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Differential Sensitivity of *Colletotrichum capsici (Syd.) Butler& Bisby* isolates to mancozeb

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ABSTRACT

Twenty-one isolates (Cc_1 to Cc_{21}) of *Colletotrichum capsici* (Syd.) Butler & Bisby collected from three different locations each in seven major chilli growing districts of Andhra Pradesh were characterized for their sensitivity to the mancozeb. The isolates obtained from various localities differed significantly in their sensitivities towards this fungicide. The mycelial growth of Cc_9 was inhibited by 72.08 per cent at 1 mg / ml while that of Cc_6 and Cc_{17} was inhibited least (4.05 % and 6.52 %) at this concentration. At 10mg / ml of mancozeb, Cc_9 was inhibited more (87.08) whereas the isolates Cc_6 and Cc_{17} gave least inhibition (12.61 and 12.23 respectively) of mycelial growth. Complete growth inhibition of Cc_9 of isolate was observed at 25mg / ml concentration at which the isolates Cc_6 and Cc_{17} gave only 31.08 and 30.16 per cent growth inhibition respectively. At 50 and 100 mg / ml concentrations minimum growth inhibition was noticed in the isolate Cc_{20} (30.83 and 32.91 respectively). The rate at which the mycelial growth inhibition occurs across the concentrations was less in Cc_4 and Cc_5 isolates. Except the isolates $Cc_{17,}$ Cc_{20} and Cc_{21} all the other isolates showed 100 per cent growth inhibition at 500mg / ml while Cc_{17} was inhibited to an extent of 55.91 per cent even at 1000mg / ml of mancozeb concentration.

Key words : Chilli, *Colletotrichum capsici*, die-back, Fruit rot, Fungicide sensitivity.

Chilli (*Capsicum annuum* L.) is one of the important cash crops among the spices and it is mainly used for culinary purpose to impart flavour, colour, vitamins and pungency. India is the largest exporter of chilli with an area of 8.16-9.08 lakh hectares and a production of 6.18-9.70 lakh tons of dry chilli annually. Andhra Pradesh has been leading state both in area and production contributing 25 per cent to the total area and 40-50 per cent total production of India followed by Karnataka, Maharashtra and Orissa (Vikas Singhal, 2003). Warangal, Guntur, Khammam, Prakasam, Ranga Reddy, Karimnagar and Nizamabad districts of Andhra Pradesh constitute 62 % of the chilli growing area in AP. Among the various biotic stresses causing quality deterioration and yield reduction, die-back and fruit rot caused by *Colletotrichum capsici* (Syd.) Butler & Bisby is the most serious disease of national importance as it affects the crop during early stage and continues till harvest and causes necrosis of tender branches and rotting of ripe fruits. The disease is occurring every year with varying intensities in these areas even if the cultivar grown is same indicating the emergence of new pathotypes in this pathogen. It was indeed the Andhra Pradesh growers' observation of gradual loss of efficacy of mancozeb against this pathogen. Keeping this in view, the present study was undertaken with 21 isolates of the pathogen to study their sensitivity against the aforesaid fungicide under *in vitro* conditions.

MATERIAL AND METHODS

Chilli isolates of die-back and fruit rot pathogen were collected during survey in the year 2005 from seven major chilli-growing districts of Andhra Pradesh. Three isolates were collected from each of the seven major chilli growing districts (Warangal, Guntur, Khammam, Prakasam, Ranga Reddy, Karimnagar and Nizamabad) of A.P and were designated with Cc numbers from Cc_1 to Cc_{21} (Table 1). The isolates were purified by single spore isolation method (Dhingra and Sinclair, 1993) and were maintained on Potato Dextrose Agar (PDA) medium. Pathogenicity of different chilli isolates of *C. capsici* was proved by spray inoculation on detached ripe fruits of susceptible chilli cultivar, Sindhur at concentrations of 4.5×10^5 conidia/ml (Bhale *et al*., 1999). Poisoned food technique was adopted to determine the sensitivity of the isolates of *C. capsici* to mancozeb at 1, 10, 25, 50, 100, 500 and 1000 Mg / ml concentrations on active ingredient basis. Three replications were maintained in respect of each isolate and each concentration. Controls were maintained by placing the five mm discs of all the isolates in the center of the non-poisoned PDA medium. The plates were incubated at 28±1 °C for 10 days. The diameter of the colony was measured in each of the treatment. Per cent growth inhibition

Table 1. Details of *Colletotrichum capsici* isolates collected from major chilli growing districts of Andhra Pradesh

Isolate Designation	District	Place of collection	Variety / Cultivar	Source of diseased sample	Per cent disease incidence
Cc_1	Warangal	Mohemmadgouse Palli	Wonder hot	Fruit	79
Cc_2	Warangal	Relakunta	Agnirekha	Fruit	74
Cc_3	Warangal	Nandigama	Red sun	Fruit	78
Cc_4	Guntur	Lam, Guntur	LCA-345	Fruit	28
Cc_5	Guntur	Rompicherla	Ankur	Twig	18
Cc_6	Guntur	Piduguralla	X 235	Fruit	29
Cc_7	Khammam	Ponnekallu	Jwala	Twig	17
Cc_8	Khammam	Ramakrishnapuram	X 235	Fruit	24
Cc_9	Khammam	Mallavaram	Selection1	Twig	30
Cc_{10}	Prakasam	Konanki	Tejaswini	Fruit	11
Cc_{11}	Prakasam	Kollapudi	G3	Fruit	13
Cc_{12}	Prakasam	Chandrapadu	Ankur	Fruit	19
Cc_{13}	Ranga Reddy	Pedaummental	Jwala	Twig	21
Cc_{14}	Ranga Reddy	ARI, Rajendranagar	Jwala	Twig	12
Cc_{15}	Ranga Reddy	Parigi	Jwala	Twig	12
Cc_{16}	Karimnagar	Huzurabad	Ankur	Fruit	37
Cc_{17}	Karimnagar	Manakondur	Wonder hot	Fruit	43
Cc_{18}	Karimnagar	Jagitial	Sindhur	Fruit	52
Cc_{19}	Nizamabad	Armur	LCA 334	Fruit	21
Cc_{20}	Nizamabad	Ankapur	Sindhur	Fruit	13
Cc_{21}	Nizamabad	Banswada	Roshini	Fruit	18

was calculated in each treatment in comparison with control plates (Vincent, 1969).

% Inhibition = ({ Mean growth in control – Mean growth in treatment} X 100)
/ Mean growth in control

RESULTS AND DISCUSSION

The sensitivity of the isolates to different concentrations of mancozeb differed significantly. The mycelial growth of Cc_9 was inhibited by 72.08 per cent at 1 Mg / ml while that of Cc_6 and Cc_{17} was inhibited least (4.05 % and 6.52 %) at this concentration. At 10 Mg / ml of mancozeb, Cc_9 was inhibited more (87.08) whereas the isolates Cc_6 and Cc_{17} gave least inhibition (12.61 and 12.23 respectively) of mycelial growth at this concentration. Complete growth inhibition of Cc_9 of isolate was observed at 25 Mg / ml concentration at which the isolates Cc_6 and Cc_{17} gave only 31.08 and 30.16 per cent growth inhibition respectively. At 50 and 100 Mg / ml concentrations minimum growth inhibition was noticed in the isolate Cc_{20} (30.83 and 32.91 respectively). The rate at which the mycelial growth inhibition occurs across the concentrations was less in Cc_4 and Cc_5 isolates. Except the isolates $Cc_{17,}$ Cc_{20} and Cc_{21} all the other isolates showed 100 per cent growth inhibition at 500 Mg / ml while Cc_{17} was inhibited to an extent of 55.91 per cent even at 1000 Mg / ml of mancozeb concentration (Plates 1 & 2).

Several plant pathogens including the species of *Colletotrichum* have developed resistance/ tolerance to fungicides under varied conditions due to the continuous and wide spread use of fungicides for the control of plant diseases caused by them. Monitoring pathogen populations for fungicide sensitivity over time is a good way to determine if resistance is developing (Franke *et al*., 1998). Sensitivity monitoring needs screening a large number of isolates collected from several locations on a wide range of fungicide concentrations. Resistance to mancozeb was observed in chilli fruit rot fungus, *C. capsici* when transferred from lower concentrations to higher doses of the fungicide (Thind and Jhooty, 1980). Differential sensitivity to

Table 2. Per cent growth inhibition of *Colletotrichum capsici* isolates by mancozeb in *invitro*

Isolate	Concentration (μg ml^{-1})						
	1	10	25	50	100	500	1000
Cc_1	28.88*	29.77	41.33	41.33	49.33	100.00	100.00
	(32.51)	(33.07)	(40.00)	(40.00)	(44.61)	(90.00)	(90.00)
Cc_2	38.83	43.79	43.79	41.79	47.10	100.00	100.00
	(38.54)	(41.43)	(41.43)	(41.43)	(43.33)	(90.00)	(90.00)
Cc_3	23.38	27.00	31.84	31.84	100.00	100.00	100.00
	(28.90)	(31.31)	(34.35)	(34.32)	(90.00)	(90.00)	(90.00)
Cc_4	30.37	31.64	36.28	36.28	54.07	100.00	100.00
	(33.43)	(34.23)	(37.03)	(37.04)	(47.30)	(90.00)	(90.00)
Cc_5	39.83	41.46	43.90	44.31	58.54	100.00	100.00
	(9.12)	(40.08)	(41.49)	(41.73)	(49.91)	(90.00)	(90.00)
Cc_6	4.05	12.61	31.08	32.43	39.64	100.00	100.00
	(11.50)	(20.79)	(33.87)	(34.71)	(39.02)	(90.00)	(90.00)
Cc_7	37.03	48.89	51.10	77.97	85.02	100.00	100.00
	(37.45)	(44.36)	(45.63)	(62.00)	(67.23)	(90.00)	(90.00)
Cc_8	45.08	53.56	53.56	53.56	65.61	100.00	100.00
	(42.17)	(47.04)	(47.04)	(47.04)	(54.10)	(90.00)	(90.00)
Cc_9	72.08	87.08	100.00	100.00	100.00	100.00	100.00
	(58.10)	(68.94)	(90.00)	(90.00)	(90.00)	(90.00)	(90.00)
Cc_{10}	50.88	70.97	73.21	75.26	91.51	100.00	100.00
	(45.50)	(57.41)	(58.82)	(61.07)	(73.07)	(90.00)	(90.00)
Cc_{11}	41.80	43.52	47.41	47.84	51.92	100.00	100.00
	(40.28)	(41.27)	(43.51)	(43.76)	(46.10)	(90.00)	(90.00)
Cc_{12}	43.47	52.71	69.02	74.45	76.62	100.00	100.00
	(41.24)	(46.55)	(56.18)	(59.64)	(61.10)	(90.00)	(90.00)
Cc_{13}	32.53	45.23	47.62	65.08	73.01	100.00	100.00
	(34.76)	(42.26)	(43.63)	(53.77)	(58.70)	(90.00)	(90.00)
Cc_{14}	28.62	52.15	58.82	60.00	83.13	100.00	100.00
	(32.34)	(46.23)	(50.08)	(50.77)	(65.76)	(90.00)	(90.00)
Cc_{15}	14.34	30.80	59.91	62.44	67.93	100.00	100.00
	(22.25)	(33.69)	(50.71)	(52.22)	(55.51)	(90.00)	(90.00)
Cc_{16}	22.52	31.22	40.70	73.51	76.67	100.00	100.00
	(28.30)	(12.23)	(39.64)	(59.04)	(61.13)	(90.00)	(90.00)
Cc_{17}	6.52	12.23	30.16	33.05	35.91	46.11	55.91
	(14.49)	(20.40)	(33.31)	(35.09)	(36.81)	(42.77)	(48.40)
Cc_{18}	16.07	22.35	31.36	30.97	53.33	100.00	100.00
	(23.62)	(28.21)	(34.05)	(33.81)	(46.91)	(90.00)	(90.00)
Cc_{19}	60.00	72.91	78.75	79.58	82.91	100.00	100.00
	(50.77)	(58.64)	(62.55)	(63.15)	(65.63)	(90.00)	(90.00)
Cc_{20}	19.16	23.33	27.50	30.83	32.91	50.41	100.00
	(25.88)	(28.87)	(31.62)	(33.72)	(35.01)	(45.23)	(90.00)
Cc_{21}	42.91	46.66	61.25	63.33	76.25	81.66	100.00
	(40.92)	(43.08)	(51.50)	(52.73)	(60.83)	(64.65)	(90.00)

	Conc.	Isolates	Interaction
S.Em ±	0.18	0.31	0.82
CD(0.01)	0.50	0.86	2.29
CV	2.25		

* Figures in parenthesis are angular transformed values.

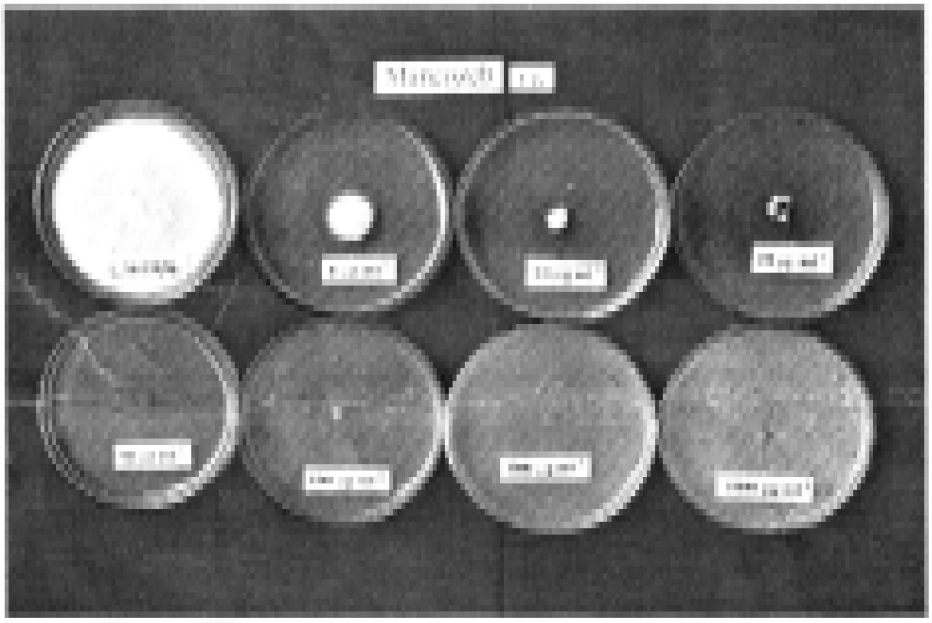

Plate 1 : Sensitivity of Cc_1 isolate of *C. capsici* against mancozeb at different concentrations.

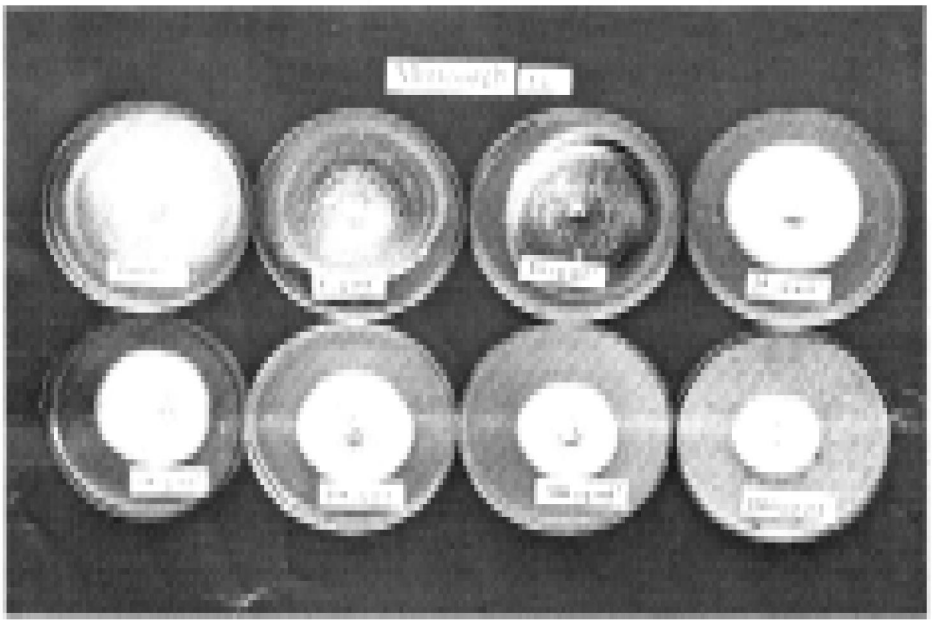

Plate 2 : Sensitivity of Cc_{11} isolate of *C. capsici* against mancozeb at different concentrations.

mancozeb was observed among the isolates of *C. capsici* obtained from betelvine (Gupta and Sen, 1988). In the present study, all the isolates were obtained from various geographical locations receiving different concentrations of this fungicide. This might be the reason for differential sensitivity of the isolates of *C. capsici* to mancozeb. Repeated use of a fungicide over long period may alter the pathogen physiology and cause loss of sensitivity among the pathogens (Viswanathan and Narayanaswamy, 1991). It is interesting to note that the isolates that were insensitive to mancozeb in the present study were collected from the areas receiving higher doses of the fungicide from last three decades. The use of this fungicide should be limited to avoid further build up and spread of insensitive strains of the pathogen, *C. capsici* in major chilli growing areas of Andhra Pradesh.

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