I J P S INTERNATIONAL JOURNAL OF PLANT SCIENCES
ISSN-0973-1547 Volume **15** | Issue 2 | July, 2020 | 67-72
DOI: 10.15740/HAS/IJPS/15.2/67-72
Visit us - *www.researchjournal.co.in*

RESEARCH ARTICLE

Assessment of chilli genotypes for anthracnose resistance under field conditions

■ **K. Arjun, T. Arumugam, M. Karthikeyan, H. Usha Nandhini Devi and S. Mohankumar**

SUMMARY

Anthracnose caused by complex of *Colletotrichum* species is an economically important disease of chilli. The study involved 132 genotypes grown under field conditions. Among the genotypes evaluated, fifteen genotypes were moderately resistant to anthracnose with fairly high yield. In the order of merit, the genotypes were CA 177 (10.74%), Paramakudi 1 (16.64%), F 507 (17.17%), Bird's eye chilli (17.85%), Kadaladi 1 (19.70%), Ramnad local (20.64%), CO 1 (20.82%), TA/CA/ 10 (21.56%), CA 166 (21.94%), CA 188 (22.29%), Paramakudi 2 (22.45%), CA 13/6 (23.42%), Chilli CO hybrid 1 (24.36%), IC 342465 (24.68%) and CA 165 (25.70%). whereas, 40 genotypes were susceptible with PDI ranging from 26.30 to 50.69 per cent and majority of the genotypes (77nos) were found to be highly susceptible to anthracnose with per cent disease index ranging from 51.81 to 96.42 per cent. The moderately resistant genotypes identified in the present investigation will serve as donors or source of resistance for anthracnose.

Key Words : Chilli, Anthracnose, *Colletotrichum* species

How to cite this article : Arjun, K., Arumugam, T., Karthikeyan, M., Usha Nandhini Devi, H. and Mohankumar, S. (2020). Assessment of chilli genotypes for anthracnose resistance under field conditions. *Internat. J. Plant Sci.*, **15** (2): 67-72, **DOI: 10.15740/ HAS/IJPS/15.2/67-72,** Copyright@ 2020: Hind Agri-Horticultural Society.

Article chronicle : Received : 15.02.2020; **Revised :** 01.05.2020; **Accepted :** 11.05.2020

MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
T. Arumugam, Horticultural College and Research Institute (T.N.A.U.), **Periyakulam (T.N.) India**
Email : tarumugam64@gmail.com

Address of the Co-authors:
K. Arjun, M. Karthikeyan and H. Usha Nandhini Devi, Department of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, **Coimbatore (T.N.) India**

S. Mohankumar, Centre for Plant Molecular Biology and Biotechnology, Tamil Nadu Agricultural University, Coimbatore, **Coimbatore (T.N.) India**

Vegetables are important part of healthy diet and are the source of many vital nutrients. A regular supply of recommended quantity of vegetables either in fresh or processed form is necessary to make a healthy diet. Among vegetables, chilli (*Capsicum annuum* L.) is one of the most cultivated vegetables and spice crop in tropical and subtropical regions of the world (Shetty *et al*., 2013 and Wahyuni *et al*., 2013). Apart from culinary purposes, chilli possesses pharmaceutical properties such as, anti-oxidant, anti-inflammatory, anti-mutagenic, anti-carcinogenic and

immuno suppressive properties to inhibit bacterial growth and platelet aggregation (Cao *et al*., 2015; Naidu and Thippeswamy, 2002; Rubio *et al*., 2013; Luo *et al*., 2011; Bhattacharya *et al*., 2010 and Bosland and Votava, 2012).

Besides fulfilling the domestic requirements, chilli remains to be a major source of foreign exchange among agricultural commodities that are exported from India. It is exported to several developed and developing countries including, USA, Canada, UK, Saudi Arabia, Singapore, Malaysia, Germany and several other countries across the world (Ashwini and Srividya, 2014). Despite continuous efforts at various levels, the chilli productivity has not gained accepted momentum. This could be attributed to various biotic and abiotic constraints. Among biotic stresses, anthracnose is considered as the second most destructive disease after chilli leaf curl virus (Senanayake *et al*., 2007) as it affects the economic part of the plant that is, fruits at both pre- and post-harvest stages, thereby staggering crop loss accounting to 10 - 80 per cent (Bagri *et al*., 2004; Pakdeevaraporn *et al*., 2005 and Than *et al*., 2008).

Symptoms initially appears as watersoaked lesions, followed by brownish discoloration and visible mycelia on the surface of fruit, that appears as characteristic concentric rings (Dastur, 1921 and Khodke and Gahukar, 1995). Apart from chilli, *Colletotrichum* is known to affect over 3000 plant species by 66 *Colletotrichum* species, but among these, three main species can cause economic damage namely., *C. scovillei* (formerly known as *C. acutatum*), followed by *C. truncatum* (formerly known as *C. capsici*) and *C. siamense* (formerly known as *C. gloeosporioides*) (Garg *et al*., 2013; Mahasuk *et al*., 2009 and Mongkolporn *et al*., 2010). Environmental factors such as temperature and humidity have the most direct influence on the germination, infection and growth of the pathogen on the host. Usually, warm (27°C) and humid environmental conditions with high relative humidity (>80%) support the infection, spread and intensity of the disease under field conditions.

Management of chilli anthracnose has been a major concern for the pathologists, with no effective control measures available at present. Currently, fungicides are being extensively used to control the disease. This practice can affect human health due to pesticide residues, left on the fruits after harvesting, which are beyond the control of consumer as the fruits of chilli are commonly eaten even without cooking (Beard *et al*., 2014 and Collotta *et al*., 2013). Furthermore, continuous use of chemical fungicides leads to adverse effects including pathogen insensitivity and environmental pollution (Schafer *et al*., 2013 and Zhu *et al*., 2015). Therefore, host plant resistance can be considered as the most pragmatic and eco-friendly approach to manage anthracnose disease in future (Mundt, 2014). Hence, the study was taken upto identify the source for the resistance to anthracnose in chilli.

MATERIAL AND METHODS

The study was carried out at the college orchard, Department of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore in 2018. One hundred and thirty-two chilli genotypes in two replications were grown in Randomised Block Design and visually screened for anthracnose disease. All recommended package of practices was followed, except the application of fungicides.

Disease severity was assessed at ripened fruit stage which coincide with anthracnose incidence as per the score chart suggested by McKinney (1923).

Score	% of infection
0	No infection
1	Less than 1 %
3	1 - 10%
5	11 - 25%
7	26 - 50%
9	More than 50%

Per cent disease index (PDI) was calculated by using the formula given by Wheeler (1969). The percentage values of disease severity were transformed into the arcsine values for statistical analysis.

$$PDI = \frac{\text{Sum of individual scores}}{\text{Number of fruits assessed}} \times \frac{100}{\text{Maximum disese score}}$$

Based on PDI, the 0 - 4 grading was followed as suggested by Bansal and Grover (1969).

Grade	Percentage of disease index	Reaction
0	No infection	Immune
1	1 – 5%	Resistant
2	6 – 25%	Moderately resistant
3	26 – 50%	Susceptible
4	More than 50%	Highly susceptible

Table 1: Reaction of chilli genotypes for anthracnose under field conditions

Reaction	Grade	PDI	Genotypes
Moderately resistant	2	6 – 25	Bird's eye chilli, CA 13/6, CA 165, CA 166, CA 188, CA 177, Chilli CO Hybrid 1, CO 1, F 507, IC 342465, Kadaladi 1, Paramakudi 1, Paramakudi 2, Ramnad Local, TA/CA/10
Susceptible	3	26 50	CA 7, CA 45, CA 60, CA 64, CA 69, CA 71, CA 80, CA 92, CA 101, CA 110, CA 126, CA 157, CA 158, CA 159, CA 161, CA 171, CA 178, CA 187, CA 207, CA 13/5, EC 599960, F2, F 6, F 701, F 706, F 707, IC 344327, IC 361982, IC 572485, KMD/PY 1, LCA 206, Long chilli, M 101, M 102, M 103, M 413, M 415, M 501, M 704, TA/CA/17
Highly susceptible	4	51 100	Aparna, Assam chilli, CA 6, CA 27, CA 29, CA 30, CA 36, CA 41, CA 46, CA 48, CA 52, CA 67, CA 77, CA 94, CA 104, CA 107, CA 108, CA 116, CA 119, CA 121, CA 139, CA 141, CA 164, CA 167, CA 168, CA 169, CA 172, CA 173, CA 175, CA 176, CA 180, CA 436, CA 620, CA 624, CA 13/2, CF 2, CP 960, EC 339043, EC 339044, EC 402109, EC 570008, EC 572484, EC 599981, EC 600023, Elephant chilli, Erode local, F 1, F 101, F 102, F 3, F 4 , F 410, F 5, F 702, G 3, Gokak local, IC 336254, IC 344386, IC 361979, Jayanthi, Jeynthi, LCA 235, LCA 625, M 10, M 105, M 106, M 412, M 707, M 708, M 714, M 8, MP 1,Paranthaman local, PLR 1, Sankarankovil local, Ujjwala, West Bengal

Table 2: Severity of anthracnose of chilli in different genotypes under field conditions

Genotypes	Anthracnose Severity (%)	Fresh fruit yield/ plant (g)	Reaction	Genotypes	Anthracnose Severity (%)	Fresh fruit yield/ plant (g)	Reaction
Aparna	63.70	93.27	HS	CA 80	32.94	211.99	S
Assam Chilli	68.69	86.41	HS	CA 92	45.46	142.15	S
Bird's Eye Chilli	17.85	128.00	MR	CA 94	60.39	100.61	HS
CA 6	72.64	67.28	HS	CA 101	38.09	181.58	S
CA 7	43.09	146.24	S	CA 104	68.70	79.33	HS
CA 13/2	86.33	34.53	HS	CA 107	71.24	70.17	HS
CA 13/5	37.69	191.70	S	CA 108	95.35	16.62	HS
CA 13/6	23.42	253.76	MR	CA 110	45.78	142.49	S
CA 27	94.75	16.48	HS	CA 116	72.85	67.53	HS
CA 29	87.74	28.26	HS	CA 119	90.86	22.56	HS
CA 30	85.97	36.78	HS	CA 121	85.28	36.88	HS
CA 36	69.72	74.01	HS	CA 126	45.82	138.20	S
CA 41	82.28	46.33	HS	CA 139	67.78	84.80	HS
CA 45	32.73	211.31	S	CA 141	60.52	101.63	HS
CA 46	50.57	129.15	HS	CA 157	44.59	146.30	S
CA 48	87.01	31.93	HS	CA 158	38.12	169.51	S
CA 52	82.39	46.14	HS	CA 159	31.50	227.55	S
CA 60	35.49	195.19	S	CA 161	32.40	218.11	S
CA 64	39.37	170.34	S	CA 164	55.68	112.90	HS
CA 67	76.74	59.61	HS	CA 165	25.70	246.99	MR
CA 69	46.22	137.42	S	CA 166	21.94	269.50	MR
CA 71	30.69	235.36	S	CA 167	63.48	99.78	HS
CA 77	89.96	27.36	HS	CA 168	50.69	130.50	HS
CA 169	86.03	33.75	HS	Elephant chilli	92.30	16.92	HS
CA 171	41.64	163.51	S	Erode local	87.27	29.13	HS
CA 172	72.62	68.91	HS	F 1	78.74	58.22	HS
CA 173	86.66	32.50	HS	F 2	46.80	138.76	S
CA 175	54.39	116.78	HS	F 3	69.99	73.68	HS

Table 2: Contd……..

Table 2: Contd……

CA 176	55.08	115.78	HS	F 4	91.86	16.99	HS
CA 177	10.74	192.58	MR	F 5	95.40	15.18	HS
CA 178	26.30	243.63	S	F 6	35.16	203.75	S
CA 180	81.37	57.67	HS	F 101	69.26	74.75	HS
CA 187	32.68	215.30	S	F 102	82.01	50.17	HS
CA 188	22.29	270.77	MR	F 410	81.82	54.63	HS
CA 207	40.05	161.40	S	F 507	17.17	218.99	MR
CA 436	73.79	64.98	HS	F 701	42.54	151.27	S
CA 620	55.76	110.54	HS	F 702	90.15	27.18	HS
CA 624	67.56	83.89	HS	F 706	41.81	160.87	S
CF 2	64.26	86.16	HS	F 707	46.88	130.73	S
Chilli Co Hybrid 1	24.36	248.61	MR	G 3	95.44	14.42	HS
CO 1	20.82	281.49	MR	Gokak local	86.95	31.81	HS
CP 960	54.87	119.04	HS	IC 336254	73.85	65.53	HS
EC 339043	90.66	26.14	HS	IC 342465	24.68	251.04	MR
EC 339044	90.86	24.37	HS	IC 344327	37.95	183.30	S
EC 402109	51.95	128.49	HS	IC 344386	87.36	28.44	HS
EC 570008	56.46	104.37	HS	IC 361979	90.38	27.09	HS
EC 572484	95.64	14.28	HS	IC 361982	31.20	232.37	S
EC 599960	31.85	223.54	S	IC 572485	28.54	240.94	S
EC 599981	82.46	45.12	HS	Jayanthi	86.61	32.52	HS
EC 600023	64.09	89.69	HS	Jeynthi	91.00	18.13	HS
Kadaladi 1	19.70	264.82	MR	Ramnad Local	20.64	285.21	MR
KMD/PY 1	32.49	212.68	S	Sankarankovil Local	68.90	75.56	HS
LCA 206	37.75	191.62	S	TA/CA/10	21.56	276.79	MR
LCA 235	63.93	91.11	HS	TA/CA/17	45.13	142.43	S
LCA 625	51.81	126.98	HS	Ujjwala	72.40	70.04	HS
Long Chilli	32.98	210.69	S	West Bengal	82.46	44.26	HS
M 8	90.93	22.79	HS	S.E.±	1.11	1.94	
M 10	84.64	42.68	HS	C.D. (P=0.05)	2.18	3.85	
M 101	42.16	159.01	S	C.V. (%)	2.33	1.62	
M 102	42.61	154.46	S				
M 103	42.59	149.18	S				
M 105	59.90	102.03	HS				
M 106	69.35	74.17	HS				
M 412	54.26	119.63	HS				
M 413	38.11	169.90	S				
M 415	33.59	205.71	S				
M 501	35.72	198.72	S				
M 704	29.55	241.98	S				
M 707	73.57	68.13	HS				
M 708	76.42	64.95	HS				
M 714	65.04	86.08	HS				
MP 1	77.95	59.85	HS				
Paramakudi 1	16.64	357.93	MR				
Paramakudi 2	22.45	253.02	MR				
Paranthaman Local	94.92	16.76	HS				
PLR 1	96.42	51.52	HS				

Figures in parentheses are arcsine transformed values

RESULTS AND DISCUSSION

In the present study, chilli genotypes were screened for anthracnose under natural conditions. Analyzed data revealed that, all the genotypes reacted for anthracnose and the responses differed significantly. Based on the disease incidence under field conditions, the genotypes were categorized into three distinct groups. Among 132 genotypes, fifteen genotypes were moderately resistant to anthracnose. In the order of merit, the fifteen genotypes were CA 177 (10.74%), Paramakudi 1 (16.64%), F 507 (17.17%), Bird's eye chilli (17.85%), Kadaladi 1 (19.70%), Ramnad local (20.64%), CO 1 (20.82%), TA/CA/10 (21.56%), CA 166 (21.94%), CA 188 (22.29%), Paramakudi 2 (22.45%), CA 13/6 (23.42%), Chilli Co hybrid 1 (24.36%), IC 342465 (24.68%) and CA 165 (25.70%). Whereas, 40 genotypes were susceptible with PDI ranging from 26.30 to 50.69 per cent and the majority of the genotypes (77nos) were found to be highly susceptible to anthracnose with PDI ranging from 51.81 to 96.42 per cent. The data on disease severity and PDI of chilli genotypes to anthracnose are presented in Table 1 and 2, respectively.

The results also suggest that, the fresh fruit yield was negatively correlated with severity of anthracnose incidence in chilli. Moderately resistant genotypes were found to be significantly superior with respect to average fresh fruit yield of 128.00 – 357.93 g/plant. Incidentally, variety CO 1 and Chilli CO hybrid 1 released by Tamil Nadu Agricultural University were found to be moderately resistant to anthracnose, which reconfirms the results of Angadi *et al*. (2003) and Pugalendhi *et al*. (2010). Although none of the genotypes were either immune nor resistant to anthracnose, the moderately resistant genotypes identified in the present investigation will serve as donors or source of resistance for anthracnose in chilli breeding.

REFERENCES

Angadi, H.D., Naik, M.K., Patil, M.G. and Patil, R.G. (2003). Evaluation of chili genotypes against anthracnose disease. *Veg Sci.*, **30**:164-165.

Ashwini, N. and Srividya, S. (2014). Potentiality of *Bacillus subtilis* as biocontrol agent for management of anthracnose disease of chilli caused by *Colletotrichum gloeosporioides* OGC1.3 *Biotech.*, **4** : 127-136.

Bagri, R.K., Choudhary, S.L. and Rai, P.K. (2004). Management of fruit rot of chilli with different plant products. *Indian Phytopathol.*, **57**:107-109.

Bansal, R.D. and Grover, R.K. (1969). Reaction of chilli (*Capsicum frutescens*) varieties to *Colletotrichum capsici*. *J. Res. Punjab Agric. Univ.*, **6** : 345–348.

Beard, John D., David, M., Umbach, Jane A. Hoppin, Marie Richards, Michael C.R. Alavanja, Aaron Blair, Dale P. Sandler and Freya, Kamel (2014). Pesticide exposure and depression among male private pesticide applicators in the agricultural health study. *Environ. Health Perspect*., **122** : 984-991.

Bhattacharya, A., Chattopadhyay, A., Mazumdar, D., Chakravarty, A. and Pal, S. (2010). Antioxidant constituents and enzyme activities in chilli peppers. *Int. J. Veg. Sci*., **16** (3) : 201-211.

Bosland, P.W. and Votava, E.J. (2012). Peppers: Vegetable and spice capsicums. *Crops Prod. Sci, Horti.*, **12**:1–11.

Cao, Siwei, Huoji Chen, Shijian Xiang, Junhui Hong, Lidong Weng, Hongxia Zhu and Qiang Liu (2015). Anti-cancer effects and mechanisms of capsaicin in chili peppers. *Am. J. Plant Sci.*, **6** (19):3075.

Collotta, Martina, Pier, A. Bertazzi and Valentina, Bollati (2013). Epigenetics and pesticides. *Toxicology*, **307** : 35-41.

Dastur, Jehangir Fardunji (1921). Die-back of chillies: (*Capsicum* spp.) in Bihar: *Dep. Agril. Ind. Bot. Ser.*, **11** : 129-44.

Garg, Ruchi, Sanjay Kumar, Rajesh Kumar, Murugan Loganathan, Sujoy Saha, Sanjeet Kumar, Awadhesh, B. Rai and Bijoy, K. Roy (2013). Novel source of resistance and differential reactions on chilli fruit infected by *Colletotrichum capsici*. *Australas. Plant Pathol.*,**42** (2) : 227-233.

Khodke, S.W. and Gahukar, K.B. (1995). Changes in biochemical constituents of chilli fruits infected with *Colletotrichum gloeosporioides* Penz. *J. Maharashtra Agric. Univ.*, **20** : 142-143.

Luo, Xiu-Ju, Jun Peng and Yuan-Jian, Li (2011). Recent advances in the study on capsaicinoids and capsinoids. *Eur. J. Pharmacol.*, **650** (1):1-7.

Mahasuk, P., Taylor, P.W.J. and Mongkolporn, O. (2009). Identification of two new genes conferring resistance to *Colletotrichum acutatum* in *Capsicum baccatum*. *Phytopathology*, **99** (9) : 1100-1104.

McKinney, H.H. (1923). A new system of grading plant diseases. *J. Agric. Res*., **26** (2):195-218.

Mongkolporn, Orarat, Paweena Montri, Thunyawan Supakaew and Paul, W.J. Taylor (2010). Differential reactions on mature green and ripe chili fruit infected

by three *Colletotrichum* spp. *Plant Dis.*, **94** (3) : 306-310.

Mundt, Christopher C. (2014). Durable resistance: a key to sustainable management of pathogens and pests. *Infect. Genet. Evol.*, **27** : 446-455.

Naidu, K. Akhilender and Thippeswamy, N.B. (2002). Inhibition of human low density lipoprotein oxidation by active principles from spices. *Mol. Cell. Biochem.*, **229** (1-2) : 19-23.

Pakdeevaraporn, P., Wasee, S., Taylor, P.W.J. and Mongkolporn, O. (2005). Inheritance of resistance to anthracnose caused by *Colletotrichum capsici* in capsicum. *Plant Breed.*, **124** (2):206-208.

Pugalendhi, L., Veeraragavathatham, D., Sathiyamurthy, V.A. and Natarajan, S. (2010). High yielding and moderately resistant to fruit rot disease chilli hybrid-CCH 1 (TNAU Chilli Hybrid CO1). *Electron. J. Plant Breed.*, **1** (4):1049-1059.

Rubio, Laura, Maria-José Motilva and Maria-Paz Romero (2013). Recent advances in biologically active compounds in herbs and spices: a review of the most effective antioxidant and anti-inflammatory active principles. *Crit. Rev. Food Sci. Nutr.*, **53** (9):943-953.

Schafer, Ralf B., Nadine, Gerner, Ben, J. Kefford, Jes, J. Rasmussen, Mikhail, A. Beketov, Dick, de Zwart, Matthias Liess and Peter, C. von der Ohe (2013). How to characterize chemical exposure to predict ecologic effects on aquatic communities? *Environ. Sci. Technol.*, **47** (14) : 7996-8004.

Senanayake, D.M.J.B., Mandal, B., Lodha, S. and Varma, A. (2007). First report of chilli leaf curl virus affecting chilli in India. *Plant Pathol.*, **56** : 343.

Shetty, A.A., Magadum, S. and Managanvi, K. (2013). Vegetables as sources of antioxidants. *J. Food Nutr. Disor.*, **2** (1) : 2.

Than, Po, Haryudian, Prihastuti, Sitthisack, Phoulivong, Paul, W. J. Taylor and Kevin, D. Hyde (2008). Chilli anthracnose disease caused by *Colletotrichum* species. *J. Zhejiang Univ. Sci.*,**B.9** (10) : 764.

Wahyuni, Yuni, Ana-Rosa Ballester, Enny Sudarmonowati, Raoul, J. Bino and Arnaud, G. Bovy (2013). Secondary metabolites of capsicum species and their importance in the human diet. *J.Nat. Prod.*, **76** (4):783-793.

Wheeler, B.E.J. (1969). *An introduction to plant diseases.* Wiley and Sons, London, pp. 374.

Zhu, Yu Cheng, John Adamczyk, Thomas Rinderer, Jianxiu Yao, Robert Danka, Randall Luttrell and Jeff Gore. (2015). Spray toxicity and risk potential of 42 commonly used formulations of row crop pesticides to adult honey bees (Hymenoptera: Apidae). *J. Econ. Entomol.*, **108** (6) : 2640-2647.