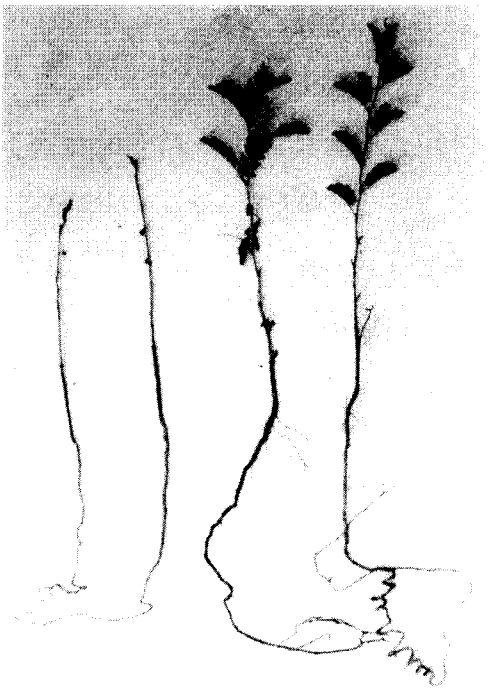

Figure 2 A pair each of healthy (right) and infected (left) seedlings of *Prosopis cineraria*

Materials and methods

In vitro *studies*

Seven fungitoxicants, namely, Captaf, Bavistin, Blitox, Indofil M-45, Emisan, Thiram and Topsin-M, were screened for their toxicity against mycelial growth of *F. solani* by poisoned food technique (Palmiter & Keith 1937). Aseptically, PDA medium was poisoned with each fungicide at a concentration of 50, 100, 250, 500, 750 and 1000 ppm on a. i. basis separately. Radial growth of mycelium was measured after five days of inoculation to get the average area (cm^2) of mycelial growth. Per cent inhibition of mycelial growth was also calculated. Each treatment consisted of five replications.

Seed treatment

All the above fungicides were tried as seed dressers. The doses were used on formulation basis for treating the seed of khejri at 2 g kg^{-1}. Ten treated seeds were sown in polythene bags containing sterilised soil inoculated with *F. solani*. Controls without fungicide were also maintained. Each treatment consisted of three replications.

Soil drenching

Soil inoculated with *F. solani* was drenched with the seven fungicides (formulation basis) at a concentration of 0.2% w/v except for control and filled into polythene bags. Ten untreated seeds were sown in each bag and irrigated regularly.

Soil amendments

Five different types of organic material, namely, wheat straw, bean straw, saw dust, cotton cake and mustard cake were tested against *F. solani* as soil amendments. Sterilised soil was divided into different lots. Each lot was thoroughly mixed with ground wheat straw, bean straw and saw dust separately at 25 g kg^{-1} whereas cotton cake and mustard cake at 15 g kg^{-1} soil. The amended lots were filled into polythene bags and irrigated to keep the mixture moist and kept as such for 15 days. After that the bags were inoculated with fungal culture. Biological antagonist fungus *Trichoderma viride* was also tested against *F. solani.* Seeds were put into Petri dishes containing ten-day-old culture of *T. viride* on PDA . After shaking the Petri dishes for two to three minutes, the seeds were taken out for sowing in soil inoculated with *F. solani.*

Soil inoculation method

In all the experiments, except for *in vitro* studies, auxenic culture of *F. solani* was raised on oat seed sand medium, mixed in a ratio of 3:2 and moistened with water. A total of 200 g each of this mixture was kept in 500 ml flask. The flasks were plugged and sterilised in an autoclave at 121.5 °C (15 lbs $inch^{-2}$ pressure) for one hour. These flasks were inoculated with freshly grown three mycelial mats of 5-mm size each and incubated at 25 °C for 16 days. The inocula produced was added to sterilised soil in polythene bags at a concentration of 6 g kg^{-1}. After 24 hours of soil inoculation, 10 khejri seeds were sown in the polythene bags. The seeds had previously been sterilised with 0.1% $HgCl_2$ solution and washed repeatedly three to four times with sterilised distilled water. Seeds sown in uninoculated soil served as control treatment. The inoculated bags were covered with polythene sheets for 24 hours to maintain humidity.

Observations

The data, unless otherwise stated, on pre-emergence mortality (PEM) and post-emergence mortality (POM) were recorded after 10 and 45 days of sowing. The per cent disease control was also calculated.

Results and discussion

In vitro *studies*

Tables 1 and 2 showed that with the increase in concentration of fungicides, there was a corresponding decrease in mycelial growth, thus, contributing to increased inhibition. Among the fungicides, Topsin-M was found to be most effective; it resulted in 100% inhibition of mycelial growth at all the concentrations tested. Emisan and Bavistin also showed good inhibition with readings more than 99%. Indofil M-45, Thiram and Captaf were moderately effective whereas Blitox ranked last in order of efficacy. Several workers have proved the effectiveness of thiophanate methyl, carbendazim, benomyl and mancozeb against *F. solani* (Harsh 1993, Tu & Zheng 1993, Sen & Bhardwaj 1995).

Table 1 Average area (cm^2) of mycelial growth using poisoned food technique

Fungicide	Concentration (ppm)						
	0	50	100	250	500	750	1000
Topsin-M	33.01	0.00	0.00	0.00	0.00	0.00	0.00
Emisan	33.01	0.09	0.00	0.00	0.00	0.00	0.00
Bavistin	33.01	0.12	0.00	0.00	0.00	0.00	0.00
Indofil M-45	33.01	3.27	2.69	1.07	0.26	0.09	0.00
Thiram	33.01	3.77	1.21	0.99	0.44	0.06	0.00
Captaf	33.01	3.97	1.35	0.87	0.64	0.59	0.27
Blitox	33.01	27.81	23.00	18.92	17.16	14.79	13.23

Table 2 Per cent inhibition of mycelial growth using poisoned food technique

Fungicide	Concentration (ppm)						
	0	50	100	250	500	750	1000
Topsin-M	-	100	100	100	100	100	100
Emisan	-	99.7	100	100	100	100	100
Bavistin	-	99.6	100	100	100	100	100
Indofil M-45	-	90.1	91.8	96.7	99.2	99.7	100
Thiram	-	88.6	96.3	97.0	98.6	99.8	100
Captaf	-	88.0	95.9	97.4	98.1	98.2	99.2
Blitox	-	17.8	30.3	42.3	48.0	55.1	59.9

Seed treatment

As seed dressers, all the fungicides except Emisan, gave significantly higher disease control compared with the control treatment (Table 3). Bavistin provided 90% disease control in PEM and 78.6% in POM. The next highest control was observed in Topsin-M (81.8 and 78.6% respectively). These observations are in accordance with Zheng (1986) and Harsh (1993). Monga and Grover (1991) also

Table 3 Effect of seed treatment with different fungicides on seedling mortality

Fungicide	Concentration (g kg^{-1} seed)	PEM (%)	PDC	POM (%)	PDC
Bavistin	2	3 3 (7 38)	90 0	10 0 (18 53)	78 6
Topsin-M	2	6 7 (12 96)	81 8	10 0 (18 53)	78 6
Indofil M-45	2	13 3 (21 23)	63 8	13 3 (21 23)	71 5
Captaf	2	13 3 (21 23)	63 8	13 3 (21 23)	71 5
Thiram	2	16 7 (23 94)	54 5	16 7 (23 94)	64 3
Blitox	2	20 0 (26 64)	45 5	30 0 (33 27)	35 8
Emisan	2	23 3 (28 85)	36 5	30 0 (33 27)	35 8
Control	-	36 7 (37 28)	-	46 7 (43 14)	-
CD(p = 0 05)		10 22		5 36	

Figures in parentheses are angular transformed values PEM, POM and PDC stand for pre-emergence mortality, post-emergence mortality and per cent disease control respectively

found that cowpea treated with carbendazim gave maximum disease control against *F. solani*. The performance of the other fungicides in descending order of efficacy was Indofil M-45, Captaf, Thiram and Blitox.

Soil drenching

Results from presowing drenching of fungicides indicated that Bavistin retained its supremacy and protected maximum PEM and POM (81.7 and 71.5% respectively) followed by Topsin-M (72.8 and 71.5% respectively) (Table 4). Jamaluddin *et al.* (1988), Harsh *et al.* (1992) and Sharma *et al.* (1993) also reported similar results. Sen and Bhardwaj (1995) observed soil drenching with Bavistin (0.1%) was effective against *Robinia* wilt caused by *Fusarium* spp.

Soil amendments

Maximum PEM control (54.5%) was recorded in seed treated with *Trichoderma* followed by mustard cake (45.5%) (Table 5). However, POM control was also high in soil amended with mustard cake and *Trichoderma* treated seed. Minimum control in PEM (18.3%) and POM (28.7%) was observed in wheat straw amended soil. The present findings are in accordance with observations by Dasgupta and Gupta (1989), Chakrabarti and Sen (1991) and Srivastava and Singh (1991) who reported that mustard cake, groundnut cake and saw dust used as soil amendment materials were able to reduce the density of *F. solani*. Manka and Prezezborski (1987) observed that *T. viride* reduced damping-off caused by *F. oxysporum* in pine nurseries.

Table 4 Effect of soil drenching with different fungicides on the seedling mortality

Fungicide	Concentration (w/v basis)	PEM (%)	PDC	POM (%)	PDC
Bavistin	0.2%	6.7 (12.96)	81.7	13.3 (21.23)	71.5
Topsin-M	0.2%	10.0 (18.53)	72.8	13.3 (21.23)	71.5
Indofil M-45	0.2%	13.3 (21.33)	63.8	16.7 (23.94)	64.2
Captaf	0.2%	16.7 (23.94)	54.5	20.0 (26.64)	57.2
Thiram	0.2%	16.7 (23.94)	54.5	16.7 (23.94)	64.2
Blitox	0.2%	26.7 (31.06)	27.3	30.0 (33.27)	35.8
Emisan	0.2%	26.7 (31.06)	27.3	30.0 (33.27)	35.8
Control	-	36.7 (37.28)	-	46.7 (43.14)	-
CD (p = 0.05)		8.66		6.08	

Figures in parentheses are angular transformed values. PEM, POM and PDC stand for pre-emergence mortality, post-emergence mortality and per cent disease control respectively.

Table 5 Effect of different soil amendments on the seedling mortality

Soil amendment	PEM (%)	PDC	POM (%)	PDC
Wheat straw (2.5w/w basis)	30.0 (32.99)	18.3	33.3 (35.20)	28.7
Bean straw (2.5w/w basis)	30.0 (33.20)	18.3	30.0 (33.20)	35.8
Saw dust (2.5w/w basis)	26.7 (30.98)	27.3	30.0 (33.20)	35.8
Cotton cake (1.5w/w basis)	26.7 (30.98)	27.3	33.3 (35.20)	28.7
Mustard cake (1.5w/w basis)	20.0 (26.55)	45.5	23.3 (28.77)	50.1
Trichoderma viride (seed treatment)	16.7 (23.84)	54.5	23.3 (28.77)	50.1
Control (inoculated with fungus)	36.7 (37.28)	-	46.7 (43.14)	-
CD (p = 0.05)	6.71		4.84	

Figures in parentheses are angular transformed values. PEM, POM and PDC stand for pre-emergence mortality, post-emergence mortality and per cent disease control respectively.

It is thus concluded that pre-emergence and post-emergence seedling mortality caused by *F. solani* in *P. cineraria* can be minimised by treating the seed (2 g kg^{-1}) or drenching the soil (0.2% solution) with Bavistin or Topsin-M fungicides. Mustard cake as soil amendment and *Trichoderma viride* as seed dresser are also good alternatives to control *F. solani.*

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