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Identification of resistant sources against wilt of chilli (*Capsicum annuum* L.) caused by *Fusarium solani* (Mart.) Sacc.

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Thirty chilli genotypes were screened against Fusarium wilt under laboratory condition by three different inoculation techniques viz., seed inoculation, rapid-root-dip transplanting method and sick pot method. Among 30 genotypes IHR-3018 showed consistently resistant reaction in both seed inoculation and root-dip-transplanting method. DS-1 and LCA-206 were moderately resistant and remaining genotypes were found to be susceptible to highly susceptible. However, in sick pot method high percentage of mortality was noticed due to consideration of both pre and post-emergence infection, as a result even IHR-3018 and LCA-312 were categorized under moderately resistant genotypes.

Key words : *Capsicum annuum*, *Fusarium solani*, genotypes, resistant, susceptible

INTRODUCTION

Chilli (*Capsicum annuum* L.) is the universal spice of India which belongs to family Solanaceae. Chillies are native of Central and South America and were introduced to India by Portuguese in the later part of sixteenth century. This spice was found to be much stronger than black pepper. The most notable feature of *Capsicum* is its flavour, imparted by an alkaloid, capsaicin and the red pigments viz., capsanthin, capsorubin and capxanthin which are in great demand as natural food colour and even can replace artificial colours. Chillies are excellent source of vitamin A, C and E and even carbohydrates, proteins, minerals besides their industrial and pharmaceutical uses.

The crop suffers from many diseases like damping off, anthracnose or fruit rot or dieback, wilt, murda complex, leaf spots and powdery mildew. Of late, wilt caused by *Fusarium solani* (Mart.) Sacc., is becoming more serious in chilli growing tracts of India (Singh *et al.*, 1998) and so also in Karnataka particularly in black cotton soil leading up to 25 % yield loss (Madhukar and Naik, 2004). The wilt incidence is recorded to be in the range 2-75 per cent with an average of 16.53 per cent in Raichur, 19.36 per cent in Gulbarga, and 42.10 per cent in Bellary districts of Karnataka (Anonymous, 2005). The disease appears even on young seedlings but the highest mortality occurs at flowering and fruiting stages. Although the disease first appears in patches in a field, it can extend to the entire field, if chilli is cultivated repeatedly in the same field. The inoculum of *Fusarium* moves from field to field along with irrigation water enabling the spread of the disease. Presently, most of the commercial chilli cultivars particularly Byadagi and Guntur grown in southern parts India and else where are susceptible to wilt. Hence, there is an urgent need to undertake screening of available genotypes for identification of wilt resistant sources.

Host plant resistance has been an apt choice in all crop improvement programme and is perhaps the best method available to tackle the soil borne diseases in particular. Fusarium wilt is a typical soil borne disease which can only be mitigated appropriately by use of disease resistant cultivars. Further, the use of resistant variety will go a long way not only in reducing loss due to disease but also in avoiding fungicidal toxicity likely to occur due to their application to the soil. Hence, *in vitro* screening of several genotypes against *F. solani* was conducted by using three methods of inoculation *viz.*, seed inoculation, rapid- root-dip transplanting and sick pot method.

MATERIAL AND METHODS

Chilli genotypes collected from Indian Institute of Horticultural Research (IIHR), Hessarghatta and the

Department of Horticulture, College of Agriculture, Raichur were used for screening against Fusarium wilt.

Isolation of Fusarium and preparation of inoculum

Infected plants of chilli were collected from wilted fields. The isolation of the fungus was done by following standard tissue isolation method under aseptic condition. The infected tissues of the root were cut into small bits of size 1-2 mm and surface sterilized in 1:1000 mercuric chloride solution for one minute and washed repeatedly thrice in sterile distilled water to remove the traces of mercuric chloride before transferring them to sterile potato dextrose agar (PDA) slants under aseptic condition and incubated at 28±1° C for growth. The culture, thus obtained was purified by single spore isolation method.

Seed inoculation technique

Apparently healthy chilli seeds were selected and surface sterilized with mercuric chloride (0.1 %). The seeds were dipped in *F. solani* spore suspension (concentration of $1X10^7$ conidia/ml) for 12 hrs, thereafter they were sown on blotter paper lined on Petri-plates with three replications. Twenty five seeds in each replications and one control were maintained and were incubated for 10 days. Data on per cent seed germination and seedling death were recorded.

Rapid-root-dip transplanting technique

Method developed by Naik *et al.* (1996) was followed. Chilli seedlings were raised in a plastic trays containing sterilized sand in a nylon net-house and protected with two insecticidal sprays of Malathion (0.1 %) and Monocrotophos (0.05 %) to prevent the viral disease. Three weeks old seedlings were uprooted, roots thoroughly washed in running tap water and 3 mm tip of roots were cut and immersed in spore suspension of *F. solani* and planted in a plastic tray containing sterilized soil. Ten plants were planted in each row with three replications and one uninoculated control (without dipping in spore suspension) was maintained. Data on per cent disease incidence (PDI) was recorded up to 20 days after planting.

Sick pot technique

The fungus was multiplied on sorghum grain medium at 28±1° C for three weeks and the giant culture obtained was used as soil inoculum. The medium was prepared by soaking the surface sterilized sorghum grains for over night with 2 per cent sucrose solution and water drained off. The soak grains were packed in [half kg capacity] autoclavable polythene cover with 200 g each, wrapped the polythene cover with cotton cloth and autoclaved at 121°C for 30 min. for three consecutive days. The sterilized sorghum grains were inoculated with *F. solani* under aseptic condition and incubated for three weeks. The inoculum was added to the sterilized soil at the rate of 10 per cent [w/w basis] for making the soil sick and the quantity of *Fusarium* colony forming unit per gram of soil were assessed.

Chilli seeds were surface sterilized with $HgCl_2$ (0.1 %) for one minute and washed repeatedly thrice in sterile water to remove the traces of mercuric chloride and planted in sick pot containing *F. solani*. Data on per cent wilt incidence was recorded.

Computation of disease index

The disease incidence was computed by taking into consideration the pre-emergence and post-emergence seedling death by employing formula.

$$\text{Pre-emergence seedling death} = \frac{\text{No. of seedlings emerged in healthy soil} - \text{No. of seedling emerged in sick soil}}{\text{No. of seedlings emerged in healthy soil}} \times 100$$

$$\text{Post-emergence seedling death} = \frac{\text{No. of seedlings killed}}{\text{No. of seedlings emerged}} \times 100$$

RESULTS AND DISCUSSION

Among thirty genotypes screened for resistance against *F. solani*, none of them were found to be immune and only genotypes IHR-3018, 51C-11-179 and LCA-312 showed resistant reaction, whereas LCA-206, IHR-3006, GPC-80 and DS-1 were moderately resistant in seed inoculation technique and the remaining genotypes were found to be susceptible. On the other hand, IHR-3018 was the only one genotype which showed the resistant reaction in rapid-root-dip-transplanting technique. Genotypes of chilli, LCA-206, 51C-11-179, DS-1 and LCA-312 showed moderately resistant reaction and the remaining genotypes were susceptible. In sick pot technique, none of the genotypes showed

Table 1 : Wilt incidence recorded in various chilli genotypes against *F. solani* by different screening techniques

Genotypes	Per cent wilt incidence			
	Seed inoculation technique	Rapid-root-dip trans-planting	Sick pot tech-nique	Average incide-nce
51C-11-179	6.66	13.33	26.66	15.55
Arka Lohit	36.66	36.66	56.66	38.88
Byadagi Chakkalabbi	73.33	40.00	59.99	57.77
Byadagi Dabbi	53.33	50.00	79.99	61.10
Byadagi Kaddi (H)	46.66	36.66	43.33	42.21
Byadagi Kaddi (D)	56.66	56.66	49.99	54.43
Byadagi Gundigeri	56.66	60.00	66.66	61.10
Byadagi Saunsi	56.66	53.33	53.32	54.44
CO-1	73.33	76.66	59.99	69.99
DS-1	16.33	23.33	29.99	23.32
G-3	33.33	36.66	39.99	36.66
G-4	26.66	43.33	59.99	43.32
GPC-80	23.33	33.33	49.99	35.55
GPC-82	26.66	33.33	59.99	39.99
H-1	66.66	46.66	46.66	53.32
H-20	36.66	46.66	46.66	43.32
H-232	43.33	46.66	43.33	44.44
IHR-3006	23.33	33.33	36.66	31.10
IHR-30178	6.66	10.00	13.33	9.99
IHR-3023	66.66	70.00	86.66	74.44
Induwas Local	26.66	26.66	36.66	29.99
KDC-6	36.66	36.66	46.66	39.99
LCA-206	16.66	13.33	29.99	19.99
LCA-301	6.66	33.33	46.66	38.88
LCA-304	66.66	35.66	49.99	57.77
LCA-312	10.00	13.33	13.33	12.22
Pant C-3	26.66	33.33	33.33	31.10
PMR-5	26.66	26.66	43.33	32.21
Pusa Jwala	53.33	46.66	76.66	58.88
VA	73.33	76.66	73.33	74.44

Note : Ten seeds and seedlings of chilli were used in each cultivar for the purpose of arriving wilt incidence

resistant reaction but IHR-3018 and LCA-312 showed moderately resistant reaction and the remaining 28 genotypes were either susceptible or highly susceptible (Table 1).

The overall result of screening of genotypes using three inoculation techniques (Table 2) indicated that none of the genotypes were immune and only genotype IHR-3018 showed consistently resistant reaction both in seed inoculation and rapid-root-dip transplanting technique. DS-1 and LCA-206 were moderately resistant and the remaining ones were susceptible. However, sick pot method encountered higher percentage of mortality obviously due to consideration of both pre and post-emergence infection. Hence, even IHR-3018 and LCA-312 were categorized under moderate resistance and the remaining were susceptible. Genotypes commonly cultivated in north Karnataka region such as Byadagi Kaddi, Byadagi Dabbi, and Byadagi Gundigeri were found to be susceptible to the Fusarium wilt and is a matter of great concern. In general the genotypes gave a very wide response to *Fusarium* infection. Such wide response of chilli genotypes for Fusarium wilt was earlier observed by Ahmed *et al.* (1994), Nayeema *et al.* (1995) and Singh *et al.* (1998). Similar type of response was observed by several workers (Chauhan, 1988 ; Singh *et al.* 1996 ; Singh *et al.* 1997) in crops such as watermelon, pigeonpea, chickpea, cumin, potato, linseed and in many other crops including chilli in recent years (Devika Rani *et al.* 2006). Different methods also indicated the concurrence

Table 2 : Categorization of chilli genotypes into different degrees of resistance against *F. solani* by different techniques

Per cent of infection	Reaction	Seed inoculation technique	Rapid-root-dip transplanting	Sick pot technique	Average of three screening techniques
0	Immune	Nil	Nil	Nil	Nil
1-10	Resistant	IHR-3018, LCA-312, 51C-11-179.	IHR-3018	Nil	IHR-3018.
11-25	Moderately resistant	DS-1, GPC-80, IHR-3006, LCA-206.	DS-1, LCA-206, LCA-312, 51C-11-179.	IHR-3018, LCA-312.	51C-11-179, DS-1, LCA-206, LCA-312.
26-50	Susceptible	Arka Lohit, Byadagi Dabbi, Byadagi Kaddi (H), Byadagi Kaddi (D), G-3, G-4, GPC-82, H-20, H-232, Induwas local, KDC-1, LCA-301, Pant C-3, PMR-5.	Arka Lohit, Byadagi Chakkalabbi, Byadagi Dabbi, Byadagi Kaddi (H), G-3, G-4, GPC-80, GPC-82, H-1, H-20, H-232, Induwas local, IHR-3006, KDC-1, LCA-301, Pant C-3, PMR-5, Pusa jwala.	Byadagi Kabbi (D), Byadagi Kaddi (H), DS-1, G-3, GPC-80, H-1, H-20, H-232, IHR-3006, Induwas Local, KDC-1, LCA-206, LCA-301, LCA-304, Pant C-3, PMR-5, 51C-11-179.	Arka Lohit, Bydagai Kaddi (H), G-3, G-4, GPC-80, GPC-82, H-20, H-232, IHR-3006, Induwas Local, KDS-6, LCA-301, Pant C-3, PMR-5.
51-100	Highly susceptible	Byadagi Chakkalabbi, Byadagi Gudigeri, Bydagai saunsi, CO-1, H-1, IHR-3023, LCA-304, Pusa Jwala, VA.	Byadagi Gudigeri, Bydagai Kaddi (D), Byadagi saunsi, CO-1, IHR-3023, LCA-304, VA	Arka Lohit, Byadagi Chakkalabbi, Byadagi Dabbi, Byadagi Gudigeri, Bydagai saunsi, CO-1, G-4, GPC-82, IHR-3023, Pusa Jwala, VA.	Byadagi Dabbi, Byadagi Gudigeri, Bydagai Kaddi (D), Bydagai saunsi, CO-1, H-1, IHR-3023, LCA-304, Pusa Jwala, VA.

and confirmation of behaviour of different chilli genotypes.

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