The Andhra Agric. J 69 (4): 545-551, 2022

Screening of Chickpea Genotypes for Resistance to Fusarium Wilt under Sick Plot Condition

B H Chaithanya, J Manjunath, S Ramadevi and V Jayalakshmi
Regional Agricultural Research Station, ANGRAU Nandyal, Guntur

ABSTRACT

A total of 277 chickpea genotypes obtained from various AICRP centers were evaluated to identify resistance sources against Fusarium wilt under sick plot conditions. The observations on wilt incidence were recorded at two stages *i.e.* seedling (30 DAS) and reproductive stage (60 DAS). The mean disease incidence ranged from 0-100%. Among the 277 chickpea genotypes tested, 47 genotypes were resistant, 77 genotypes were moderately resistant, 45 genotypes were moderately susceptible, 42 genotypes were susceptible and 64 genotypes were found highly susceptible The chickpea genotypes identified as resistant were further screened for their stable resistant reaction as these genotypes can be used in breeding programs to develop resistant varieties.

Keywords: *Chickpea, Cicer arietinum, Disease incidence and Fusarium wilt.*

Chickpea (*Cicer arietinum* L.) is the most important food legume crop in India. It is an important source of good-quality of protein and fiber and also helps in the management of soil fertility, particularly in rainfed conditions through its root nodules (Singh & Saxena, 1996). In India, the production of chickpeas represents 45 percent of the total production of pulses and the productivity of chickpeas was 1041 Kg/ha during 2018-19 (Nyein *et al.,* 2022). Chickpea crop was often suffered from various biotic and abiotic stresses. The Fusarium wilt disease is one of the important biotic stresses that is responsible for its low yield. Fusarium wilt caused by *Fusarium oxysporum* f. sp. *ciceris* is the most destructive soil-borne disease of chickpea and 10% annual yield losses were reported with the Fusarium wilt (Singh and Dahiya, 1973).

The losses due to early wilting (within 25 days after sowing) were more than late wilting (6 to 8 weeks after sowing), but the seeds collected from late-wilted chickpea plants were usually rough, lighter and dull than seeds collected from healthy plants (Nene & Haware, 1980). The yield losses due to Fusarium wilt are about 10-100% depending upon the agro-climatic situation (Grewal and Pal, 1970)

The management of Fusarium wilt is not possible with a single control measurement. Chemical control is alone not practical and economical because of the soil-borne nature of the pathogen. The integrated management approach is most suitable in which the use of resistant varieties is one of the best economical ways of management practice (Nene & Haware, 1980; Nene & Reddy, 1987). The pathogen can survive through chlamydospores, even up to 6 years of period in the absence of a host (Haware *et al*., 1996).

Keeping all the above information in view, the present study was designed to identify the resistant sources among chickpea genotypes against Fusarium wilt under sick plot conditions.

MATERIAL AND METHODS

In the present study, a total of 277 chickpea genotypes from different AICRP centers including resistant (WR 315) and susceptible (JG 62) checks were screened under sick plot conditions at Regional Agricultural Research Station, Nandyal during Rabi 2021-22. The experiment was conducted in a randomized block design and each test line was sown in two replications. Thirty seeds for each genotype

were sown in 3m row length with the spacing of 30 x 10 cm. The susceptible check (JG-62) was sown after every two test entries. The resistant check *i.e.* WR 315 was sown in the first and last row of the experimental plot. Data on the number of wilted plants for each test line were recorded at 30 and 60 days after sowing. The percentage of wilt incidence was calculated by using the following formula

Wilt incidence= (Number of wilted plants / Total number of plants observed) X100

The genotypes were categorized by using the below 1-9 disease scale based on disease incidence (Anonymous, 2014)

Scale	Per cent Disease Incidence (%)	Category
1	0-10%	Resistant
3	11-20%	Moderately Resistant
5	21-30%	Moderately Susceptible
7	31- 50 %	Susceptible
9	51-100 %	Highly Susceptible

Table 1. Reaction of AICRP entries against *Fusarium* wilt

S. No.	Entry	incidence (%)	Disease Reaction	S. No.	Entry	incidence (%)	Disease Reaction
1	NBeG 1149	9.86	R	27	H05-24	53.35	HS
2	BG40+D9:D22830	10.98	R	28	NBeG924	45.93	S
3	BRC 2021-09	15.62	MR	29	IPC 2018-131	18.33	MR
4	RKG 19-1	14.25	MR	30	GJG 1810	20.71	MR
5	GJG1803	21.41	MS	31	RSGD-1155	55.58	HS
6	PG290	72.5	HS	32	BRC-8	16.19	MR
7	RKG21-1	13.64	MR	33	IPCB 2014-88	33.67	S
8	IPCD 2016-127	50.26	HS	34	BC 4	52.41	HS
9	IPC2017-373	50.74	HS	35	NDG 17-6-2	11.67	MR
10	NBeG1423	13.43	MR	36	GJG 1801	6.67	R
11	RVSSG 106	58.33	HS	37	GNG 2562	9.85	R
12	IG 2021-01	8.33	R	38	DC 2021-1	75	HS
13	PG265	53.25	HS	39	Phule G 1314-3-27	15.29	MR
14	BDNG2017-01	21.67	MS	40	RLBG-10	15.48	MR
15	PG289	56.92	HS	41	IG 21-05	22.01	MS
16	BDNG 2020-68	13.1	MR	42	DCD 20-09	100	HS
17	JG 2021-71	73.5	HS	43	GJG 1903	26.81	MS
18	BG 4031	11.14	MR	44	JG 2021-69	26.67	MS
19	IG 21-06	14.18	MR	45	Phule G 181609	27.05	MS
20	Phule G 1302-3-5	8.57	R	46	DBGC 3	55.28	HS
21	RSGD-1119	51.88	HS	47	PBC 579	25.83	MS
22	GL18018	62.54	HS	48	H 19-21	56.33	HS
23	DC2021-1664	57.14	HS	49	PG 281	54.32	HS
24	H 19-16	59.21	HS	50	GL 16056	22.78	MS
25	GNG 2555	21.36	MR	51	RKG 21-3	21.67	MS
26	RG 2020-10	32.33	S	52	RLBG-9	18.33	MR

S. No.	Entry	incidence (%)	Disease Reaction	S. No.	Entry	incidence (%)	Disease Reaction
53	RSGD 1116	61.36	HS	95	DK 21-1311	7.5	R
54	KCD2019-05	50.15	HS	96	GNG 2479	68.03	HS
55	H 16-21	16.67	MR	97	GJG 1910	11.34	MR
56	GJG 1907	11.82	MR	98	CSJK-132	15.68	MR
57	IPC 2016-231	12.25	MR	99	NBeG 1428	72.41	HS
58	RSGD-984	3.96	R	100	HK 20-5	14.58	MR
59	NBeG 1328	16.36	MR	101	IG 2020-05	11.67	MR
60	IPCB 2016-25	10.74	R	102	CSJ 138	21.15	MS
61	GL 16026	33.19	S	103	RLBGMH-3	8.84	R
62	GL 18149	10.29	R	104	IGK 21-01	42.33	S
63	PG 282	56.45	HS	105	RVSSG-113	31.99	S
64	GNG-2549	11.52	MR	106	BDNG 2020-20	12.33	MR
65	GNG-2557	15.52	MR	107	RVSSG-107	66.67	HS
66	KCD 19-05	8.33	R	108	IPCKB 2016-133	52.86	HS
67	RSGD 1125	38.69	S	109	GJG 1913	18.33	MR
68	BDNG 2018-16	11.79	MR	110	IPC2017-141	89.83	HS
69	NBeG 1634	9.06	R	111	IG2020-16	18.33	MR
70	H 19-12	54.41	HS	112	GNG2518	55.12	HS
71	IG 2018-111	9.34	R	113	RVSSG-108	33.33	S
72	GNG 2513	43.97	S	114	RKGKD 17-09	13.62	MR
73	RKG 21-2	21.04	MS	115	H 16-04	66.03	HS
74	RVSSG-105	57.93	HS	116	IPC 2017-292	6.67	R
75	GJG 1913	35.47	S	117	Phule G 201301	16.76	MR
76	RVSSG-109	44.49	S	118	Phule G 171313	21.73	MS
77	GL 18148	50.08	S	119	IG 21-04	17.38	MR
78	IPC 2018-38	11.67	MR	120	PBC 501	11.67	MR
79	BG 4032	11.85	MR	121	COC-18-02	100	HS
80	BG 4029	61.96	HS	122	NBeG 1146	5.79	R
81	PBC 590	24.43	MS	123	PBC 582	13.96	MR
82	RKG 21-4	19.31	MR	124	RLBGK-7	25.96	MS
83	JG 2021-68	28.33	MS	125	Phule G 181312	15.68	MR
84	JG 2021-67	31.67	S	126	H 16-17	22.9	MS
85	Phule G1216-10-17	28.71	MS	127	BG 4033	15	MR
86	KCD 19-05	33.15	S	128	RSGD 1068	20	MR
87	IPCD 2019-222	18.75	MR	129	KCD 20-8	15.83	MR
88	NBeG 1509	56.86	HS	130	HK 19-67	16.76	MR
89	RSGD 1137	41.23	S	131	RSGD 1174	45.67	S
90	IGK 2020-02	36.22	S	132	IG 2020-15	48.95	S
91	IPCB 2015-132	20.69	MR	133	RKGK 19-9	15.56	MR
92	GL 15003	30.26	S	134	GNG 2546	25	MS
93	BG 4027	18.33	MR	135	GNG 2461	16.52	MR
94	Phule G 1221-2-6	5.06	R	136	DBGC 3	53.85	HS

S. No.	Entry	incidence (%)	Disease Reaction	S. No.	Entry	incidence (%)	Disease Reaction
137	NBeG 1430	94.44	HS	179	H 12-55	5.26	R
138	IPCK 2016-12	88.33	MR	180	IPC L 4-14	6.9	R
139	H13-03	13.03	MR	181	IPCB 2018-39	11.67	MR
140	IPC2017-253	11.01	MR	182	IPCB 19-3	8.62	R
141	KCD 20-3	5.93	R	183	GL 13001	42.5	HS
142	NBeG 1137	5.61	MR	184	RSGD -965	25.33	MS
143	IPC 2017-361	2.17	R	185	AKG 1402	8.19	R
144	BG 4035	35.71	S	186	AKG 1303	13.33	MR
145	PG 252	27.27	R	187	DCP 92-3	22.29	MS
146	H 07-120	52.08	HS	188	RSG 963	52.38	HS
147	CSJK-169	20.24	MR	189	PKV 4-1	22.77	MS
148	RSGD 834	48.13	MR	190	NC 9	31.75	S
149	CSJ-824	33.85	R	191	IG 21-07	26.28	MS
150	IPC 2017-04	10.24	S	192	RG 2020-03	5.26	R
151	NBeG 1532	21.88	MR	193	BGM 10221	6.62	R
152	RLBGMH-4	14.23	R	194	GNG 1581	62.39	HS
153	NBeG 1267	12.86	HS	195	GNG 2299	54.35	HS
154	GJG 1916	5.37	R	196	Phule Vikram	20.14	MR
155	KCK 20-17	8.39	S	197	JG 315	24.42	MS
156	IPCK 2010-124	8.99	MS	198	NBeG 1427	51.67	HS
157	RKG 20-2	8.81	HS	199	GJG 1914	56.48	HS
158	IG 21-03	3.77	S	200	GL 19607	23.41	MS
159	Phule G 1327-10-12	8.33	S	201	RSGD 997	70.37	HS
160	BG 4034	55.2	S	202	Vijay	25.95	MS
161	RVSSG 96	20.31	MR	203	Annigeri	22.32	MS
162	RKGM 20-2	14	MR	204	RLBGMH-6	55.82	HS
163	RKG 21-8	30.56	HS	205	DMHC 21-1108	8.89	R
164	BDNG 2020-8	25.73	MS	206	Phule G 201114	11.67	MR
165	GNG 2550	47.72	MR	207	IPC 2006-77	67.86	HS
166	PBC 509	16.85	MS	208	BDNK 798	9.76	R
167	COC-18-01	32.14	S	209	IPC MB 21-1	7.33	R
168	RKG 21-5	20.11	MS	210	RVSSG-110	10.36	R
169	ADBG 581	34.26	S	211	BG 4037	10.52	R
170	RKG 13-125	35	MR	212	RKG-21-9	6.92	R
171	RKG 13-416	18.33	HS	213	BGM 20215	7.14	R
172	IPCKB 2016-149	14.32	S	214	RSG 931	52.17	HS
173	GLK 18087	58.33	S	215	GCP 101	9.55	R
174	KCK 20-9	25.82	MR	216	MNK1	54.02	HS
175	GL 17020	8.33	S	217	GNG 2171	28.37	MS
176	GJGK 1824	15.07	MR	218	KCMH 20-17	13.29	MR
177	GJG 1810	8.48	R	219	BRC2021-10	7.55	R

S. No.	Entry	incidence (%)	Disease Reaction	S. No.	Entry	incidence (%)	Disease Reaction
220	NBeG 1632	57.31	HS	250	Phule G 0517	42.86	S
221	GL 17033	50.79	HS	251	RG 2015-08	19.56	MR
222	RSG 888	56.72	HS	252	RKG21-10	13.33	MR
223	NBeG 119	54.09	HS	253	H 18-08	19.71	MR
224	BGM 20211	31.88	S	254	NC 8	28.52	MS
225	Pant Gram 5	76.19	HS	255	Pant G 186	33.04	S
226	BG 4036	26.5	MS	256	NC7	34.55	S
227	JAKI 9218	14.87	MR	257	HC5	35.42	S
228	IPC 2017-351	23.61	MS	258	IG 21-08	32.98	S
229	PG 296	37.72	S	259	PG 298	32.61	S
230	H 19-36	33.04	S	260	RVSSG-111	12.5	MR
231	CSJ 515	28.33	MS	261	Indira chana	59.38	HS
232	BG 3043	34.17	S	262	CSJ 174	34.29	S
233	KPG 59	32.46	S	263	CSG 8962	28	MS
234	RVG 204	28.57	MS	264	Phule G 0405	64.29	HS
235	GNG2207	16.67	MR	265	RKG 13-414	55	HS
236	DMHC 21-1104	18.75	MR	266	RKG 20-3	31.92	MS
237	GJG 1917	15.17	MR	267	PBG 574	19.55	MR
238	JG 2021-70	21.67	MS	268	BGM 10222	27.02	MS
239	RG 2020-12	21.21	MS	269	NBeG 810	54.76	HS
240	NBeG 506	34.62	S	270	CSJ 174	62.14	HS
241	KAK2	54.17	HS	271	Vihar	32.02	S
242	GNG 1958	19.97	MR	272	Pusa 10216	56.22	HS
243	GNG 2144	13.56	MR	273	IPCK 02-29	30.67	MS
244	GBM 2	16.34	MR	274	JG 16	10.71	R
245	BG 372	39.17	S	275	JG 24	56.09	HS
246	RLBMH-5	11.32	MR	276	JG-62 (S)	100	
247	Phule G 201113	8.52	R	277	WR-315(R)	2.76	

Table 2. Categorization of chickpea genotypes based on wilt incidence

S. No.	Mortality %	Category	No of entries	Details of Entries
1	0-10% mortality	Resistant	47	NBeG 1149, BG40+D9:D22830, IG 2021-01, Phule G 1302-3-5, GJG 1801, GNG 2562, RSGD-984, IPCB 2016-25, GL 18149, KCD 19-05, NBeG 1634, IG 2018-111, Phule G 1221-2-6, DK 21-1311, RLBGMH-3, IPC 2017-292, NBeG 1146, KCD 20-3, NBeG 1137, IPC 2017-361, IPC 2017-04, GJG 1916, KCK 20-17, IPCK 2010-124, RKG 20-2, IG 21-03, Phule G 1327-10-12, GL 17020, GJG 1810, KCMH 20-15, H 12-55, IPC L 4-14, IPCB 19-3, AKG 1402, RG 2020-03, BGM 10221, DMHC 21-1108, BDNK 798, IPC MB 21-1, RVSSG-110, BG 4037, RKG-21-9, BGM 20215, GCP 101, BRC2021-10, Phule G 201113 and JG 16

2	11-20% mortality	Moderately Resistant	77	BRC 2021-09, RKG 19-1, RKG21-1, NBeG1423, BDNG 2020-68, BG 4031, IG 21-06, GNG 2555, IPC 2018-131, GJG 1810, BRC-8, NDG 17-6-2, Phule G 1314-3-27, RLBG-10, RLBG-9, H 16-21, GJG 1907, IPC 2016-231, NBeG 1328, GNG-2549, GNG-2557, BDNG 2018-16, IPC 2018-38, BG 4032, RKG 21-4, IPCD 2019-222, IPCB 2015-132, BG 4027, GJG 1910, CSJK-132, HK 20-5, IG 2020-05, BDNG 2020-20, GJG 1913, IG2020-16, RKGKD 17-09, Phule G 201301, IG 21-04,PBC 501, PBC 582, Phule G 181312, BG 4033, RSGD 1068, KCD 20-8, HK 19-67, RKGK 19-9, GNG 2461, H13-03, IPC2017-253, CSJK-169, RLBGMH-4, NBeG 1267, RVSSG 96, RKGM 20-2, PBC 509, RKG 21-5, RKG 13-416,IPCKB 2016-149, GJGK 1824, IPCB 2018-39, AKG 1303, Phule Vikram, Phule G 201114, KCMH 20-17, JAKI 9218, GNG2207, DMHC 21-1104GJG 1917, GNG 1958, GNG 2144, GBM 2, RLBMH-5, RG 2015-08, RKG21-10, H 18-08, RVSSG-111, PBG 574
3	21-30% mortality	Moderately Susceptible	45	GJG1803, BDNG2017-01, IG 21-05, GJG 1903, JG 2021-69, Phule G 181609, PBC 579, GL 16056, RKG 21-3, RKG 21-2, PBC 590, JG 2021-68, Phule G1216-10-17, CSJ 138, Phule G 171313, RLBGK-7, H 16-17, GNG 2546, PG 252, NBeG 1532, RKG 21-8, BDNG 2020-8, KCK 20-9, RSGD -965, DCP 92-3, PKV 4-1, IG 21-07, JG 315, GL 19607, Vijay, Annigeri, GNG 2171, BG 4036, IPC 2017-351, CSJ 515, RVG 204, JG 2021-70, RG 2020-12, IPC 2018-59, RVG 202, NC 8, CSG 8962, RKG 20-3, BGM 10222, IPCK 02-29
4	31- 50 % mortality	Susceptible	42	RG 2020-10, NBeG924, IPCB 2014-88, GL 16026, RSGD 1125, GNG 2513, GJG 1913, RVSSG-109, GL 18148, JG 2021-67, KCD 19-05, RSGD 1137, IGK 2020-02, GL 15003, IGK 21-01, RVSSG-113, RVSSG-108, RSGD 1174, IG 2020-15, BG 4035, RSGD 834, CSJ-824, GNG 2550, COC-18-01, ADBG 581, RKG 13-125, NC 9, BGM 20211, PG 296, H 19-36, BG 3043, KPG 59, NBeG 506, BG 372, Phule G 0517, Pant G 186, NC7, HC5, IG 21-08, PG 298, CSJ 174 and Vihar
5	51-100 %	Highly Susceptible	64	PG290 , IPCD 2016-127, IPC2017-373, RVSSG 106, PG265, PG289, JG 2021-71, RSGD-1119, GL18018, DC2021-1664, H 19-16, H05-24, RSGD-1155, BC 4, DC 2021-1DCD 20-09, DBGC 3, H 19-21, PG 281, RSGD 1116, KCD2019-05, PG 282, H 19-12, RVSSG-105, BG 4029, NBeG 1509, GNG 2479, NBeG 1428, RVSSG-107, IPCKB 2016-133, IPC2017-141, GNG2518, H 16-04, COC-18-02, DBGC 3, NBeG 1430, IPCK 2016-12, H 07-120, BG 4034, GLK 18087, GL 13001, RSG 963, GNG 1581, GNG 2299, NBeG 1427, GJG 1914, RSGD 997, RLBGMH-6, IPC 2006-77, RSG 931, MNK1, NBeG 1632, GL 17033, RSG 888, NBeG 119, Pant Gram 5, KAK2, Indira chana, Phule G 0405, RKG 13-414, NBeG 810, CSJ 174, Pusa 10216, JG 24

Similar results were made by Shah *et al.* (2015) who screened 54 chickpea genotypes under filed conditions and found 23 resistant genotypes, while, Hotkar *et al.* (2018) studied 31 ICRISAT entries for two consecutive years (2014-16) and found that ten entries showed resistant reaction. Similarly, Veenashri *et al.* (2020) evaluated 129 chickpea lines in wilt sick plot and reported that 34 lines exhibited resistant reaction with < 10% wilt incidence.

Among 227 entries screened under field conditions, 47 entries showed resistant reaction. Out of total 47 resistant entries found, four Nandyal Gram entries *i.e* NBeG 1149, NBeG 1634, NBeG 1146 and NBeG 1137 were developed from RARS, Nandyal. Acharya N G. Ranga Agricultural University. The resistant lines identified in the present study can be further exploited in the resistant breeding programme.

LITERATURE CITED

Anonymous 2014. AICRP on Chickpea annual work shop. RARI, Durgapura, Rajasthan. 1st August to 3rd September.

Grewal J S and Pal M 1970. Proc. IV Annual workshop on pulse crops, Punjab Agricultural University, Ludhiana, India. Page No.168.

Haware M P, Nene Y L and Natarajan M 1996. Survival of *Fusarium oxysporum* f. sp. ciceri. Plant Disease. 66:809-810.

Hotkar S, Jayalakshmi S K and Suhas P D 2018. Screening for resistant sources in chickpea entries against Fusarium wilt. Journal of Pharmacognosy and Phytochemistry 7(5): 663-665.

Nene Y L and Haware M P 1980. Screening chickpea for resistance to wilt. Plant Disease. 64:379-380.

Nene Y L and Reddy M V 1987. Chickpea diseases and their controlIn: The Chickpea. (Eds.): M. C. Saxena and K. B. Singh. CAB International, Oxon, United Kingdom. . Pages 233-270.

Nyein A K, Kundu K K, Malik D P and Janailin S P 2022. Production and Trade of Chickpea (*Cicer aneityum*) in India and Myanmar. Indian Journal of Applied Business and Economic Research.3(1):81-97.

Shah T M, Imran M, Atta B M, Shafiq M, Aslam M and Hussain K 2015. Screening of chickpea advanced lines for sources of resistance against blight and wilt two major diseases of chickpea. Pakisthan Journal of Botany. 47(6):2443-2448.

Singh K B and Dahiya B S 1973. Breeding for wilt resistance in chickpea In: Symposium on Wilt Problem and Breeding for Wilt Resistance in Bengal Gram. Indian Research Institute, New Delhi, India. Pages 13-14.

Singh K B and Saxena M C 1996. Winter chickpea in Mediterranean type environments. International Center for Agricultural Research in Dry Areas. Aleppo, Syria.

Veenashri J, Laxuman, Susmita H and Mahalinga D 2020. Screening chickpea (*Cicer arietinum* L.) for resistance to wilt (*Fusarium oxysporum* f.sp. *ciceri*) under field condition. International Journal of Current Microbiology and Applied sciences. 9(7):233-241.

Received on 02.07.2022 and Accepted on 20.12.2022