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SHORT COMMUNICATION

Efficacy of fungicides on inhibition of mycelial growth of *Alternaria solani*, the incitant of Early blight disease of Tomato

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Alternaria solani (Ellis and Martin) Jones and Grouse is a destructive pathogen causing considerable loss in yield in all the tomato growing areas of Odisha. The efficacy of fifteen fungicides at concentration of 0.05%, 0.10%, 0.15%, 0.25% and 0.30% were tried *in vitro* to assess the growth inhibition of the test fungus. Out of the fifteen fungicides tested, sixer (Mancozeb + Carbendazim) 0.2% and score (Difenoconazole) at 0.05% inhibited the mycelia growth by 95%. At 0.10%, Bavistin (Carbendazim) and at 0.15% Ridomil MZ (Metalaxyl + Mancozeb), Bravo (Chlorothalonil) at 0.2% and Topsin-M (Thiophante methyl) 0.15% recorded 85% growth inhibition of the test fungus. At 0.3% all most all chemicals were found effective in inhibiting the mycelial growth except Cursor (Flusilazole) which had only 58.2% inhibition. Hence, the fungicides such as score (0.15%), Bavistin (0.15%), Sixer (0.2%), Bravo (0.2%), Ridomil MZ (0.2%) and Topsin-M (0.15%) were most efficacious in inhibiting the growth of *A. solani*.

Key words: Early blight, tomato, fungicides, efficacy

The estimated area and production of tomato in India are about 3,50,000 ha and 53,00,000 tons respectively. About 200 diseases have been reported on Tomato. Among these, Early blight (*Alternaria solani*), Late blight (*Phytophthora infestans*), Bacterial Wilt and Brown rot (*Ralstonia solanacearum*) and Leaf curl complex are most common and serious diseases of Tomato worldwide including India.

Early blight caused by *Alternaria solani* is a major production constraint in Tomato wherever the crop is grown. In India the disease occurs in all parts of the country which causes major loss in fruit yield as high as 86% yield loss has been reported (50-86%) in tomato (Mathur and Sekhawat, 1986). In Odisha the disease occurs in severe form and suit-

ability and efficacy of chemicals particularly new generation fungicides are yet to be tried.

Spraying of broad spectrum fungicides like Mancozeb and Captan have been recommended for the control of Early blight of Tomato while the number of applications of these chemicals are more, they are less persistent on the foliage. Thus the efficacy of these chemicals with respect to disease control was found to be inadequate. One of the reasons attributed to the low sensitivity of *A. solani* to fungicides is the production of dark brown to black pigment called melanin by the pathogen which enhanced the survival and competitive abilities of the fungus under certain environmental conditions. Therefore, in the present investigation, the efficacy of fifteen numbers of chemicals including some new generation fungicides against the test pathogen *A. solani* was tested *in vitro*.

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Table 1 : Formulations of different fungicides used along with their commercial name, chemical name and active ingredients

Commercial name	Chemical name	Active ingredient	Formulation
Sixer	Mancozeb + Carbendazim	1, 2 - [Ethazole-diylbis (carbamodithio) (2 -)] Manganese Zinc salt & Methyl 1H-benzimidazole-2-yl carbamate	Mancozeb 63% WP + Carbendazim 12% WP
Hi-dice	Copper hydroxide	Copper hydroxide	77%WP
Bavistin	Carbendazim	2-(methoxy-carbamyl) benzimidazole	50%WP
Bravo	Chlorothalonil	Tetrachloro isophthalonitrile	75% WP
Score	Difencconazole	cis, trans-3-chloro - 4 - {4 methyl - 2 - (1H-1, 2, 4-triazol - 1 -yl)methyl) - 1, 3-dioxolan - 2 - yl} Phenyl 4-chlorophenyl ether	10%WP
Ridomil-MZ	Metalaxyl + Mancozeb	DL-N-(26-dimethyl phenyl) - N - (2, methoxy acetyl) - alanitrate + ethylene bisdithiocarbamate	72%WP
Tilt	Propiconazole	1 - [[2(2,4-Dichlorophenyl) - 4-propyl - 1, 3 dioxolan - 2-yl) methyl] 1-H-1, 2, 4 - triazole	25% EC
Contaf	Hexaconazole	2-(2,4-dichlorophenyl)-1- (1H01, 2, 4-triazol - 1 - yl) hexan-2 - 01	5% SC
Topas	Penconazole	1-(2, 4-dichloro-b-propylphenethyl) - 1H-1, 2 - 4 - triazole	87% WP
Topsin-M	Thiophanate methyl	1, 2-Bis (methoxy carbonyl thioureido) benzene	50% WP
Antracol	Propineb	Polymeric ainc propylenesis (dithiocarbamate)	75% WP
Indofil M 45	Mancozeb	Manganese ethylene bis-dithio carbamate + Zn ⁺⁺	75% WP
Cursor	Flusilazole	Bis (4 - fluorophenyl) (methyl) (1H -1, 2, 4 -triazol - 1 - yl methyl) silane	40% EC
Qurate gold	Cymoxanil + Mancozeb	1-(2-cyano-2- methoxy iminoacetyl) - 3 - ethylurea	Cymoxanil 8% WP+ Mancozeb 64% WP
Vitavax power	Carboxin+ Thiram	5, 6-dihydro - 2 - methyl - 1, 4-Oxathin - 3 - carboxamide	75% WP

Figures in parentheses are angular transformed values and statistics applied to them

Fifteen different fungicides such as Sixer, Hi-dice, Bavistin, Dhanucop, Bravo, Score, Ridomil-MZ, Tilt, Contaf, Topas, Topsin M, Antracol, Indofil M-45, Cursor and Curate gold were tried in six different concentrations of 0.05, 0.10, 0.15, 0.20, 0.25 and 0.30% in order to find out the efficacy of these chemicals against *A. solani* by the poisoned food technique (Nene and Thapliyal, 1979). The experiment was conducted by agar disc method. The required concentrations of chemicals were prepared and incorporated into sterilized cooled PDA medium. Twenty ml. of medium was poured into 90mm. sterilized petriplates and all plates were inoculated with actively growing 5mm. mycelia disc of test fungus. All the petriplates were incubated at 28±1°C for 8 days. Each treatment was replicated thrice. A control plate without fungicide was maintained. The activity was measured in terms of inhibitory zone of *A. solani* in each concentration of individual fungicide and compared with control checks. The per cent inhibition of mycelial growth

under each concentration of fungicide was worked out by using the following formulae :

$$I = \frac{dc-dt}{dc} \times 100$$

where I = Inhibition per cent of diameter growth
dc = diameter growth of fungal colony in control
dt = diameter growth of fungal colony in treatment

The commercial name, active ingredient and formulation of different fungicides used in the present investigation are given in Table 1.

The efficacy of 15 numbers of fungicides on the inhibition of mycelial growth of *A. solani* is presented in the Table 2 and Fig. 1. It may be seen from the Table 2 and Fig. 1 that Sixer, Bavistin, Score, Ridomil MZ and Topsin-M performed significantly with respect to inhibition of the mycelial growth of *A. solani* in different concentrations. At 0.05% concentration Sixer and Score recorded in-

Table 2 : Inhibition of mycelial growth by fungicides in different concentrations

Fungicides	0.05%	0.10%	0.15%	0.20%	0.25%	0.30%
Sixer (Mancozeb 65% + Carbendazim 8%)	86.3 (68.32)	92.5 (74.13)	98.6 (82.71)	100 (90.0)	100 (90.0)	100 (90.0)
Hi-dice (Copper hydroxide)	42.5 (40.68)	56.8 (48.71)	72.4 (58.31)	85.8 (67.90)	92.3 (73.99)	100 (90.0)
Bavistin (Carbendazim)	68.2 (55.56)	86.5 (68.47)	92.4 (74.09)	99.0 (84.51)	100 (90.0)	100 (90.0)
Dhanucop (Copper oxychloride)	48.4 (44.08)	62.3 (52.12)	79.8 (63.30)	90.0 (70.06)	99.4 (85.73)	100 (90.0)
Bravo (Chlorothalonil)	60.2 (50.89)	71.5 (57.62)	86.4 (68.42)	98.6 (80.89)	100 (90.0)	100 (90.0)
Score (Difenconazole)	98.1 (82.36)	99.4 (86.38)	100 (90.0)	100 (90.0)	100 (90.0)	100 (90.0)
Ridomil MZ (Metalaxyl 8% + Mancozeb64%)	68.2 (55.68)	79.4 (63.01)	90.2 (71.89)	99.1 (85.03)	100 (90.0)	100 (90.0)
Tilt (Propiconazole)	24.3 (29.52)	36.8 (37.35)	48.2 (43.97)	60.1 (50.83)	70.8 (57.31)	82.8 (65.54)
Contaf (Hexaconazole)	38.5 (38.35)	46.3 (42.88)	52.8 (46.61)	68.4 (55.80)	78.9 (62.68)	90.1 (71.73)
Topas (Penconazole)	38.4 (38.29)	42.8 (40.86)	60.1 (50.83)	78.4 (62.31)	82.3 (65.15)	94.3 (76.29)
Topsin M (Thiophanate methyl)	64.5 (53.44)	72.8 (58.57)	94.6 (79.32)	99.5 (86.07)	100 (90.0)	100 (90.0)
Antracol (Propineb)	46.5 (42.99)	52.8 (46.61)	74.5 (59.68)	86.2 (68.21)	98.8 (84.08)	100 (90.0)
Indofil M-45 (Mancozeb)	28.2 (32.06)	46.6 (43.05)	62.8 (52.43)	78.4 (62.31)	91.2 (72.79)	100 (90.0)
Cursor (Flusilazole)	24.8 (29.86)	32.5 (34.75)	39.4 (38.88)	46.2 (42.82)	51.5 (45.86)	58.2 (49.72)
Curate gold (Cymoxanil 8% + Mancozeb 64% wp)	29.3 (32.77)	46.5 (42.99)	64.8 (53.62)	84.2 (66.60)	90.0 (84.38)	100 (90.0)
SE(m) ±	(0.45)	(0.55)	(0.61)	(1.05)	(0.57)	(0.53)
CD (0.05)	(1.30)	(1.59)	(1.75)	(3.05)	(1.64)	(1.54)
CV%	(1.68)	(1.79)	(1.68)	(2.57)	(1.26)	(1.10)

Figures in parentheses are angular transformed values and statistics applied to them

inhibition by more than 85%. But at 0.10%, reduction in mycelial growth was prominent in Sixer, Bavistin and Score. Ridomil MZ, Bravo and Topsin M registered more than 85% of growth inhibition at 0.15% concentration. At 0.30% all most all

chemicals were found effective in inhibiting fungal growth except Cursor which had only 58.2% inhibition. As Score totally inhibited mycelial growth at 0.15% onwards, Sixer at 0.20%, Bavistin (0.15%), Bravo (0.2%), Ridomil MZ (0.2%) and Topsin M

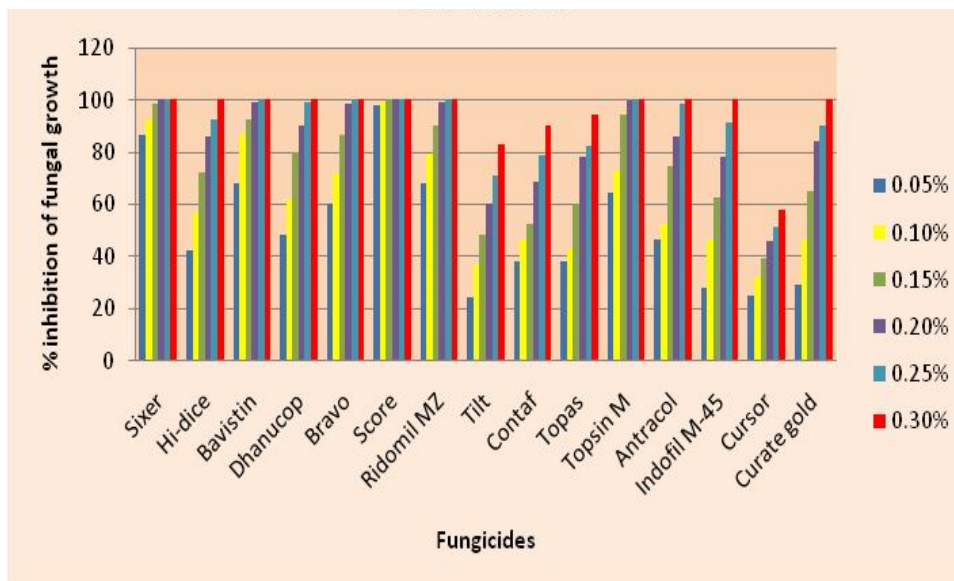


Fig. 1 : Inhibition of mycelial growth by fungicides in different concentrations

(0.15%), these fungicides were found to be most efficacious against the test fungus as evident from the laboratory test.

Evaluation of fungicides *in vitro* is a handy tool to screen large number of chemicals. In the present study, it was revealed that contact fungicides like Copper oxychloride, Copper hydroxide, Mancozeb and Chlorothalonil were found to be highly effective in inhibiting the growth of *A. solani*. Among systemic fungicides, Carbendazim, Difenconazole, Metalaxyl MZ and Thiophanate methyl, were found to be highly effective in inhibiting the growth of *A. solani*. The efficacy of systemic chemical Difenconazole against *A. solani* even at a minimum concentration of 250 ppm, non systemic chemical Mancozeb at 1000 ppm and combination of systemic and non systemic chemical i.e. Metalaxyl + Mancozeb at 1000 ppm were found efficacious

against *A. solani* as reported by Patel and Choudhury (2010) which is in agreement with the present finding. In laboratory study, Osowski (2003) reported, there was 91.66% mycelial growth inhibition by Saaf and Mancozeb which also supports the present finding. However, Propiconazole, Penconazole and Flusilazole were not so effective in the present investigation against *A. solani*.

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