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In-vitro Efficacy of Different Fungicides against Pathogens Causing Wilt of Betelvine

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ABSTRACT

Different non systemic, systemic and combi product fungicides were evaluated in vitro against Sclerotium rolfsii, Rhizoctonia bataticola and Fusarium solani causing wilt of betelvine. Among the non systemic fungicides evaluated Captan showed maximum per cent inhibition in mycelia growth of S. rolfsii (62.96), R. bataticola (85.93) and F. solani (84.07) at 0.3% concentration. Among the different systemic fungicides tested, Hexaconazole and Propiconazole at 0.15% concentration showed cent percent inhibition against S. rolfsii, Propiconazole showed cent per cent inhibition of R. bataticola.. Tebuconazole and Propiconazole showed cent per cent inhibition of F. solani. Among the combi-products tested Captan 70 %+ Hexaconazole 5% WP (Taqat) showed cent per cent inhibition against S. rolfsii and F. solani at 0.1, 0.2 and 0.3% concentration, for R. bataticola at 0.2 and 0.3% concentration. Least inhibition in mycelia growth was recorded in Tricyclazole 18% + Mancozeb 62% WP (Merger).

Key words: *Betelvine, Fungicides, Sclerotium rolfsii, Rhizoctonia bataticola and Fusarium solani.*

INTRODUCTION

Betelvine (*Piper betle* L.) commonly known as pan is a perennial, dioecious creeper belonging to the family *Piperaceae* and is a native of central and eastern Malaysia. It is valued both as mild stimulant and for its medicinal properties. It occupies a significance place in Hindu religious ceremonies and chewing pan is an age old custom in Asia especially in India.

Successful cultivation of betelvine suffers from root and aerial diseases among these wilt/ root rot caused by many fungal pathogens like *Phytophthora* spp., *Rhizoctonia solani*, *R. bataticola*, *Fusarium* spp, *Pythium* spp and *Sclerotium rolfsii* along with root knot nematode *Meloidogyne incognita* results in significant yield losses[1]. It is necessary to generate information on the efficacy of available new fungicides and botanicals under laboratory conditions. Since this forms the prerequisite for field evaluation the present study was under taken to screen various fungicides *In-vitro* to manage the wilt of betelvine.

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MATERIAL AND METHODS

The experiment was conducted at Department of Plant Pathology, College of Agriculture, Dharwad during 2015-16. Efficacy of different non-systemic, systemic and combi-product fungicides at different concentrations were evaluated on radial growth of the test fungi by poisoned food technique[2].

Isolation of pathogens

The pathogens *Sclerotium rolfsii*, *Rhizoctonia bataticola* and *Fusarium solani* were isolated from the diseased parts of the wilt affected betelvine plants by following standard tissue isolation method. Pure cultures were maintained on Potato Dextrose Agar slants.

Evaluation of fungicides

The efficacy of non-systemic and combi-product fungicides at the concentrations of 0.1, 0.2 and 0.3 % and systemic fungicides at the concentration of 0.05, 0.10 and 0.15 % was assayed. The fungicides were tested against the pathogens by adopting 'Poisoned food technique'. The required concentration of chemicals was prepared and incorporated into sterilized, cooled potato dextrose agar. Twenty ml of molten cooled medium was poured into 90 mm sterilized Petri dishes and all plates were inoculated with actively growing five mm mycelial disc of pathogens separately. The plates prepared without any fungicide served as control. The experiment was conducted in completely randomised block design (CRBD) with three replications in each treatment. The inoculated plates were incubated at $27\pm1^{O}C$ for seven days and colony diameter was recorded. Per cent inhibition of mycelial growth over control was calculated by using the formula of Vincent[6].

$$I = \frac{C - T}{C} \times 100$$

Where

I = Per cent inhibition of mycelial growth

C= Growth of mycelium in control.

T = Growth of mycelium in treatment.

RESULTS AND DISCUSSION

Among the non-systemic fungicides, Captan showed 62.96% inhibition of *Sclerotium rolfsii* followed by Zineb (60.56%), 85.93% inhibition of *Rhizoctonia bataticola* was found in Captan followed by 85.19% in Copper oxychloride these two are on par with each other. In case of *Fusarium solani* 84.07% inhibition recorded in Captan followed by Zineb (82.59%) (Table 1 and Plate 1). This may be due to interference of captan with respiration and growth of the fungus. These results are in agreement with the findings of Rather *et al.*[4], they found Captan as effective in inhibiting the mycelial growth of *Fusarium oxysporum, Phytopthora capsici, Rhizoctonia solani* and *S. rolfsii* causing wilt complex in bellpepper.

Among the systemic fungicides, Hexaconazole at 0.05, 0.10 and 0.15% concentration showed cent percent inhibition against *S. rolfsii*, Propiconazole and Hexaconazole showed cent per cent inhibition of *R. bataticola.* At 0.15%. Tebuconazole and Propiconazole showed cent per cent inhibition of *F. solani* at 0.15% (Table 2 and Plate 2). This inhibition by triazole fungicides may be due to their interference with the ergosterol biosynthesis. Similar findings were reported by Sangeetha and Jahagirdar[5] on *S. rolfsii*, *R. bataticola* and *Fusarium sp.* causing root rot complex of soybean, where as Hexaconazole and Propiconazole recorded maximum inhibiton of all the three pathogens.

Among the combi-products tested Captan 70 %+ Hexaconazole 5% WP (Taqat) showed cent per cent inhibition against all the three pathogens. Hexaconazole 4% + Zineb 68% WP (Avtar), Thiram 37.5 + Carboxin 37.5 WP (Vitavax power) and Tebuconazole 50%+ trifloxystrobin 25% WG (Nativo) showed cent per cent inhibition of *S. rolfsii* at 0.1, 0.2 and 0.3% concentration and were significantly superior over Tricyclazole 18% + Mancozeb 62% WP (Merger) which was found to be least effective (75.37%). In case of *R. bataticola* Carbendazim 12% + Mancozeb 63% WP (SAAF) and Hexaconazole 4% + Zineb 68% WP (Avtar) recorded cent percent inhibition of pathogen growth at all concentrations tested. Captan 70 %+ Hexaconazole 5% WP (Taqat) and Thiram

37.5 + Carboxin 37.5 WP (Vitavax power) recorded cent per cent inhibition at 0.2 and 0.3%. In case of *F. solani*, Captan 70 %+ Hexaconazole 5% WP (Taqat), Carbendazim 12% + Mancozeb 63% WP (SAAF) and Tebuconazole50%+ trifloxystrobin 25% WG (Nativo) recorded cent per cent inhibition of radial growth of the pathogen at all concentrations tested (Table 3 and Plate 3). Combi product have different mode of action and avoids the development of resistance to systemic fungicides. Similar results were observed earlier by Raghu[3] who found that Captan 70 %+ Hexaconazole 5% WP (Taqat) and Hexaconazole 4% + Zineb 68% WP (Avtar) recorded maximum inhibition of mycelia growth of fungi causing chilli wilt.

Table 1: Inhibition of mycelia growth of betelvine wilt pathogens by different non systemic fungicides

Name of the Chemical	Per cent inhibition											
	Sclerotium rolfsii				*Rhizoctonia bataticola*				*Fusarium solani*			
	0.1	0.2	0.3	Mean	0.1	0.2	0.3	Mean	0.1	0.2	0.3	Mean
Chlorothalonil (Kavach 75 WP)	17.78 (24.95) *	22.22 (28.14)	40.37 (39.47)	**26.79 (30.85)**	37.04 (37.50)	43.89 (41.51)	45.74 (42.58)	**42.22 (40.53)**	56.67 (48.86)	62.04 (51.99)	69.63 (56.59)	**62.78 (52.48)**
Mancozeb (Indofil M-45 75 WP)	14.26 (22.19)	17.22 (24.53)	24.81 (29.89)	**18.77 (25.54)**	44.63 (41.94)	51.30 (45.77)	70.19 (56.94)	**55.37 (48.21)**	60.74 (51.23)	71.11 (57.52)	73.70 (59.18)	**68.51 (55.98)**
Captan (Captaf 50 WP)	24.63 (29.76)	51.85 (46.08)	62.96 (52.54)	**46.48 (42.80)**	81.30 (64.42)	84.81 (67.10)	85.93 (68.01)	**84.01 (66.50)**	59.07 (50.25)	73.33 (58.94)	84.07 (66.52)	**72.15 (58.57)**
Zineb (DithaneZ-78 75WP)	45.37 (42.36)	50.93 (45.55)	60.56 (51.12)	**52.28 (46.35)**	72.78 (58.58)	75.74 (60.52)	78.70 (62.55)	**75.74 (60.55)**	62.78 (52.43)	66.48 (54.65)	82.59 (65.38)	**70.61 (57.49)**
Copper oxychloride (Blitox 50 WP)	0.00 (0.00)	0.00 (0.00)	17.78 (24.94)	**5.93 (8.31)**	80.00 (63.47)	82.96 (65.66)	85.19 (67.40)	**82.72 (65.51)**	68.33 (55.79)	72.22 (58.23)	79.26 (62.95)	**73.27 (58.99)**
Mean	20.40 (23.85)	28.44 (28.86)	41.29 (39.59)	**30.05 (30.77)**	61.95 (53.18)	67.74 (56.11)	73.15 (59.49)	**68.01 (56.26)**	61.51 (51.71)	69.03 (56.27)	77.85 (62.12)	**69.46 (56.70)**
	S. Em.±		**C.D. at 1%**		**S. Em.±**		**C.D. at 1%**		**S. Em.±**		**C.D. at 1%**	
Fungicides (F)	**0.21**		**0.84**		**0.20**		**0.80**		**0.23**		**0.90**	
Concentration (C)	**0.16**		**0.65**		**0.16**		**0.63**		**0.18**		**0.70**	
Interaction (FxC)	**0.37**		**1.46**		**0.35**		**1.40**		**0.40**		**1.56**	

* Figures in parenthesis are arcsine transformations

Table 2: Inhibition of mycelia growth of betelvine wilt pathogens by different systemic fungicides

Name of the chemicals	Per cent inhibition											
	Sclerotium rolfsii				*Rhizoctonia bataticola*				*Fusarium solani*			
	0.05	0.10	0.15	Mean	0.05	0.10	0.15	Mean	0.05	0.10	0.15	Mean
Carbendazim (Bavistin 50 WP)	0.00 (0.00)*	3.70 (11.01)	7.41 (15.78)	**3.70 (8.93)**	82.96 (65.63)	84.63 (66.92)	88.15 (69.87)	**85.25 (67.47)**	83.70 (66.20)	85.56 (67.67)	62.67 (53.22)	**77.31 (62.36)**
Difenconazole (Score 25 EC)	79.07 (62.78)	81.85 (64.79)	83.89 (66.34)	**81.60 (64.64)**	38.15 (38.14)	48.89 (44.36)	69.81 (56.68)	**52.28 (46.39)**	71.30 (57.61)	71.30 (57.61)	73.70 (59.15)	**72.10 (58.12)**
Hexaconazole (Contaf 5 EC)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**	72.78 (58.55)	80.37 (63.70)	100.00 (90.00)	**84.38 (70.75)**	74.82 (59.88)	79.81 (63.31)	83.15 (65.77)	**79.26 (62.99)**
Thiophanate methyl(Roko 70 WP)	0.00 (0.00)	8.15 (16.55)	18.33 (25.35)	**8.83 (13.96)**	75.56 (60.38)	80.74 (63.97)	84.81 (67.08)	**80.37 (63.81)**	40.00 (39.23)	46.30 (42.87)	72.22 (58.20)	**52.84 (46.77)**
Tebuconazole (Folicure 250 EC)	88.85 (70.50)	100.00 (90.00)	100.00 (90.00)	**96.28 (83.50)**	73.70 (59.15)	74.63 (59.76)	96.48 (81.15)	**81.60 (66.68)**	87.59 (69.38)	89.59 (71.19)	100.00 (90.00)	**92.40 (76.86)**
Propiconazole (Tilt 25 EC)	94.44 (76.36)	97.96 (81.81)	100.00 (90.00)	**97.47 (82.72)**	84.44 (66.77)	88.15 (69.87)	100.00 (90.00)	**90.86 (75.55)**	81.30 (64.38)	87.96 (69.71)	100.00 (90.00)	**89.75 (74.70)**
Mean	60.39 (49.94)	65.28 (59.03)	68.27 (62.91)	**64.64 (57.29)**	71.26 (58.10)	76.23 (61.43)	89.87 (75.80)	**79.12 (65.11)**	73.11 (59.45)	81.95 (69.39)	81.95 (69.39)	**77.27 (63.63)**
	S. Em.±		**C.D. at 1%**		**S. Em.±**		**C.D. at 1%**		**S. Em.±**		**C.D. at 1%**	
Fungicides (F)	**0.22**		**0.85**		**0.65**		**2.48**		**2.44**		**9.38**	
Concentration (C)	**0.16**		**0.60**		**0.46**		**1.76**		**1.72**		**6.63**	
Interaction (FxC)	**0.38**		**1.47**		**1.12**		**4.30**		**4.22**		**16.24**	

* Figures in parenthesis are arcsine transformations

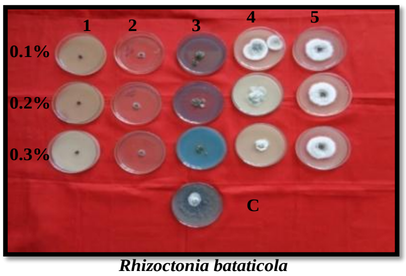
Table 3: Inhibition of mycelia growth of betelvine wilt pathogens by different combiproduct fungicides

Name of the chemicals	Per cent inhibition											
	Sclerotium rolfsii				*Rhizoctonia bataticola*				*Fusarium solani*			
	0.1	**0.2**	**0.3**	**Mean**	**0.1**	**0.2**	**0.3**	**Mean**	**0.1**	**0.2**	**0.3**	**Mean**
Captan 70 %+ Hexaconazole 5% WP (Taqat)	100.00 (90.00) *	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**	83.89 (66.34)	100.00 (90.00)	100.00 (90.00)	**94.63 (82.11)**	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**
Carbendazim 12% + Mancozeb 63% WP SAAF	85.37 (67.52)	87.59 (69.40)	92.04 (73.64)	**88.33 (70.18)**	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**
Hexaconazole 4% + Zineb 68% WP (Avtar)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**	83.15 (65.76)	85.00 (67.22)	87.04 (68.99)	**85.06 (67.32)**
Thiram 37.5 %+ Carboxin 37.5% WP (Vitavax power)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**	83.70 (66.20)	100.00 (90.00)	100.00 (90.00)	**94.57 (82.07)**	83.89 (66.34)	85.56 (67.67)	87.96 (69.71)	**85.80 (67.90)**
Tricyclazole 18% + Mancozeb 62% WP (Merger)	67.96 (55.53)	73.52 (59.03)	75.37 (60.25)	**72.28 (58.27)**	82.41 (65.20)	84.63 (66.92)	87.59 (69.40)	**84.88 (67.17)**	67.96 (55.53)	70.37 (57.02)	73.70 (59.15)	**70.68 (57.23)**
Tebuconazole50%+ trifloxystrobin 25% WG (Nativo)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**	84.07 (66.48)	83.52 (66.05)	100.00 (90.00)	**89.20 (74.18)**	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	**100.00 (90.00)**
Metiram complex 55 % + Pyraclostrobin 5 % WG (Cabrio top)	79.08 (62.79)	86.67 (68.59)	87.41 (69.23)	**84.38 (66.87)**	84.44 (66.77)	84.44 (66.77)	92.78 (74.46)	**87.22 (69.34)**	70.00 (56.79)	72.59 (58.43)	74.81 (59.88)	**72.47 (58.37)**
Mean	90.34 (77.98)	92.54 (79.57)	93.54 (80.45)	**92.14 (79.33)**	88.35 (73.00)	93.22 (79.96)	97.19 (84.84)	**92.93 (79.27)**	86.43 (73.49)	87.64 (74.33)	89.07 (75.39)	**87.71 (74.40)**
	S. Em.±		**C.D. at 1%**		**S. Em.±**		**C.D. at 1%**		**S. Em.±**		**C.D. at 1%**	
Fungicides (F)	**0.19**		**0.73**		**0.20**		**0.75**		**0.22**		**0.84**	
Concentration (C)	**0.13**		**0.48**		**0.13**		**0.49**		**0.14**		**0.55**	
Interaction (FxC)	**0.33**		**1.27**		**0.34**		**1.31**		**0.38**		**1.46**	

* Figures in parenthesis are arcsine transformations

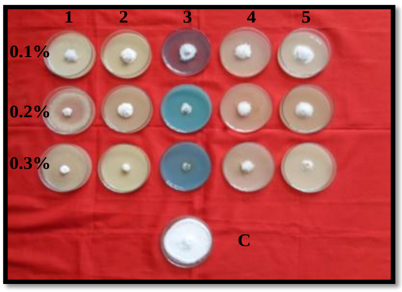
Sclerotium rolfsii

1- Chlorothalonil
2- Mancozeb
3- Captan
4- Zineb
5- Copper oxychloride
C- Control



Rhizoctonia bataticola

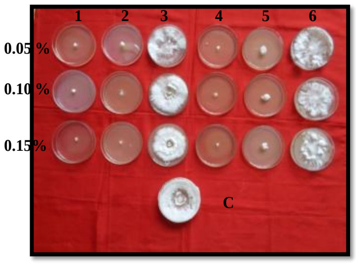
1- Captan
2- Chlorothalonil
3- Copper oxychloride
4- Mancozeb
5- Zineb
C- Control



Fusarium solani

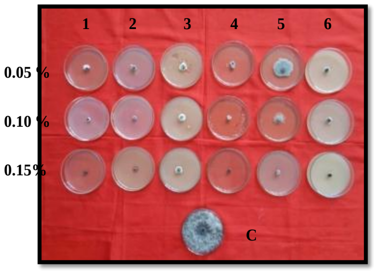
1- Captan
2- Zineb
3- Copper oxychloride
4- Chlorothalonil
5- Mancozeb
C- Control

Plate 1: *In vitro* evaluation of non systemic fungicides against betelvine wilt pathogens



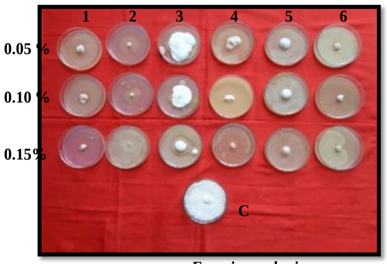
1- Propiconazole
2- Tebuconazole
3- Thiophanate methyl
4- Hexaconazole
5- Difenconazole
6- Carbendazim
C- Control

Sclerotium rolfsii



1- Propiconazole
2- Tebuconazole
3- Thiophanate methyl
4- Hexaconazole
5- Difenconazole
6- Carbendazim
C- Control

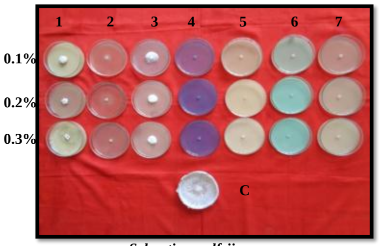
Rhizoctonia bataticola



1- Thiophanate methyl
2- Tebuconazole
3- Carbendazim
4- Hexaconazole
5- Difenconazole
6- Propiconazole
C-Control

Fusarium solani

Plate 2: *In vitro* evaluation of systemic fungicides against betelvine wilt pathogens



1- Cabrio top
2- Nativo
3- Merger
4- Vitavax power
5- Avatar
6- SAAF
7- Taqat
C- Control

Sclerotium rolfsii

1- Cabrio top
2- Nativo
3- Merger
4- Vitavax power
5- Avatar
6- SAAF
7- Taqat
C- Control

Rhizoctonia bataticola

1- SAAF
2- Cabrio top
3- Nativo
4- Merger
5- Taqat
6- Vitavax power
7- Avatar
C- Control

Fusarium solani

Plate 3: *In vitro* evaluation of combi-product fungicides against betelvine wilt pathogens

CONCLUSION

Chemical management is an important tool for control of diseases, including soil-borne diseases. Identification of efficacy of new fungicides under *In -vitro* would enable consolidation of different components required to formulate integrated disease management under *In-vivo*.

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