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In vitro efficacy of fungitoxicants on the growth of *Fusarium oxysporum* f.sp.*carthami* isolates causing wilt of safflower

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ABSTRACT

Fusarium oxysporum f.sp. *carthami* causes wilt of safflower and results in a considerable yield loss. The efficacy of five fungitoxicant at 1,10,25,50,100,500 and 1000µg/ml concentrations were tested against nineteen isolates of *Fusarium oxysporum* f.sp.*carthami*. As the concentrations of fungitoxicants increased, the per cent inhibition also increased. Carbendazim was best fungicide for inhibiting the growth of *Fusarium oxysporum* f.sp.*carthami* followed by Propiconazole, Thiram, Captan and Copper oxychloride. Even 1g/ml of Carbendazim was equal or better than 1000 µg/ml of rest of the fungicides in inhibiting the growth of *Fusarium oxysporum* f.sp.*carthami*.

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INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is one of the most important *Rabi* oilseed crop cultivated from centuries in India. In India, the crop is grown on an area of 425.30 thousand ha with the production of 201.20 thousand tonnes with an average productivity of 473 kg/ha (Anonymous, 2002). Wilt is common disease, spreading widely and causing yield losses upto 80 per cent threatening the crop cultivation (Sastry and Chattopadhyay, 1997). The disease is essential soil borne and poses greater problem in management. Study was therefore made to examine efficacy of different fungicides against *Fusarium oxysporum* f.sp.*carthami*.

MATERIAL AND METHODS

Wilt affected safflower plant sample were collected from safflower growing areas of Marathwada region. Nineteen isolates were isolated and purified by hyphal tip method (Dohroo and Sharma, 1992). The culture were identified on the basis of morphological characters (Booth, 1971). Five fungicides namely, Carbendazim (Bavistin, 50% WP), Copper oxychloride (Blitox, 50% WP), Captan (Captaf , 50% WP), Thiram (Thiram , 75% WP) and Propiconazole (Tilt , 25% EC) were evaluated against nineteen isolates of *Fusarium oxysporum* f.sp.*carthami* (FOC) at 1,10,25,50,100 and 1000 µg/ml concentrations using poisoned food technique (Nene and Thapliyal, 1993) in *in vitro*.

Poisoned food technique:

The required quantity of fungicides was added to the potato dextrose agar (PDA) medium at Luke warm stage to get 100 µg/ml concentrations on active ingradient basis. The stock solution was prepared. From this stock, serial dilutions were made by adding required quantity of PDA so as to get 1000, 500, 100, 50, 25, 10 and 1 µg/ ml.

Five mm discs of the test fungal isolates of *Fusarium oxysporum* f.sp. *carthami* were cut with sterile cork borer and transferred aseptically to the center of poisoned medium. Similarly controls were maintained by placing five mm discs of all the test isolates in the center of the non poisoned PDA medium. All the Petri plates were incubated at 25 ±1°C in BOD incubator for 10 days. The diameter of fungal colony was measured in each of the treatment. Per cent inhibition in mycelial growth of fungus was observed.

RESULTS AND DISCUSSION

Perusal of results presented in Table1, indicated that at lower concentration (1 µg/ml^{-1}) of Carbendazim, the isolate FOC-18 showed maximum inhibition of mycelial growth (100 %) followed by the isolate FOC-5 (88.88 %). The isolates FOC 18 showed highest growth inhibition (100 %) at all concentrations of Carbendazim. The lowest growth inhibition was observed FOC 39 (67.03%) at 10 µg/ml^{-1} concentration. At 25 µg/ml^{-1} concentration isolate FOC 18 was completely inhibited followed by isolates FOC 21 (90.74%), FOC 24 (90.07%), FOC 30 (92.96 %) and FOC 36 (91.85%).The isolates FOC 18 showed maximum (100%) growth inhibition at 50 µg/ ml^{-1} concentration. At 1000 µg/ml^{-1}, highest growth inhibition (100%) was observed in the isolates FOC 12, 18, 21, 30 and 44. Based on mean per cent growth inhibition the isolate from FOC 18 was highly sensitive to Carbendazim followed by the isolates FOC 5, 16, 21, 30, 36 and 44.The mean growth inhibition increased with

Table 1: Per cent growth inhibition of FOC isolates with different concentrations of carbendazim

Isolate No.	*1 µg	*10 µg	*25 µg	*50 µg	*100 µg	*500 µg	*1000 µg	Mean
FOC-5	88.88 (70.56)	89.62 (71.20)	89.62 (71.20)	90.74(72.29)	91.11 (72.66)	93.33 (75.28)	93.33 (72.28)	90.95
FOC-10	79.25 (62.96)	82.59 (65.35)	84.81 (67.08)	88.14 (69.85)	91.48 (73.03)	92.96 (74.70)	94.81(76.98)	87.72
FOC-12	77.03 (61.35)	80.74 (63.98)	86.66 (68.57)	89.25 (70.86)	90.74 (72.28)	94.07(76.02)	100.00 (89.98)	88.35
FOC-14	60.74 (51.19)	72.59 (58.43)	75.92 (60.60)	79.05 (62.75)	82.96 (62.63)	88.14 (70.02)	93.33 (75.13)	78.96
FOC-16	83.70 (66.23)	86.66 (68.57)	89.25 (70.86)	89.99 (71.67)	92.96 (74.70)	93.70 (75.73)	94.07 (76.02)	90.04
FOC-18	100.00 (89.98)	100.00 (89.98)	100.00 (89.98)	100.00 (89.98)	100.00 (89.98)	100.00 (89.98)	100.00 (89.98)	100.00
FOC-21	87.40 (69.23)	88.88 (70.52)	90.74 (72.29)	94.07 (76.50)	94.07 (75.92)	94.44 (76.38)	100.00 (89.98)	92.80
FOC-24	88.14 (69.85)	90.00 (71.61)	90.07 (71.63)	92.22 (73.88)	93.33 (75.05)	93.70 (75.57)	94.07 (75.92)	91.74
FOC-27	73.33 (58.92)	76.29 (60.85)	80.00 (63.43)	82.22 (65.07)	90.74 (72.33)	93.70 (75.57)	94.07 (75.92)	84.33
FOC-29	65.18 (53.83)	70.36 (57.01)	74.81 (59.91)	79.25 (62.89)	82.59 (65.35)	94.80 (76.97)	91.48 (73.03)	79.78
FOC-30	87.40 (69.23)	90.74 (72.29)	92.96 (74.70)	93.33 (75.28)	93.70 (75.73)	94.44 (76.38)	100.00 (89.98)	93.22
FOC-32	78.14 (62.12)	81.11 (64.23)	82.96 (65.63)	86.66 (68.57)	88.14 (69.94)	90.37 (71.92)	93.33 (75.13)	85.81
FOC-35	77.03 (61.36)	80.74 (63.96)	86.66 (68.65)	89.23 (70.84)	90.74 (72.33)	94.07 (76.02)	95.55 (77.86)	87.72
FOC-36	87.03 (68.89)	89.25 (70.86)	91.85 (73.42)	92.59 (74.28)	93.70 (75.48)	9.07 (76.02)	94.44 (77.04)	91.84
FOC-39	64.44 (53.40)	67.03 (54.95)	69.25 (56.31)	72.59 (58.43)	76.29 (60.86)	82.58 (65.34)	89.99 (71.56)	74.59
FOC-41	76.29 (60.85)	79.25 (62.89)	82.96 (65.63)	86.29 (68.26)	89.22 (70.87)	90.74 (72.29)	92.22 (73.88)	85.28
FOC-42	63.70 (52.95)	67.40 (55.17)	71.48 (57.71)	77.03 (61.35)	81.48 (64.50)	85.92 (67.98)	90.74 (72.29)	76.82
FOC-44	85.55 (67.65)	88.88 (70.52)	90.74 (72.29)	91.85 (73.42)	94.07 (76.50)	95.55 (78.02)	100.00 (89.98)	92.37
FOC-47	77.03 (61.35)	79.62 (63.16)	82.96 (65.63)	85.18 (67.38)	90.36 (71.91)	89.62 (71.20)	91.85 (73.42)	85.23
Mean	79.96	82.19	84.93	87.35	89.87	92.43	94.90	87.23
S.E. ±	0.93	0.59	0.80	1.13	1.18	1.35	1.21	
C.D. (P=0.01)	3.44	2.18	2.96	4.19	4.37	5.00	4.48	

* - Mean of three replications - Figures in parenthesis are angular transformed values

increase in concentration of Carbendazim.

Perusal of results from Table 2, indicated that at lower concentration (1 μg/ml^{-1}) of Copper oxychloride the isolate FOC 24 exhibited maximum growth inhibition (18.88 %) and minimum growth inhibition (1.85 %) was observed in the isolate FOC 18. At 10 μg/ml^{-1}, maximum inhibition was observed in the isolate FOC 24 followed by other isolates FOC 32, 41 and 44. FOC 24 isolate showed maximum growth inhibition at 1 μg/ml^{-1} to 500 μg/ml than other isolates. At 500 μg/ml concentration, maximum growth inhibition was noticed in the isolates FOC 5 (52.22 %) and FOC 10 (42.96 %) and minimum growth inhibition was noticed in the isolates FOC 42 (11.85 %). At 1000 μg/ml^{-1} concentration, maximum growth inhibition was noticed in the isolate FOC 5 (68.14 %) followed by FOC 10 (54.07 %), FOC 14 (52.22 %), FOC 18 (52.96 %) and FOC 35 (52.96 %). The mean per cent growth inhibition among the isolates varied from 10.20 to 25.81 per cent. Least inhibition was noticed in the isolate FOC 27 and highest inhibition was noticed in the isolate FOC 5. Mean per cent growth inhibition among the isolates at different concentrations of Copper oxychloride varied from 6.85 to 40.15 per cent.

Perusal of results from Table 3, indicated that maximum per cent growth inhibition was recorded in the isolate FOC 39 (78.51 %) followed by isolate FOC 44 (72.22 %) and minimum per cent inhibition was recorded in the isolate FOC 10 (2.96 %) at 1 μg /ml^{-1} of Captan. At 10 μg/ml^{-1} concentration maximum growth inhibition was observed in the isolate FOC 32 (87.03 %) followed by isolate FOC 39 (81.48 %) and minimum growth inhibition was observed in the isolate FOC 18 (5.92%). The isolate FOC 32 (91.85 %) was highly sensitive at 25 μg/ml^{-1}. At 25 μg/ml^{-1}, minimum or least growth inhibition was observed in the isolate FOC 42 (9.62 %) which was highly insensitive. At 50 μg/ml^{-1} the isolate FOC 32 showed maximum inhibition of mycelial growth (92.59 %) and isolate FOC 42 showed minimum (11.11 %). Maximum inhibition was observed in FOC 32 at 100, 500 and 1000 μg/ml^{-1} concentration while minimum in

Table 2 : Per cent growth inhibition of FOC isolates with different concentrations of copper oxychloride

Isolate No.	*1 μg	*10μg	*25 μg	*50 μg	*100 μg	*500 μg	*1000 μg	Mean
FOC-5	8.14 (16.55)	8.88 (17.32)	11.11 (19.45)	14.81 (22.62)	17.40 (24.65)	52.22 (46.26)	68.14 (55.63)	25.81
FOC-10	7.03 (15.37)	7.40 (15.77)	7.77 (16.17)	10.74 (19.12)	12.96 (21.09)	42.96 (40.94)	54.07 (47.33)	20.41
FOC-12	4.81 (12.63)	7.03 (15.37)	9.25 (17.70)	8.14 (16.57)	10.71 (19.10)	18.88 (25.74)	45.55 (42.44)	14.91
FOC-14	2.96 (9.89)	4.81 (12.66)	6.29 (14.52)	8.14 (16.57)	8.88 (17.32)	22.96 (28.61)	52.22 (46.26)	15.18
FOC-16	2.59 (9.24)	6.29 (14.52)	8.51 (16.95)	10.33 (18.74)	12.96 (21.09)	21.48 (27.60)	42.96 (40.94)	15.01
FOC-18	1.85 (7.81)	4.44 (12.15)	6.29 (14.52)	7.40 (15.77)	10.74 (19.12)	35.18 (36.37)	52.96 (46.69)	16.98
FOC-21	9.62 (18.06)	10.00 (18.41)	12.96 (21.08)	12.96 (21.09)	14.81 (22.62)	21.85 (27.86)	48.51 (44.14)	18.67
FOC-24	18.88 (25.74)	20.37 (26.82)	21.11 (27.34)	22.96 (28.61)	24.81 (29.85)	27.40 (31.55)	30.74 (33.66)	23.75
FOC-27	3.33 (10.50)	5.92 (14.05)	7.03 (15.37)	10.37 (18.77)	10.37 (18.77)	13.70 (21.71)	20.74 (27.08)	10.20
FOC-29	5.18 (13.15)	7.03 (15.37)	9.25 (17.70)	12.59 (20.77)	15.18 (22.92)	20.74 (27.08)	38.51 (38.34)	15.49\
FOC-30	6.29 (14.52)	7.40 (15.77)	10.37 (18.77)	11.48 (19.79)	12.96 (21.08)	16.29 (23.79)	29.99 (33.19)	13.54
FOC-32	8.14 (16.55)	11.48 (19.79)	17.40 (24.64)	19.25 (26.01)	19.62 (26.28)	24.07 (29.32)	37.77 (37.91)	19.67
FOC-35	6.29 (14.52)	9.62 (18.06)	9.99 (18.41)	12.22 (20.44)	15.92 (23.48)	29.62 (22.95)	52.96 (46.69)	19.52
FOC-36	3.70 (11.05)	9.25 (17.70)	9.62 (18.06)	12.96 (21.08)	14.81 (22.66)	17.03 (24.36)	41.85 (40.30)	15.60
FOC-39	8.14 (16.57)	8.80 (17.24)	12.96 (21.08)	15.92 (23.50)	17.77 (24.90)	20.37 (26.82)	28.51 (32.26)	16.07
FOC-41	11.85 (20.12)	15.18 (22.92)	17.40 (24.64)	18.14 (25.20)	19.62 (26.29)	21.85 (27.86)	25.18 (30.10)	18.46
FOC-42	7.03 (15.37)	8.51 (16.95)	8.51 (16.95)	9.62 (18.06)	10.37 (18.78)	11.85 (20.12)	21.48 (27.60)	11.05
FOC-44	9.62 (18.06)	12.59 (20.77)	14.44 (22.32)	15.92 (23.50)	17.40 (24.62)	20.74 (27.08)	32.96 (35.02)	17.66
FOC-47	4.81 (12.66)	8.51 (16.95)	10.36 (18.76)	12.96 (21.08)	14.07 (22.01)	24.07 (29.36)	37.77 (37.91)	16.08
Mean	6.85	9.13	11.08	12.99	14.80	24.38	40.15	17.05
S.E. ±	0.34	0.36	0.39	0.44	0.64	0.65	0.61	----
C.D. (P=0.01)	1.26	1.33	1.44	1.63	2.37	2.41	2.26	---

* - Mean of three replications - Figures in parenthesis are angular transformed values

FOC 42 at above concentrations. This indicates that FOC 42 is resistant to Captan while FOC 32 and 39 is sensitive. The mean growth inhibition among the isolate was maximum in the isolate was maximum in the isolate FOC 39 (85.86 %) and minimum in the isolate FOC 42 (12.16 %).The mean growth inhibition among the isolates at different concentration varied from 18.18 to 53.46 per cent.

Perusal of results from Table 4, indicated that at lower concentration (1 μg/ml) of Thiram, the isolate FOC 5 (62.00 %) showed maximum growth inhibition, while the isolates FOC 44 and 47 showed no mycelial growth inhibition. At 10 μg/ml^{-1} FOC 5 showed maximum growth inhibition (63.00 %) and FOC 47 showed minimum growth (0.0%). At 25 μg/ml^{-1}, maximum growth inhibition was observed in the isolate FOC 5 (64.33 %) followed by isolate FOC 14 (63.66 %) and minimum growth inhibition was observed in the isolate FOC 47 (9.00 %). At 50 and 100 μg/ml^{-1} concentration of Thiram isolate FOC 5 showed maximum inhibition and FOC 47 showed minimum inhibition. At 500 μg/ml^{-1}, high growth inhibition was observed in the isolate FOC 12 (77.00 %) followed by isolates FOC 10 (76.00%), FOC-5 (73.66 %). Least growth inhibition was observed in the isolate FOC 44 (12.66%). At 1000 μg/ml, maximum growth inhibition was observed in the isolate FOC 5 (85.66 %) followed by isolate FOC 10 (82.00 %), FOC 14 (81.33 %) and FOC 12 (78.66 %) having more growth inhibition than other isolates. Based on mean per cent growth inhibition, the isolate FOC 5 was highly sensitive to Thiram while the isolates FOC 44 and 47 were least sensitive to the fungicide. Mean per cent growth inhibition among the isolates at different concentrations varied from 28.71 to 64.99 per cent.

Perusal of results from Table 5, indicated that at lower concentration 1 μg/ml^{-1} the isolate FOC 47 (65.92 %) showed maximum growth inhibition followed by isolate FOC 42 (52.59 %). Minimum growth inhibition was observed in the isolate FOC 18 (4.81 %). At 10 μg/ml^{-1}, the isolate FOC 47 (68.14 %) again showed

Table 3: Per cent growth inhibition of FOC isolates with different concentrations of Captan

Isolate No.	*1 μg	*10μg	*25 μg	*50 μg	*100 μg	*500 μg	*1000 μg	Mean
FOC-5	4.44 (12.15)	20.74 (27.08)	31.85 (34.35)	34.07 (35.68)	40.36 (39.43)	51.48 (45.84)	60.36 (50.97)	34.75
FOC-10	2.96 (9.89)	10.36 (18.76)	26.66 (31.08)	37.40 (37.69)	41.48 (40.08)	57.03 (49.03)	63.33 (52.73)	34.17
FOC-12	12.22 (20.44)	14.81 (22.62)	22.96 (28.61)	41.10 (39.86)	44.44 (41.80)	48.88 (44.35)	54.07 (47.33)	34.07
FOC-14	14.81 (22.60)	16.29 (23.79)	21.48 (27.60)	29.99 (33.19)	33.33 (35.24)	36.29 (37.03)	43.33 (41.15)	27.93
FOC-16	4.44 (12.15)	9.62 (18.06)	15.18 (22.92)	21.48 (27.60)	22.22 (28.10)	24.81 (30.28)	28.14 (32.03)	17.98
FOC-18	4.44 (12.15)	5.92 (14.07)	21.48 (27.60)	32.59 (34.80)	42.96 (40.94)	44.44 (41.79)	51.48 (45.84)	29.04
FOC-21	8.14 (16.57)	19.62 (26.28)	28.14 (32.03)	33.33 (35.24)	36.29 (37.03)	42.96 (40.94)	45.92 (42.65)	30.63
FOC-24	31.11 (33.89)	31.85 (34.35)	33.33 (35.24)	35.92 (36.81)	39.25 (38.78)	44.44 (41.79)	44.44 (41.80)	37.19
FOC-27	4.81 (12.63)	18.14 (25.20)	28.51 (32.26)	33.33 (35.24)	44.81 (42.39)	51.48 (45.84)	55.18 (47.96)	33.75
FOC-29	19.25 (26.02)	21.85 (27.86)	22.96 (28.61)	24.44 (29.61)	25.18 (30.11)	27.77 (31.78)	31.85 (34.35)	24.75
FOC-30	5.18 (13.15)	8.85 (17.29)	10.36 (18.76)	13.32 (21.39)	16.29 (23.79)	20.00 (26.55)	22.20 (28.09)	13.74
FOC-32	35.92 (36.81)	87.03 (68.89)	91.85 (72.72)	92.59 (74.28)	93.62 (75.47)	94.44 (76.38)	100 (89.98)	85.06
FOC-35	12.96 (21.08)	15.55 (23.21)	20.00 (26.55)	60.74 (51.19)	72.59 (58.43)	75.72 (60.55)	79.25 (63.25)	48.11
FOC-36	9.62 (18.06)	12.59 (20.77)	15.92 (23.50)	17.77 (24.92)	19.25 (26.01)	22.22 (28.10)	23.33 (28.84)	17.24
FOC-39	78.51 (62.37)	81.48 (64.50)	83.70 (66.23)	86.29 (68.26)	88.51 (70.22)	90.37 (72.32)	92.22 (73.88)	85.86
FOC-41	14.07 (22.01)	14.81 (22.62)	17.03 (24.36)	20.74 (27.07)	22.96 (28.61)	27.40 (31.55)	31.11 (33.89)	21.16
FOC-42	5.55 (13.61)	6.66 (14.94)	9.62 (18.06)	11.11 (19.45)	14.81 (22.62)	16.29 (23.79)	21.10 (27.32)	12.16
FOC-44	72.22 (58.19)	74.81 (59.91)	77.03 (61.35)	79.62 (63.19)	82.59 (65.35)	84.44 (66.87)	87.40 (69.36)	79.73
FOC-47	4.81 (12.63)	7.40 (15.77)	11.11 (19.45)	14.07 (22.01)	15.55 (23.19)	18.51 (25.47)	22.59 (28.36)	13.43
Mean	18.18	25.17	31.00	37.88	41.92	46.26	53.46	36.26
S.E. ±	0.46	0.54	0.57	0.80	0.76	1.14	1.19	---
C.D. (P=0.01)	1.70	2.00	2.11	2.96	2.81	4.22	4.41	---

* - Mean of three replications - Figures in parenthesis are angular transformed values

maximum growth inhibition followed by isolates FOC 30 (54.07 %), FOC 32 (54.07 %) and FOC 42 (54.81 %). And minimum growth inhibition was again observed in the isolate FOC 18 (9.36 %). Isolate FOC 47 showed maximum growth inhibition and isolate FOC 18 minimum growth inhibition again at 25 and 50 µg/ml^{-1} concentration of Propiconazole. At 100 µg/ml^{-1}, maximum growth inhibition and highly sensitive reaction was observed in the isolate FOC 42 (79.25 %) followed by isolate FOC 47 (76.29 %). Minimum growth inhibition was observed in the isolate FOC 44 (27.03 %) followed by isolate FOC 18 (29.99 %). Isolate FOC 42 (87.03 %) showed maximum growth inhibition followed by isolates FOC 29 (84.81 %), FOC 24 (82.22 %), FOC 47 (81.85 %) and FOC 36 (81.11 %). Minimum growth inhibition was observed in the isolate FOC 35 (40.36 %). At 1000 µg/ml^{-1}, highest growth inhibition was observed in the isolates FOC 20, 36 and 42 (100%) which were highly sensitive. The minimum growth inhibition was observed in the isolate FOC 35 (52.59%). Maximum growth inhibition was observed in the isolate FOC 47 (75.02%) which was highly sensitive and FOC 18 which was least sensitive to the fungicide. Mean per cent growth inhibition, of all the isolates at different concentration varied from 28.33 to 80.24 per cent.

Thus, it was concluded that Carbendazim was best fungicide for inhibiting the growth of the *Fusarium oxysporum* f. sp. *carthami*. It was followed by Propiconazole, Thiram, Captan and Copper oxychloride. The results are in agreement with Desai (1986) .Further, Mehetre (1988) reported control of *Fusarium oxysporum* f.sp. *carthami* in safflower with Thiram 75 WP. Kapoor and Kumar (1991) found Carbendazim to be most toxic to *Fusarium oxysporum*. Hyas *et al.* (1992) found that Tilt (Propiconazole) to be most effective in controlling *Fusarium oxysporum* f. sp. *carthami*.

Table 4 : Per cent growth inhibition of FOC isolates with different concentrations of Thiram

Isolate No.	*1 µg	*10µg	*25 µg	*50 µg	*100 µg	*500 µg	*1000 µg	Mean
FOC-5	62.00 (51.94)	63.00 (52.53)	64.33 (53.34)	69.33 (56.36)	72.66 (58.47)	73.66 (59.13)	85.66 (67.94)	70.09
FOC-10	46.67 (43.07)	48.00 (43.84)	58.66 (49.98)	63.33 (52.73)	68.33 (55.86)	76.00 (60.67)	82.00 (64.90)	63.28
FOC-12	30.66 (33.61)	42.66 (40.77)	60.66 (51.15)	62.66 (52.33)	71.66 (57.83)	77.00 (61.51)	78.66 (62.51)	60.57
FOC-14	57.66 (49.43)	62.33 (52.13)	63.66 (52.93)	64.66 (53.53)	70.33 (56.99)	72.66 (58.47)	81.33 (64.39)	67.52
FOC-16	41.33 (40.01)	42.33 (40.58)	52.33 (46.33)	57.33 (49.21)	68.33 (55.76)	72.66 (58.47)	73.33 (58.92)	58.23
FOC-18	28.66 (32.34)	40.66 (39.61)	52.33 (46.33)	53.00 (46.71)	60.66 (55.15)	68.33 (55.76)	72.66 (58.47)	53.76
FOC-21	39.66 (39.01)	48.66 (44.22)	50.66 (45.37)	58.66 (49.98)	63.00 (52.53)	69.33 (56.39)	75.33 (60.22)	57.90
FOC-24	38.33 (38.23)	38.33 (40.13)	51.33 (45.75)	62.66 (52.33)	71.33 (57.61)	71.33 (57.62)	71.66 .(57.83)	57.85
FOC-27	26.66 (31.08)	49.66 (44.79)	50.66 (45.37)	57.66 (49.40)	60.66 (51.15)	67.33 (55.13)	71.33 (57.62)	54.85
FOC-29	31.33 (34.03)	36.00 (36.85)	40.66 (39.60)	40.66 (39.61)	43.66 (41.34)	62.00 (51.94)	67.33 (55.13)	45.95
FOC-30	24.66 (29.75)	30.66 (33.61)	43.00 (40.96)	45.33 (42.31)	58.66 (49.98)	68.66 (55.96)	69.00 (56.18)	48.57
FOC-32	34.33 (35.86)	38.66 (38.40)	41.33 (40.00)	43.33 (41.15)	52.33 (46.33)	52.33 (46.33)	63.00 (52.53)	45.61
FOC-35	25.66 (30.42)	26.66 (31.07)	28.66 (32.35)	30.66 (33.61)	4866 (44.22)	51.33 (45.75)	59.66 (50.57)	38.76
FOC-36	18.66 (25.58)	21.33 (27.49)	28.66 (32.34)	31.33 (34.03)	49.00 (44.43)	56.66 (48.84)	65.66 (54.13)	38.7
FOC-39	13.66 (21.67)	16.00 (23.56)	23.66 (29.07)	32.66 (34.84)	41.33 (40.00)	43.66 (41.34)	49.33 (44.61)	31.47
FOC-41	11.66 (19.95)	17.00 (24.34)	17.33 (24.57)	20.00 (26.54)	39.00 (38.63)	46.00 (42.70)	53.66 (47.09)	29.23
FOC-42	14.00 (21.83)	16.33 (23.82)	19.33 (26.06)	21.33 (27.49)	29.33 (32.76)	31.33 (34.03)	41.33 (40.00)	24.71
FOC-44	0.00 (0.00)	6.66 (14.92)	10.00 (18.41)	11.00 (19.35)	12.66 (20.83)	12.66 (20.80)	31.33 (34.03)	12.04
FOC-47	0.00 (0.00)	0.00 (0.00)	9.00 (17.45)	22.66 (28.41)	33.00 (35.04)	30.66 (33.60)	42.66 .(40.77)	19.71
Mean	28.71	33.94	40.32	44.64	53.39	58.08	64.99	46.29
S.E. ±	1.04	1.05	0.81	0.75	1.04	1.13	1.04	
C.D. (P=0.01)	3.85	3.89	3.00	2.78	3.85	4.19	3.85	

* - Mean of three replications - Figures in parenthesis are angular transformed values

Table 5 : Per cent growth inhibition of FOC isolates with different concentrations of Propiconazole

Isolate No.	*1 µg	*10µg	*25 µg	*50 µg	*100 µg	*500 µg	*1000 µg	Mean
FOC-5	29.99 (33.03)	32.59 (34.80)	41.11 (39.87)	43.70 (41.37)	52.22 (46.26)	65.18 (53.83)	76.29 (60.86)	48.72
FOC-10	28.51 (32.24)	30.37 (33.42)	32.59 (34.80)	35.92 (36.81)	41.83 (40.29)	45.55 (42.44)	65.18 (53.85)	39.99
FOC-12	31.11 (33.89)	35.92 (36.81)	41.85 (40.30)	44.81 (41.62)	51.85 (46.05)	68.14 (55.63)	84.44 (66.87)	51.16
FOC-14	18.14 (25.18)	21.85 (27.86)	24.07 (29.36)	25.18 (30.10)	54.07 (47.33)	63.70 (52.95)	78.51 (62.41)	40.79
FOC-16	22.96 (28.61)	28.14 (32.02)	30.74 (33.66)	32.59 (34.80)	41.83 (40.29)	51.48 (45.84)	67.40 (55.18)	39.30
FOC-18	4.81 (12.63)	9.36 (17.81)	16.29 (23.79)	20.74 (27.08)	29.99 (33.19)	45.18 (42.22)	85.92 (67.98)	30.32
FOC-21	19.25 (26.00)	29.25 (32.72)	34.81 .(36.14)	51.48 (45.84)	61.85 (51.84)	73.70 (59.16)	88.88 (70.56)	51.31
FOC-24	24.07 (29.32)	30.74 (33.66)	43.70 (41.37)	54.81 (47.76)	63.70 (52.95)	82.22 (65.07)	92.59 (74.28)	55.97
FOC-27	8.88 (17.25)	19.25 (26.01)	22.96 (28.61)	31.11 (33.89)	45.92 (42.65)	54.07 (47.33)	65.18 (53.83)	35.34
FOC-29	29.62 (32.93)	36.29 (37.02)	45.92 (42.64)	54.81 (47.76)	71.48 (57.71)	84.81 (67.17)	100.00 (89.98)	60.41
FOC-30	48.14 (43.92)	54.07 (47.33)	55.92 (48.39)	59.99 (50.76)	68.14 (55.64)	77.77 (61.87)	85.92 (67.96)	64.28
FOC-32	46.66 (43.07)	54.07 (47.33)	57.40 (49.25)	65.18 (53.83)	70.36 (57.01)	80.74 (64.00)	87.77 (69.53)	66.02
FOC-35	25.55 (30.34)	19.25 (25.97)	20.74 (27.08)	25.18 (30.10)	33.70 (35.46)	40.36 (39.43)	52.59 (46.47)	31.05
FOC-36	34.74 (36.08)	41.85 (40.30)	42.96 (40.94)	49.62 (44.77)	65.92 (54.29)	81.11 (64.23)	100.00 (89.98)	59.45
FOC-39	20.37 (26.78)	24.07 (29.36)	30.36 (33.42)	34.81 (36.15)	42.96 (40.94)	48.88 (44.35)	63.33 (52.73)	37.82
FOC-41	14.44 (22.32)	19.99 (26.55)	20.37 (26.82)	23.33 (28.84)	37.03 (37.47)	56.66 (48.82)	74.81 (59.89)	35.23
FOC-42	52.59 (46.47)	54.81 (47.75)	57.40 (49.45)	65.92 (54.28)	79.25 (62.91)	87.03 (68.92)	100.00 (89.98)	71.00
FOC-44	12.59 (20.74)	19.25 (26.00)	20.74 (27.08)	23.70 (29.11)	27.03 (31.31)	54.07 (47.33)	65.92 (54.28)	31.90
FOC-47	65.92 (54.28)	68.14 (55.64)	70.37 (57.02)	72.59 (58.43)	76.29 (60.88)	81.85 (64.78)	89.99 (71.60)	75.02
Mean	28.33	33.11	37.38	42.91	53.44	65.39	80.24	48.68
S.E. ±	1.19	0.83	0.74	0.84	0.79	0.89	0.97	---
C.D. (P=0.01)	4.41	3.07	2.74	3.11	2.93	3.30	3.59	---

* - Mean of three replications - Figures in parenthesis are angular transformed values

Plate 1a : Effect of different concentrations of carbendazim against mycelial growth of isolate FOC- 18

Plate 1b : Effect of different concentrations of copper oxychloride against mycelial growth of isolate FOC- 27

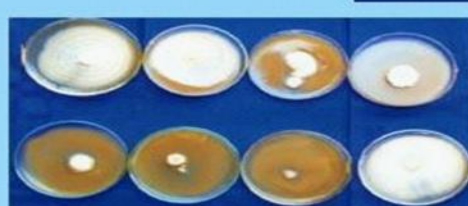

Plate 1c : Effect of different concentrations of capatan against mycelial growth of isolate FOC- 32

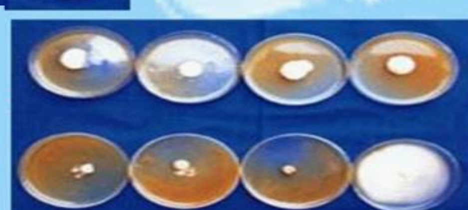

Plate 1d : Effect of different concentrations of thiram against mycelial growth of isolate FOC- 05

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