

Screening of chilli germplasm for anthracnose resistance

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Abstract : In an evaluation of chilli (*Capsicum annuum* L.) germplasm with ninety three genotypes for yield and resistance to anthracnose disease it was found that there were significant differences for all the traits studied, indicating large amount of diversity among them. Based on the evaluation three resistant donors Sin 1, Sin 2 and Sin 3 and five moderately resistant lines Arka Lohit, CC 4, KDC 1, Pepper Hot and Ujwala were chosen as potential parents to synthesise F₁ hybrids with lesser anthracnose incidence and reasonably good fruit yield.

Key words : Chilli, germplasm, diversity, anthracnose, fruit yield.

Introduction

Among the major constraints in the production of hot pepper, anthracnose caused by seed-borne pathogen, is very deleterious causing considerable damage to the crop both in yield and quality of the produce. The yield loss in South India has been reported to be 30 per cent (Durairaj, 1972). The disease is prevalent in almost all the major chilli growing areas of India causing major concern on quality of the produce thereby total harvestable good quality chilli. Improvement in the quality and productivity of Indian chillies will enable us to increase exports of chilli and chilli products from India, effectively meeting the competition from other producing and exporting countries. Under such circumstances, although disease resistance is the major objective, it is essential to consider the quantitative characters, especially, the yield. Resistance to disease when dominant over susceptibility can be directly availed in F₁ hybrids, thus eliminating the tediousness of selecting resistant segregants in successive generations. Thus, F₁ hybrid in chilli has great potential but so far not a single F₁ hybrid has been released in the country with complete

resistance to anthracnose. Therefore, hybrids having moderate resistance with good horticultural traits need to be developed. For hybridization, selection of efficient parents to be used in the breeding programme is the most essential, and such sources are identified by the well established technique of screening the germplasm. Hence the present study was undertaken at the Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 1999-2000, to ascertain the performance of germplasm lines for resistance to chilli anthracnose disease and to identify the best genotypes showing resistance to anthracnose.

Materials and Methods

Ninety three genotypes from the germplasm, which had been maintained through continuous selfing at the Department of Vegetable Crops, were used for anthracnose screening study. These lines were evaluated both under field conditions and through artificial inoculation. These genotypes of chilli were raised in the field in a randomized block design, replicated twice. All the

Table 1. Reaction of chilli genotypes to anthracnose disease in the field and controlled conditions

Accession No.	Total phenol content (mg/100g)	Natural condition			Controlled condition		
		Fruit rot PDI	Grade	Reaction	Fruit rot PDI	Grade	Reaction
CA 141	20.6	44.67	3	S	33.33	3	S
CA59	38.6**	25.77**	2	MR	62.96	4	HS
CA 112	25.0	47.59	3	S	55.56	4	HS
CA70	23.6	34.42	3	S	100.00	4	HS
CAIII	34.8**	43.77	3	S	100.00	4	HS
CA71	23.2	35.52	3	S	77.78	4	HS
CA102	24.2	37.96	3	S	77.78	4	HS
CA81	21.8	45.47	3	S	100.00	4	HS
CA48	39.2**	37.44	3	S	77.78	4	HS
CA36	34.6**	35.29	3	S	100.00	4	HS
CA4	27.6	45.08	3	S	85.19	4	HS
CAII	39.2**	41.95	3	S	62.96	4	HS
CA73	36.8**	44.76	3	S	40.74	3	S
CA61	22.8	45.67	3	S	66.67	4	HS
LCA416	21.8	43.45	3	S	62.96	4	HS
CA7	37.2**	36.14	3	S	62.96	4	HS
LCA491	34.0**	33.22*	3	S	55.56	4	HS
CA94	22.4	35.44	3	S	62.96	4	HS
Sin 1	46.0**	3.48**	1	R	33.33	3	S
Sin 2	50.0**	4 12**	1	R	33.33	3	S
Sin 3	45.8**	4 14**	1	R	40.74	3	S
CA20	23.8	36.82	3	S	55.56	4	HS
Phule	21.0	32.37*	3	S	85.19	4	HS
CA63	22.6	40.57	3	S	77.76	4	HS
Pusa	21.4	39.30	3	S	62.96	4	HS
Jwala							
CA58	20.6	36.26	3	S	92.59	4	HS
CA67	23.6	40.82	3	S	85.19	4	HS
YDS	36.8**	40.98	3	S	85.19	4	HS
Yellow							
CA64	29.6	40.87	3	S	40.74	3	S
CA97	39.4**	38.84	3	S	100.00	4	HS
CA29	23.0	46.74	3	S	70.37	4	HS
Polyster	23.0	36.08	3	S	62.96	4	HS
CA95	39.6**	23.80**	2	MR	62.96	4	HS
CA116	23.2	29.39**	3	S	62.96	4	HS
CA24	38.6**	33.33*	3	S	85.19	4	HS
CA 15	34.8**	40.57	3	S	70.37	4	HS

(Contd..)

Accession No.	Total phenol content (mg/100g)	Natural condition			Controlled condition		
		Fruit rot PDI	Grade	Reaction	Fruit rot PDI	Grade	Reaction
CA88	39.2**	38.85	3	S	85.19	4	HS
CA31	27.6	40.18	3	S	33.33	3	S
CA121	34.6**	34.53	3	S	77.78	4	HS
CA34	39.2**	38.68	3	S	40.74	3	S
CA35	21.8	41.30	3	S	55.56	4	HS
CA37	37.2**	43.83	3	S	62.96	4	HS
CA49	38.8**	41.90	3	S	85.19	4	HS
CA41	22.4	38.45	3	S	40.74	3	S
CA52	23.8	41.68	3	S	100.00	4	HS
CA60	22.2	38.97	3	S	33.33	3	S
CA106	22.6	46.41	3	S	85.19	4	HS
CA3	22.0	35.70	3	S	33.33	3	S
CA110	38.6**	42.92	3	S	33.33	3	s
CA53	34.2**	41.67	3	S	33.33	3	s
CA114	39.0**	46.95	3	S	62.96	4	HS
CA 115	45.2**	24.13**	2	MR	40.74	3	s
CA 117	19.4	40.16	3	S	100.00	4	HS
CA118	24.6	47.21	3	S	85.19	4	HS
CA101	38.2**	50.03	3	S	100.00	4	HS
CA129	38.4**	35.07	3	S	62.96	4	HS
CA75	34.6**	36.74	3	S	40.74	3	S
LCA 206	33.4**	38.73	3	S	100.00	4	HS
CA100	36.4**	40.03	3	S	33.33	3	S
CA82	25.2	42.53	3	S	33.33	3	S
CA 103	26.8	47.24	3	S	62.96	4	HS
CA46	35.6**	43.78	3	S	85.19	4	HS
DG-14-2	22.2	36.74	3	S	77.78	4	HS
CA119	34.8**	43.23	3	S	70.37	4	HS
LCA 283	38.2**	39.70	3	S	62.96	4	HS
CA 108	37.2**	34.46	3	S	70.37	4	HS
CA 17	21.4	48.14	3	S	55.56	4	HS
CA28	22.8	47.46	3	S	40.74	3	S
CA21	16.0	52.29	4	HS	40.74	3	S
CA27	21.8	50.50	3	S	85.19	4	HS
CA92	37.8**	31.69**	3	S	100.00	4	HS
LCA 252	37.2**	48.36	3	S	100.00	4	HS
CA77	22.8	48.01	3	S	100.00	4	HS
CA139	30.4	44.38	3	S	62.96	4	HS
CA96	34.8**	37.76	3	S	85.19	4	HS

(Contd..)

Accession No.	Total phenol content (mg/100g)	Natural condition			Controlled condition		
		Fruit rot PDI	Grade	Reaction	Fruit rot PDI	Grade	Reaction
CA25	31.4	45.13	3	S	77.78	4	HS
CA107	31.2	47.07	3	S	70.37	4	HS
CAIO	32.2*	46.40	3	S	33.33	3	S
CA9	25.6	50.01	3	S	33.33	3	s
CHD35	23.2	43.78	3	S	33.33	3	s
CHD8	23.2	49.64	3	S	55.56	4	HS
CO 4	23.2	49.63	3	S	77.78	4	HS
CO 3	26.4	41.10	3	S	62.96	4	HS
CA66	25.8	41.34	3	S	62.96	4	HS
Pepper Hot	40.8**	16.10**	2	MR	77.78	4	HS
Ujwala	44.4**	22.13**	2	MR	33.33	3	S
CC4	40.4**	23.55**	2	MR	55.56	4	HS
KDC1	40.6**	23.33**	2	MR	85.19	4	HS
Punjab Lai	19.2	52.21	4	HS	62.96	4	HS
CF53	34.8**	29.16**	3	S	100.00	4	HS
Punjab Guchhedar	37.2**	38.88	3	S	62.96	4	HS
CC3	28.6	27.77**	3	S	100.00	4	HS
Arka	40.4**	9.93**	2	MR	40.74	3	S
Lohit							
Grand Mean	30.4763	38.2805			66.4275		
SEd	0.6771	2.2466			0.6269		
CD (0.05)	1.3450	4.4624			1.2449		
CD (0.01)	1.7812	5.9093			1.6486		
CV (%)	2.22	5.87			0.94		

* Significant at 5 per cent level

** Significant at 1 per cent level

HS - Highly susceptible

S - Susceptible

MR - Moderately resistant

R - Resistant

recommended package of practices were followed, except application of fungicide.

Also, these ninety three genotypes of chillies were screened for resistance to anthracnose disease by artificial inoculation method in a completely randomized design with two replications. Before transplanting, the seedlings were immersed in the conidial suspension of

the pathogen for about 5 minutes. Inoculum was also sprayed after fruit setting for ensuring infection on fruits. The fruits were also punctured with needles and the culture suspension was swabbed on them with moist cotton and tied with polybags to maintain humidity. For recording disease reaction, five plants were selected and per cent fruit infection of each line was calculated on ripe fruits after fourth

day of inoculation as suggested by Kadu *et al.* (1978).

For assessing intensity of anthracnose disease, score chart suggested by McKinney (1923) was used.

Category value	% of fruit area infected
0	No infection
1	<1 % of area affected
3	1-10% of area affected
5	11-25% of area affected
7	26-50% of area affected
9	More than 50% of area affected

Per cent disease index (PDI) was calculated by using the formula given by Wheeler (1969).

$$\text{PDI} = \frac{\text{Sum of individual ratings}}{\text{Number of fruits assessed}} \times \frac{100}{\text{Maximum disease grade}}$$

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

Grade	Amount of disease (PDI)	Reaction
0	No infection	Immune
1	1-5% disease	Resistant
2	6-25% disease	Moderately resistant
3	26-50% disease	Susceptible
4	51-100% disease	Highly susceptible

The observations, namely number of fruits per plant, fresh fruit yield per plant and

dry fruit yield per plant were recorded in five randomly selected and tagged plants in each replication and the mean was calculated. Folin Ciocalteu reagent method was followed for estimating the total phenols (Bray and Thrope, 1954). The mean data of the genotypes obtained for each character were tabulated and subjected to analysis of variance (Panse and Sukhatme, 1957).

Results and discussion

The results obtained by screening the chilli genotypes for resistance against anthracnose disease in the field under natural conditions are presented in Table 1. By screening the genotypes using 0 to 4 grade scale, it was observed that the differences among the genotypes were significant. The per cent disease index values arrived at for different genotypes ranged between 3.48 and 52.29. In the field, among the 93 genotypes screened against anthracnose, none were found to be immune. Three single plant selections namely Sin 1, Sin 2 and Sin 3 made in advanced generations of a hybrid and maintained by selfing, were found to be resistant with the PDI of 3.48, 4.12 and 4.14 respectively, scoring the grade 1. Eight lines were found to be moderately resistant (PDI - 6 to 25 per cent), scoring the grade 2. In order of merit, the eight were Arka Lohit (PDI - 9.93), Pepper Hot (PDI - 16.10), Ujwala (PDI - 22.13), KDC 1 (PDI - 23.33), CC 4 (PDI - 23.55), CA 95 (PDI - 23.80), CA 115 (PDI - 24.13) and CA 59 (PDI - 25.77). Only two lines scored the highest grade 4 (PDI - 51 to 100 per cent), thereby grouped under highly susceptible (Punjab Lai - 52.21 and CA 21 - 52.29). All the remaining 80 genotypes were found to be susceptible to anthracnose disease, scoring the grade 3 (PDI- 26 to 50 per cent). The total phenol content varied significantly among the genotypes, which ranged

Table 2. Yield attributes of the chilli genotypes screened for anthracnose resistance

Accession No.	Number of fruits per plant	Fresh fruit yield per plant (g)	Dry fruit yield per plant (g)	Estimated fresh fruit yield per hectare (t)	Estimated dry fruit yield per hectare (t)
CA141	73.2	190.0	34.20	10.56	1.90
CA59	116.1**	237.5**	41.80	13.20**	2.32
CA112	88.2	187.5	43.88	10.42	2.44
CA70	117.3**	338.4**	81.22**	18.80**	4.52**
CA111	93.8	215.5**	48.70**	11.97**	2.71**
CA71	124.8**	252.2**	42.88	14.01**	2.38
CA102	102.1**	259.7**	44.93*	14.43**	2.50*
CA81	89.8	196.0	37.64	10.89	2.09
CA48	78.4	165.7	33.81	9.21	1.88
CA36	60.7	160.5	34.19	8.92	1.90
CA4	99.4*	183.6	44.42	10.20	2.47
CA11	72.3	167.5	36.85	9.31	2.05
CA73	123.5**	210.5**	37.05	11.70**	2.06
CA61	124.7**	265.3**	50.41**	14.74**	2.80**
LCA416	96.5	181.1	35.50	10.06	1.97
CA7	91.2	191.0	40.11	10.61	2.23
LCA491	85.1	205.4*	43.34	11.41**	2.41
CA94	100.9**	200.7	75.06**	11.15	4.17**
Sin 1	130.1**	258.8**	58.88**	14.38**	3.28**
Sin 2	156.6**	282.8**	64.34**	15.72**	3.58**
Sin 3	128.4**	222.1**	51.36**	12.34**	2.86**
CA20	86.7	195.3	38.08	10.85	2.12
Phule	149.2**	301.3**	60.26**	16.74**	3.35**
CA63	63.3	168.5	37.07	9.36	2.06
Pusa Jwala	99.9**	275.4**	65.27**	15.31**	3.63**
CA58	62.1	203.5*	44.77*	11.31*	2.49*
CA67	127.9**	240.7**	53.44**	13.37**	2.97**
YDS Yellow	161.8**	260.8**	56.33**	14.49**	3.13**
CA64	56.2	134.7	26.27	7.49	1.46
CA97	64.1	143.1	29.19	7.95	1.62
CA29	90.8	156.3	28.61	8.69	1.59
Polyster	94.1	207.5**	45.03*	11.53**	2.51**
CA95	77.4	245.4**	43.44	13.63**	2.42
CA 116	84.2	138.1	19.75	7.68	1.10
CA24	41.6	92.4	20.88	5.14	1.16
CA15	71.8	180.0	26.98	10.00	1.50
CA88	87.3	130.6	30.96	7.26	1.72
CA31	121.2**	289.0**	54.91**	16.06**	3.05**
CA121	118.4**	200.6	38.92	11.15	2.16
CA34	94.2	222.4**	42.26	12.36**	2.35
CA35	81.1	190.7	41.95	10.60	2.33

(Contd..)

Accession No.	Number of fruits per plant	Fresh fruit yield per plant (g)	Dry fruit yield per plant (g)	Estimated fresh fruit yield per hectare (t)	Estimated dry fruit yield per hectare (t)
CA37	84.0	173.9	38.26	9.66	2.13
CA49	95.3	230.5**	55.32**	12.81**	3.08**
CA41	78.5	122.5	28.79	6.81	1.60
CA52	84.0	167.6	38.55	9.31	2.14
CA60	106.8**	260.7**	52.14**	14.48**	2.90**
CA106	75.7	180.8	33.45	10.05	1.86
CA3	66.4	120.5	29.28	6.70	1.63
CA 110	58.1	127.3	22.15	7.07	1.23
CA53	90.0	180.6	41.54	10.04	2.31
CA114	115.2**	287.5**	60.38**	15.97**	3.36**
CA 115	80.9	215.4**	47.39**	11.97**	2.63**
CA 117	91.5	185.8	42.73	10.33	2.38
CA118	64.0	187.3	33.71	10.41	1.87
CA 101	53.9	150.6	30.23	8.37	1.68
CA129	69.0	125.3	28.20	6.96	1.57
CA75	70.1	152.6	36.62	8.48	2.03
LCA 206	87.1	195.3	33.60	10.85	1.87
CA 100	57.2	160.7	37.29	8.93	2.07
CA82	77.7	185.8	40.88	10.33	2.27
CA103	87.9	171.3	25.70	9.52	1.43
CA46	73.7	220.6**	52.73**	12.26**	2.93**
DG-14-2	109.9**	210.1**	46.22**	11.68**	2.57**
CA119	74.8	195.6	42.45	10.87	2.36
LCA 283	94.0	140.2	35.06	7.79	1.95
CA108	77.0	150.7	29.39	8.37	1.63
CA 17	127.0**	219.4**	50.69**	12.19**	2.82**
CA28	101.8**	172.3	47.21**	9.58	2.62**
CA21	85.1	189.7	43.63	10.54	2.43
CA27	80.8	195.7	45.01*	10.88	2.50*
CA92	75.5	140.4	39.31	7.80	2.18
LCA 252	74.5	139.6	29.88	7.76	1.66
CA77	81.3	217.7**	41.36	12.10**	2.30
CA139	61.9	177.5	39.05	9.86	2.17
CA96	115.6**	250.4**	51.83**	13.92**	2.88**
CA25	76.3	225.5**	48.26**	12.53**	2.68**
CA107	95.1	223.7**	45.64**	12.43**	2.54**
CA 10	93.5	195.6	41.08	10.87	2.29
CA9	85.2	250.1**	65.03**	13.90**	3.62**
CHD35	57.8	144.0	36.15	8.00	2.01
CHD8	92.4	280.4**	61.69**	15.58**	3.43**
CO 4	50.4	223.4**	50.49**	12.41**	2.81**
CO 3	106.1**	230.0**	50.14**	12.78**	2.79**
CA66	83.9	163.6	32.72	9.09	1.82

(Contd..)

Accession No.	Number of fruits per plant	Fresh fruit yield per plant (g)	Dry fruit yield per plant (g)	Estimated fresh fruit yield per hectare (t)	Estimated dry fruit yield per hectare (t)
Pepper Hot	126.1**	163.8	63.25**	9.10	3.52**
Ujwala	118.9**	172.3	45.08*	9.57	2.50*
CC4	121.2**	156.1	70.44**	8.68	3.91**
KDC1	121.2**	146.2	43.72	8.12	2.43
Punjab Lai	120.3**	120.6	25.20	6.70	1.40
CF53	155.1**	172.7	36.79	9.59	2.05
Punjab Guchhedar	155.2**	179.5	40.20	9.97	2.23
CC3	118.2**	145.5	31.43	8.08	1.75
Arka Lohit	142.3**	270.5**	75.64**	15.03**	4.21**
Grand Mean	93.8866	195.8425	42.9854	10.8803	2.3875
SEd	2.1811	3.6804	0.8622	0.2045	0.0480
CD(0.05)	4.3323	7.3105	1.7126	0.4061	0.0953
CD(0.01)	5.7370	9.6808	2.2679	0.5378	0.1261
CV (%)	2.32	1.88	2.01	1.88	2.01

* Significant at 5 per cent level ** Significant at 1 per cent level

from 16.0 to 50.0 mg per 100 g. The resistant and moderately resistant genotypes under field conditions were found to be significantly superior with respect to phenol content. The genotypes exhibited significant differences for the yield attributes (Table 2), namely, number of fruits per plant, fresh and dry fruit yields per plant. The estimated fresh and dry fruit yields per hectare were also found to differ significantly among the 93 genotypes.

The results obtained by screening the chilli genotypes for resistance against anthracnose disease in pot culture under artificial conditions are presented in Table 1. The per cent disease index values ranged between 33.33 and 100.00. All the 93 genotypes scored grades of 3 or 4 and were found to be either susceptible or highly susceptible. None of the genotypes was immune or resistant to anthracnose disease, when inoculated artificially.

Thus among the ninety three genotypes screened under natural epiphytotic conditions for resistance to anthracnose, based on the resistance score, three genotypes viz., Sin 1, Sin 2 and Sin 3 which recorded the least incidence were selected as donors for resistance. Though they exhibited 'susceptible' category score when artificially inoculated by fungal pathogen, there seem to be an inbuilt resistance to the pathogen under natural epiphytotic conditions in these genotypes when compared to other ninety genotypes. Besides, five other lines viz., Arka Lohit, CC 4, KDC 1, Pepper Hot and Ujwala were found to exhibit moderate resistance to anthracnose. The resistance in these eight lines might be due to the presence of appreciable amount of total phenols recorded as reported by Bhullar *et al.* (1972), Azad (1991), Jeyalakshmi *et al.* (1999) and Borua and Das (2000). Incidentally it was observed that these selected lines recorded fairly good

yield, too. Wide genetic divergence between the lines, usually, results in high heterosis in the hybrids. With wider geographical and genetic diversity, crosses of the most distantly related population however, showed less heterosis than crosses of population assumed to be less distantly related. This suggests that the maximum heterosis occurs at an intermediate level of genetic diversity (Moll *et al.*, 1974). In the present study, taking into consideration the aim of developing Fi hybrids with high yield coupled with resistance to anthracnose, though the parental lines may not be genetically much diversified, they were selected such that they possess high or moderate level of resistance with fairly good yield, so that the hybrids developed will be of commercial value.

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