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In vitro evaluation of fungicides against *Asperisporium caricae* causing papaya black spot

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Abstract

Five contact fungicides, four systemic fungicides and four combiproduct fungicides were evaluated for their effectiveness against *A. caricae* under *in vitro* condition by following poisoned food technique. Among contact fungicide tested Mancozeb 75% WP (44.35%) showed maximum and Copper hydroxide 50% WP (24.03) showed least inhibition of radial mycelial growth. Carbendazim 50% WP and Propiconazole 25% EC showed complete mycelial inhibition among the four systemic fungicide evaluated whereas, least inhibition was reported on Hexaconazole 5% EC (38.33%). Among the combiproduct fungicides used in the treatment to evaluate their efficacy against *A. caricae* 100% inhibition was obtained by (Carbendazim 12% + Mancozeb 63%) 75% WP and Picoxystrobin 7% + Propiconazole 12% SC whereas, Metiram 5% + Pyrachlostrobin 55% WG (21.60%) imparted minimum mycelial growth inhibition.

Keywords: Papaya, black spot disease, contact fungicides, systemic fungicides, combiproduct fungicides

Introduction

Carica papaya L. is an herbaceous laticiferous plant commonly cultivated in the tropics and subtropics as a food and cash crop. The importance of papaya to agricultural and the world's economy is evident by its wide distribution. This crop was once had a status of home garden crop but then emerged to that of commercial orchards in many tropical countries. It is one of the highest producer of fruits per hectare (Singh, 1990) [7]. Among common fruits, papaya stands first on nutritional scores for the percentage of vitamin A, vitamin C, potassium, folate, niacin, thiamine, riboflavin, iron and calcium, and fiber (Huerta-Ocampo *et al.*, 2012) [1].

Recently, black spot (*Asperisporium caricae* (Speg.) Maubl.) disease has emerged as one of the most lethal papaya diseases, inciting lesions on leaves and fruits. Abundant spotting on leaves cause defoliation and in excess of 50 per cent leaf fall occurs. The lesions on the fruits affect the appearance, depreciates the market value, in addition to it facilitates the infection by post-harvest pathogens (Ventura *et al.*, 2003) [8]. So, effective management of disease is necessary for prosperity of papaya cultivating farmers. Till date, use of fungicides is sole technique comparatively effective in management of papaya black spot disease in field condition. Few fungicides *viz.*, Difenoconazole, Chlorothalonil, Propiconazole and Hexaconazole were found effective in managing this disease (Shanthamma *et al.*, 2018) [6]. In this view present study was conducted to evaluate the effect of some of the contact, systemic and combiproduct fungicides in inhibiting the radial growth of mycelia under *in vitro* condition.

Material and methods

Effect of fungicides on *Asperisporium caricae* under *in vitro* condition

The bio-efficacy of non-systemic fungicides (table 1), systemic fungicides (table 2) and combiproducts fungicides (table 3) was tested against *A. caricae* to check radial growth inhibition percentage on potato dextrose agar media following poisoned food technique (Nene and Thapliyal, 1973) [3] under *in vitro* condition.

Required quantities of individual fungicides were added to the molten and cooled potato dextrose agar separately in order to obtain the desired fungicide concentration. 20mL of the poisoned media was then poured into clean Petri dishes. Mycelial discs of 5 mm size from

actively growing culture of the fungus were cut out by a sterile cork borer and one such disc was placed at the center of each agar plate. Control was maintained with no fungicides added to the medium. Each treatment has been replicated three times. Such plates were then incubated for 10 days at room temperature, and measured radial colony growth.

The efficacy of a fungicide was expressed as a percent inhibition of mycelial growth over control which was calculated using Vincent's (1947)^[9] suggested formula. The per cent values were subjected to arc sine transformation and analyzed statistically.

Table 1: Contact fungicides and their concentrations used for *in vitro* evaluation against *A. caricae*

Sl. No.	Fungicides	Trade name	Concentration (ppm)
1	Propineb 70% WP	Antracol	10,50,100 &250
2	Copper hydroxide 50% WP	Kocide	10,50,100 &250
3	Zineb 75% WP	Parzate	10,50,100 &250
4	Mancozeb 75% WP	Dhanuka M- 45	10,50,100 &250
5	Captan 50% WP	Captaf	10,50,100 &250

Table 2: Systemic fungicides and their concentrations used for *in vitro* evaluation against *A. caricae*

Sl. No	Fungicides	Trade name	Concentration (ppm)
1	Propiconazole 25% EC	Bumper	10,50,100 &250
2	Difenoconazole 25% EC	Score	10,50,100 &250
3	Carbendazim 50% WP	Bavestin	10,50,100 &250
4	Hexaconazole 5% EC	Contaf	10,50,100 &250

Table 3: Combiproducs and their concentrations used for *in vitro* evaluation against *A. caricae*

Sl. No	Fungicides	Trade name	Concentration (ppm)
1	Metiram 5%+Pyrachlostrobin 55% WG	Cabrio top	10,50,100 &250
2	Carbendazim 12% + Mancozeb 63% WP	SAAF	10,50,100 &250
3	Captan 70% + Hexaconazole 5% WP	Taqat	10,50,100 &250
4	Picoxystrobin 7% + Propiconazole 12% SC	Galileo Way	10,50,100 &250

Results and Discussion

In vitro evaluation of efficacy of contact fungicides against papaya black spot fungi

Significant reduction in growth of fungus was noticed in all treatments in comparison with control. Highest inhibition was imparted by Mancozeb (44.35%) followed by Zineb (38.52%), Propineb (36.75%), Captan (32.51%) and least

inhibition was noticed by Copper hydroxide (24.03%). Results related to effect of contact fungicide on *A. caricae* under *in vitro* condition is depicted in table 4 and fig.1. These results were in conformity with that of Manjunath (2012)^[2] wherein he reported highest mycelial inhibition of *Cercospora sesami* by Mancozeb 75% WP among the contact fungicides tested in the experiment under *in vitro* condition.

Table 4: Efficacy of different contact fungicides to inhibit mycelial growth of *Asperisporium caricae* under *in vitro* condition

Sl. No.	Fungicides	Percent inhibition of the pathogen over control				Mean
		Concentration (ppm)				
		10	50	100	250	
1	Propineb 70% WP	11.84 (20.14)	43.16 (41.08)	44.80 (42.03)	47.21 (43.42)	36.75 (37.33)
2	Copper hydroxide 50% WP	9.26 (17.73)	23.89 (29.27)	30.37 (33.46)	32.58 (34.82)	24.03 (29.36)
3	Zineb 75% WP	20.74 (27.10)	31.48 (34.14)	47.79 (43.75)	54.06 (47.35)	38.52 (38.38)
4	Mancozeb 75% WP	22.21 (28.13)	44.06 (41.61)	52.59 (46.50)	58.52 (49.93)	44.35 (41.77)
5	Captan 50% WP	17.05 (24.40)	27.05 (31.35)	37.05 (37.51)	48.89 (44.38)	32.51 (34.78)
	Mean	16.22 (23.76)	33.93 (35.64)	42.52 (40.71)	48.25 (44.02)	35.23 (36.42)
		Fungicide(F)		Concentration(C)		F×C
	SEm±	0.16		0.14		0.32
	CD @ 1%	0.62		0.55		1.24
	CV%	1.61%				

Note: values in parenthesis are arcsine transformed values

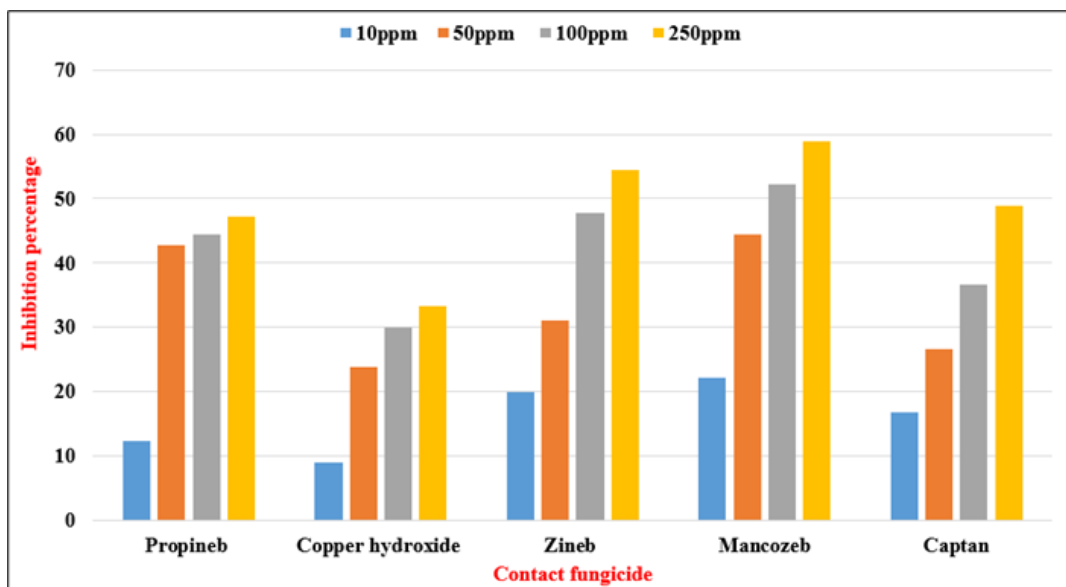


Fig 1: Efficacy of different contact fungicides on mycelial inhibition percentage of *Asperisporium caricae*

In vitro evaluation of systemic fungicides on papaya black spot fungi

Significant reduction in growth of mycelia was obtained by all the four fungicides at all the four concentration. Complete inhibition (100%) of fungus was noticed in Carbendazim 50% WP and Propiconazole 25% EC treatment at all the

concentrations used. Next best inhibition was observed in the treatment of Difenconazole (73.42%), minimum inhibition was obtained by Hexaconazole treatment (38.33%). Significant difference was observed between each of the four fungicides and four concentration. Results pertaining to this is shown in table 5 and fig.2.

Table 5: Efficacy of different systemic fungicides to inhibit mycelial growth of *Asperisporium caricae* under in vitro condition

Sl. No.	Fungicides	Percent inhibition of the pathogen over control				Mean
		Concentration (ppm)				
		10	50	100	250	
1	Carbendazim 50% WP	100.00 (90.04)	100.00 (90.04)	100.00 (90.04)	100.00 (90.04)	100 (90.04)
2	Hexaconazole 5% EC	32.96 (35.05)	35.19 (36.04)	39.63 (39.03)	45.56 (42.47)	38.33 (38.27)
3	Difenconazole 25% EC	58.52 (49.93)	72.22 (58.22)	76.67 (61.14)	86.30 (68.30)	73.42 (58.99)
4	Propiconazole 25% EC	100.00 (90.04)	100.00 (90.04)	100.00 (90.04)	100.00 (90.04)	100 (90.04)
Mean (%)		72.87 (58.63)	76.85 (61.27)	79.07 (62.80)	82.96 (65.65)	77.93 (62.01)
		Fungicide (F)		Concentration (C)		F×C
SEm±		0.17		0.17		0.33
CD@ 1%		0.64		0.64		1.29

Note: values in parenthesis are arcsine transformed values

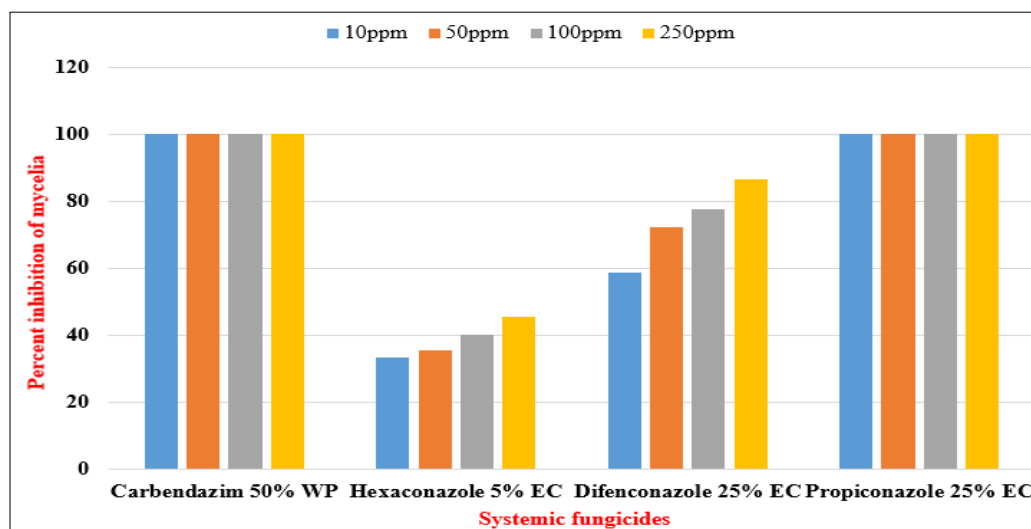


Fig 2: Efficacy of different systemic fungicides on mycelial inhibition percentage of *Asperisporium caricae*

Results obtained in this experiment were in confirmation with findings of Reddikumar *et al.* (2015) ^[5] wherein they reported 88.99% average inhibition of *A. caricae* by *in vitro* treatment with Difconazole at different concentration. Apart from this the results obtained by Patel (2019) ^[4] also reports that Carbendazim 50% WP inhibited 100% mycelial growth of *A. caricae* under *in vitro* study.

***In vitro* evaluation of combiproduct fungicide on papaya black spot fungi**

All the four combiproduct fungicides significantly reduced

the mycelial growth. Complete inhibition was obtained by Mancozeb + Carbendazim (100%) and Picoxystrobin + Propiconazole (100%) treatment. 82.92% inhibition was recorded in Captan + Hexaconazole treatment. Metiram +Pyrachlostrobin (21.60%) showed least inhibition percentage (table 6 and fig.3). Results were consistent with the findings of Manjunath (2012) ^[2] who reported cent percent inhibition of mycelial growth of *Cercospora sesami* by the treatment of (Carbendazim 12% + Mancozeb 63%) 75% WP under *in vitro* condition.

Table 6: Efficacy of different combiproduct fungicides to inhibit mycelial growth of *Asperisporium caricae* under *in vitro* condition

Sl. No.	Fungicides	Percent inhibition of the pathogen over control				Mean
		Concentration (ppm)				
		10	50	100	250	
1	Mancozeb 12% + Carbandazim 63% WP	100.00 (90.04)	100.00 (90.04)	100.00 (90.04)	100.00 (90.04)	100 (90.04)
2	Metiram 5% +Pyrachlostrobin 55% WG	5.92 (14.09)	21.85 (27.88)	26.18 (30.79)	32.45 (34.73)	21.60 (27.70)
3	Captan 70% + Hexaconazole 5% WP	72.59 (58.45)	81.48 (64.53)	87.96 (69.72)	89.63 (71.24)	82.92 (65.61)
4	Picoxystrobin 7% + Propiconazole 12% SC	100.00 (90.04)	100.00 (90.04)	100.00 (90.04)	100.00 (90.04)	100 (90.04)
Mean		69.62 (56.58)	75.83 (60.57)	78.53 (62.42)	80.51 (63.83)	76.12 (60.77)
		Fungicides (F)		Concentration (C)		F×C
SEm±		0.16		0.16		0.33
CD @ 1%		0.64		0.64		1.29

Note: values in parenthesis are arcsine transformed values

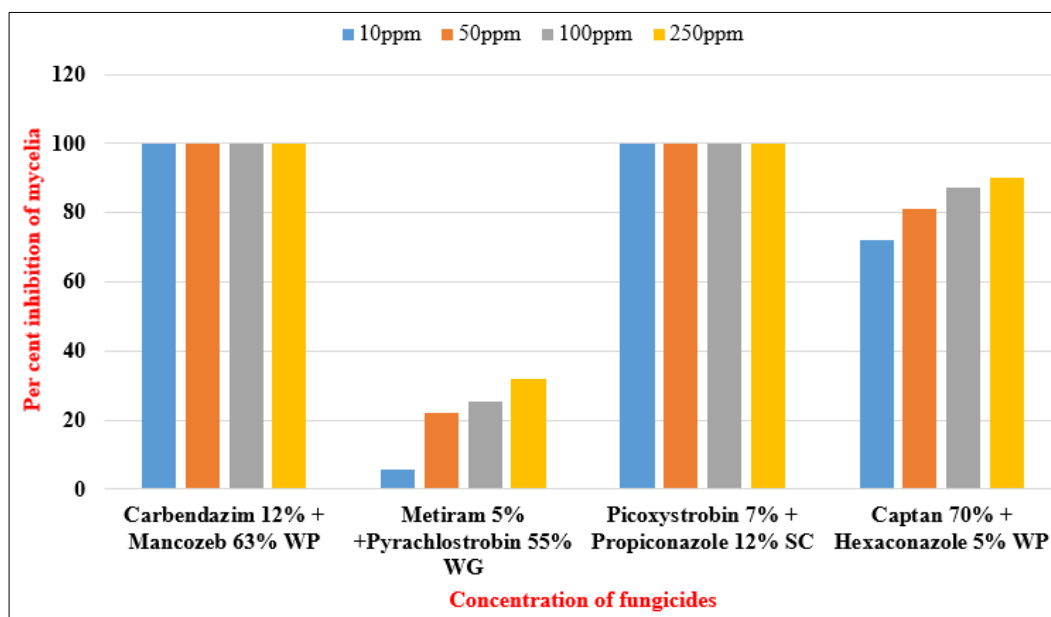


Fig 3: Efficacy of different combiproduct fungicides on mycelial inhibition percentage of *Asperisporium caricae*

Conclusion

From the present study it is evident that some fungicides are effective in completely inhibiting the mycelial growth of *Asperisporium caricae* on PDA media when the media was poisoned with these fungicides. These fungicides were effective even at low concentration (10ppm) in inhibiting the mycelial growth. The future studies need to be focus on ascertaining the effectiveness of these fungicides in reducing the papaya black spot disease under field condition.

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