

## CHEMICAL CONTROL OF SUDDEN DECLINE DISEASE OF DATE PALM (*PHOENIX DACTYLIFERA* L.) IN SINDH, PAKISTAN

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### Abstract

Khairpur is the biodiversity center of date palm in Pakistan. The date palm orchards are suffering from a sudden decline disease (SDD) problem caused by a soil born fungus *Fusarium solani*, which is threatening date palm industry in this region. The efficacy of six different fungicides was tested against *Fusarium solani* under *In vitro* and *In vivo* conditions to control the sudden decline disease of date palm. The experiment was arranged in Randomized Complete block Design (RCBD) in the lab and Randomized Complete Block Design (RCBD) in field conditions. Bavistin D.F showed complete suppression of *Fusarium solani* followed by Topsin-M, Alette and Ridomil gold at 150 ppm concentration followed by 100 ppm and 50 ppm. The maximum mean colony growth was recorded in control medium (17.8) followed by Copper oxychloride at 50ppm (15.1). The Bavistin D.F proved to be the highly effective fungicide also under field conditions followed by Topsin-M, Alette, Ridomil, Mancozeb and Copper oxychloride. In untreated control plants, disease severity was increased with increase in time. The treated plants recovered and produced fruit next season.

### Introduction

The date palm (*Phoenix dactylifera* L.) is considered as one of the most important crop of the country and holds a very significant position on the agricultural horizon of Sindh. Khairpur is the biodiversity center of date palm having more than 300 varieties (Markhand *et al.*, 2010). Date palm trees in Sindh province particularly Khairpur are suffering from a serious disease the sudden decline syndrome caused by a soil born fungus *Fusarium solani* (Maitlo *et al.*, 2009). This disease destroyed many orchards and dispersed trees at this area. The number of infected trees is increasing day by day but some areas are considered as infection spots (Abul Soad *et al.*, 2011; Maitlo *et al.*, 2009). Nowadays sudden decline has become a real threat for current date palm cultivation in Sindh particularly at Khairpur. Moreover it restricts the extension of new cultivations of date palm.

The symptoms are similar to bayoud disease that is the most destructive soil born fungal disease of date palm caused by *Fusarium oxysporium* f. sp. *albedinis* (Al-Akaidy, 1994). This disease first originated in North Africa particularly in Morocco, where more than 12 million trees of date palm have been destroyed in a century (Djerbi, 1983).

The decline disease of date palm has also been reported by several workers from different date palm growing areas of the world. However, they reported various fungal pathogens responsible for this disease such as *Fusarium oxysporium* f.sp. *albedinis*, *Fusarium moniliforme*, *Fusarium proliferatum* and *Fusarium solani* (Sarhan, 2001; Rasheed & Hafeez, 2001; Abdalla *et al.*, 2000; Maitlo *et al.*, 2009; Masood, *et al.*, 2011). The use of fungicides for the control of plant diseases is a common practice all over the world. There are several reports available in which fungicides have been used to control the plant diseases caused by soil born pathogens (Soad *et al.*, 1982; Ilieseu *et al.*, 1985; Rajput *et al.*, 2006; Iqbal *et al.*, 2010; Govindappa *et al.*, 2011; Ahmed *et al.*, 2012). The current study was conducted to evaluate some

of the available fungicides against *Fusarium solani* to control the sudden decline disease (SDD) of date palm through *In vitro* and *In vivo* applications.

### Material and Methods

**Pathogen inoculum:** The Pure culture of *Fusarium solani* was isolated from different parts of affected date palm tree and maintained on potato dextrose agar (PDA) at room temperature.

**Fungicides:** The six different fungicides were used and on the basis of their efficacy, grouped into 2 categories; Systemic and Contact fungicides. The systemic fungicides comprised of Benzimidazole, Thiophanatemethyl, Phenylamide and Phosphonate while the Contact fungicides comprised of Dithiocarbamate and Copper compound. The registration status, active ingredients, trade name and formulations of the fungicides are given in Table 1.

***In vitro* screening of fungicides against *Fusarium solani*:** Both contact and systemic fungicides were used for *In vitro* screening by food poison method (Dhingra & Sinclair, 1985). The tested fungicides were suspended in sterile water and added to molten PDA medium to obtain final concentrations of 50, 100 and 150 ppm. PDA without fungicides served as control. The streptomycin at 1ml/liter was added to avoid bacterial contamination at the time of pouring. After solidification of the medium, 1cm disk of fresh and pure culture of *Fusarium solani* was placed in the center of Petri dish. The experiment was conducted in complete randomized design (CRD). There were 3 replicates of each treatment. The petri dishes were incubated at room temperature (25±1°C) and daily radial colony growth was recorded till the upper surface in control treatment was fully covered with the mycelial growth of the fungus. The percent growth inhibition and daily mean colony diameters for each fungicide concentration were calculated by using the following

equation suggested by Nene & Thakliyar (1979) & Sunder *et al.*, (1995).

$$\frac{\text{Control} - \text{Treatment} \times 100}{\text{Control}}$$

**In vivo (Field) Experiment:** The *In vivo* experiment to evaluate 6 fungicides was conducted on the basis of the results of *In vitro* test of fungicides. The four systemic and two contact fungicides were used in foliar and soil application on dying date palm trees as shown in Table 1. The date palm trees infected with sudden decline disease were selected at Noorpur village, District Khairpur in 2009-2010. The experiment was arranged in randomized complete block design (RCBD) having 3 trees as

$$\text{Decrease disease incidence \%} = \frac{\text{Disease severity } 1^{\text{st}} - \text{Disease severity } 2^{\text{nd}} \times 100}{\text{Disease severity } 1^{\text{st}}}$$

replicates for each treatment. The plants were thoroughly sprayed three times with 15 days interval. Before first spray the plants were tagged and all dead branches were removed by pruning. After first spray treated and control plants were irrigated with canal water.

The first spray followed estimation of disease severity at the beginning of the experiment. The control treatment was kept unsprayed. The disease severity and decrease in disease incidence% (PD) were calculated at 15 days interval after each spray. The disease severity was determined using the following formula described by Chastanger & Ogawa (1979).

$$\text{Disease severity \%} = \frac{\text{Number of infected leaves} \times 100}{\text{Total number of leaves}}$$

**Table 1. Fungicide details used against *Fusarium solani* for *In vitro* culturing experiment.**

Trade name	Chemical name	Active ingredients	Formulation	Chemical group	Mode of action
Bavistin D.F	Carbendazim	50% Carbendazim	50% WP	Benzimidazole	Systemic
Topsin-M	Thiophanate-methyl	70% Thiophanate-methyl	70% WP	Thiophanate-methyl	Systemic
Ridomil Gold	Methyl <i>N</i> -(2,6-dimethylphenyl)- <i>N</i> -(methoxyacetyl)- <i>D</i> -alaninate	Mefenoxam (47.6%)	25 WP	Phenylamide	Systemic
Alliette	Fosetyl-aluminum	80% Fosetyl-aluminum	80% WP	Phosphonate	Systemic
Dithane M-45	Mancozeb	80% Mancozeb	80% WP	Dithiocarbamate	Contact
Copper oxychloride	Copper oxychloride	50% Copper oxychloride	50% WP	Copper compound	Contact

**Layout of the experiment:** Each treatment comprised 3 replicates. One Factor Randomized Complete Block Design was used and data were subjected to analysis of variance. Separation of means among treatments was determined using L.S.D test at 5% (Steel *et al.*, 1997).

## Results and Discussion

***In vitro* screening of fungicides against *Fusarium solani*:** All the fungicides at three different concentrations inhibited the mycelial growth of *Fusarium solani*. But, the systemic fungicides proved to be the best i.e., Bavistin D.F showed complete suppression of *Fusarium solani* followed by Topsin-M, Alliette and Ridomil gold at 150ppm concentration followed by 100ppm and 50ppm after 1, 2, 3 and 4 days study (Fig. 2 & Table 2). The maximum mean colony growth was recorded in control medium (17.8) followed by Copper oxychloride at 50 ppm (15.1). Iqbal *et al.*, (2010) evaluated 8 fungicides in which Benlate and Carbendazim proved to be the best fungicides giving no growth of fungus *Fusarium mangiferae* after 3, 8 and 16 days of inoculation. Banik *et al.*, (1998) also found that Carbendazim (Bavistin D.F) at 400 ppm completely inhibited the linear growth of *Lasiodiplodia theobromae* soil borne fungus followed by Thiophanate-methyl (Topsin-M) at 450 ppm.

Our results are in agreement with the findings of Bhanumathi & Ravishankar (2007) who evaluated 7 fungicides at 50, 100 and 150 ppm concentrations by Poison Food Technique and found Bavistin most effective in inhibiting radial growth of *Fusarium solani*.

***In vivo* field experiment:** The field experiment was conducted on the basis of the results obtained from *In vitro* management test of fungicides. The systemic fungicides were used as soil drench and contact fungicides were used as foliar spray for the control of sudden decline disease (SDD) of date palm under field conditions. The disease severity was recorded before the first spray and percent decrease in disease incidence was obtained after the completion of three sprays. The Bavistin D.F proved to be the highly effective fungicide also under field conditions. The maximum percent decreasing disease was recorded at first (45.4), second (72) and third spray (97.1) of Bavistin D.F followed by Topsin-M, Alliette, Ridomil, Mancozeb and Copper oxychloride (Table 3; Fig 3). In disease severity in control plants was increased with increase in time. The complete disappearance of typical symptoms of the disease was noted in the trees treated with fungicides and same trees given fruit next season (Fig. 1).

Many plant pathologists reported that several fungicides decreased the percentage of root rot disease (El-Zawahry *et al.*, 2000; Abdalla, 2002; Arain *et al.*, 2012). Our results are in close confirmation with the findings of Khanzada *et al.*, (2005) who recorded that wilt and die-back of mango caused by soil borne fungus was controlled by spray of carbendazim. Similarly, Watkins *et al.*, (1977) have also reported the broad spectrum systemic fungicide is beneficial for the decreasing of disease incidence of date palm. The chemical control could also minimize inoculum propagules and prevent re-infection process. The results of current study would suggest that proper sanitation, Irrigation and fertilization with at least 3 fortnightly sprays with Bavistin D.F would help in the control of sudden decline disease of date palm.



Fig. 1(A). Date Palm tree is showing sudden decline disease symptoms.



Fig. 1(B). Same tree given fruit next year after fungicide treatment.

**Table 2. *In vitro* management of six different fungicides against *Fusarium solani* by poison food technique method.**

Treatments (Fungicide)	Concentration (ppm)	Colony diameter				Total	Mean	Disease / Control
		1 Day	2 Day	3 Day	4 Day			
Bavistin D.F	50	2.2	2.3	3.4	5.5	13.4	3.3	81.3
	100	1.1	2.1	3.3	0.0	6.5	1.62	91.0
	150	1.00	0.0	0.0	0.0	1.00	0.2	98.8
Topsin M	50	6.5	7.2	7.5	8.6	29.8	7.4	58.4
	100	2.2	3.3	4.4	5.5	15.4	3.8	78.6.
	150	1.2	2.0	2.1	2.2	7.5	1.8	89.8
Aliette	50	7.8	8.0	9.2	10.2	35.2	8.8	50.5
	100	5.5	6.1	6.6	7.7	25.9	6.4	64.0
	150	2.2	3.3	4.4	5.5	15.4	3.8	78.6
Ridomil gold	50	9.5	10.5	11.1	12.2	43.3	10.8	39.3
	100	6.8	7.1	7.8	8.8	30.5	7.6	57.3
	150	4.5	5.5	6.5	6.1	22.6	5.6	68.5
Mancozeb	50	12.2	13.3	14.2	15.8	55.5	13.8	22.4
	100	10.2	10.5	11.5	12.2	44.4	11.1	37.6
	150	7.5	6.8	8.8	9.8	26.1	6.5	63.4
Copper oxychloride	50	13.2	14.5	15.2	17.2	60.1	15.1	15.1
	100	10.4	11.2	12	13	46.6	11.6	34.8
	150	8.2	8.9	9.2	10.1	36.4	9.1	48.8
Control	No fungicide	7.2	14.2	21.5	28.5	71.4	17.8	00
L.S.D at 0.05		0.73	0.90	1.01	1.23	3.80	1.98	6.21

Each treatment consisted of three replications

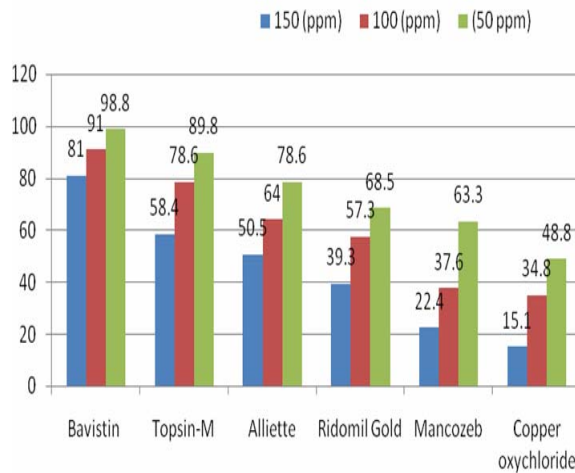


Fig. 2. Effect of different fungicides for *In vivo* management of sudden decline disease of date palm at Khairpur, Pakistan.

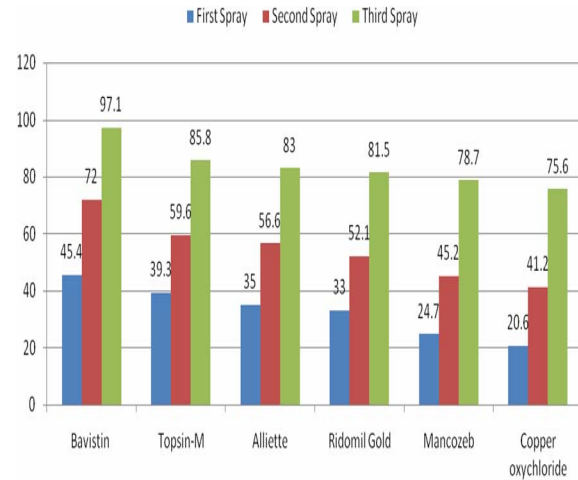


Fig 3. Effect of different fungicide for *In vitro* management of sudden decline disease of date palm at Khairpur, Pakistan.

**Table 3. Chemical control of sudden decline disease of date palm (*Phoenix dactylifera* L.) at Khairpur, Pakistan.**

Fungicide	Disease severity%				Decrease in disease incidence%		
	Before fungicide treatment	1 <sup>st</sup> Spray	2 <sup>nd</sup> Spray	3 <sup>rd</sup> Spray	1 <sup>st</sup> Spray	2 <sup>nd</sup> Spray (after 15 days)	3 <sup>rd</sup> Spray (after 15 days)
Bavistin D.F.	73.3	40	20.5	2.1	45.4	72	97.1
Topsin-M	74.3	45	30	10.5	39.3	59.6	85.8
Aliette	73.9	48	32	12.5	35.00	56.6	83.0
Ridomil gold	73.2	49	35	13.5	33.0	52.1	81.5
Mancozeb	73.1	55	40	15.5	24.7	45.2	78.7
Copper oxychloride	73.2	58	43	17.8	20.6	41.2	75.6
Control	73.2	84.2	92.2	100	0.0	0.0	0.0
L.S.D at 0.05	0.09	2.04	3.11	0.65	2.98	2.76	4.10

Each treatment consisted of three replications

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