



Full Length Research Article

SCREENING OF CHICKPEA VARIETIES, CULTIVARS AND GENOTYPES AGAINST FUSARIUM OXYSPORUM F. SP. CICERI

¹Thaware, D. S., ²Gholve, V. M. and ²Ghante, P. H.

¹Department of Plant Pathology, Ratnai College of Agriculture, Akluj (MPKV., Rahuri) 431 101, (Maharashtra), India

²Department of Plant Pathology, Marathwada College of Agriculture, Parbhani (VNMKV, 431 401 Parbhani), (Maharashtra), India

ARTICLE INFO

Article History:

Received 02nd November, 2016
Received in revised form
29th December, 2016
Accepted 29th January, 2017
Published online 28th February, 2017

Key Words:

Cicer arietinum,
Fusarium wilt,
Genotypes,
Cultivars and resistance.

ABSTRACT

Fusarium oxysporum f. sp. *ciceri* is one of the most destructive pathogen, causing wilt disease in chickpea and thereby inflicting account table quantitative as well as qualitative losses. Under natural epiphytotic conditions (Rabi 2013-2014), all the 50 chickpea entries exhibited different reactions against *Fusarium oxysporum* f. sp. *ciceri*. However, six test entries were found highly resistant (Vishal, BCP-10, BCP-21, BCP-49, BCP-60 and BCP-61), thirty one were resistant, eight were moderately resistant (BDNG 9-3, BDNG-2003-1, JAKI- 9218, BDNG-2010-1, BDNG- 801, AKG-12009, PKV Kabuli-2 and BCPK-3), two were moderately susceptible (PKV Kabuli-4 and Virat) and three were highly susceptible (JG-62, BDNGK-807 and AKG-1207). In the Rabi 2014-2015, a total 48 entries exhibited different reactions against *Fusarium* wilt of chickpea. Single test entry was found highly resistant (PG-8108), twenty one were resistant, eight were moderately resistant, ten were moderately susceptible (AKG-1306, BDNG-801, Jaki-9218, BDNG K-799, PKV Kabuli-4, BDNG-798, Krupa, PG-12310, PG-12138 and PG-0611-14), five were susceptible (AKG-1103, B.D.N. 9-3, BDNG-K-807, AKG-1208 K and PKV Kabuli-2) and three were highly susceptible (JG-62, BDNG-804 and BDNG-2013-2).

Copyright©2017, Thaware et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important pulse crop, which belongs to leguminosae family, ranking third after dry beans (*Phaseolus vulgaris* L.) and dry peas (*Pisum sativum* L.) (Dhar and Gurha, 1998). The centre of origin is in Eastern Mediterranean. India is largest producer of chickpea in world sharing 65.25 per cent in area and 65.49 per cent in production. In India chickpea is grown on 81.17 lakh ha area with production of 59.01 lakh tonnes and productivity of 727 kg/ha. The production of chickpea in Maharashtra is 7.54 lakh tonnes with productivity of 574 kg/ha which covered nearly 13.15 lakh ha of area. Maharashtra contributes about 14 per cent share in total production of country (Anonymous, 2015). Chickpea is cultivated throughout the state Maharashtra and widely grown in regions of Western Maharashtra, Marathwada and Vidharbha. The major limiting factor in chickpea production is *Fusarium* wilt which is caused by *F. oxysporum* Schlechtend. Fr. f. sp. *ciceris* (Padwick) Matuo and K. Sato. (Nene and Reddy, 1987).

*Corresponding author: Thaware, D. S.,
Department of Plant Pathology, Ratnai College of Agriculture, Akluj (MPKV., Rahuri) 431 101, (Maharashtra), India.

It was first reported in Indo-Pak sub-continent (Butler, 1918). At national level the yield losses encountered due to wilt may vary between 5 to 10 per cent (Singh and Dahiya, 1973). It observed damage to be upto 61 per cent at seedling stage and 43 per cent at flowering stage (Nema and Khare, 1973). In general, the disease causes substantial yield losses which may reach even 100 per cent under favourable weather conditions (Jalali and Chand, 1992). The chickpea is cultivated as a rain fed crop in Maharashtra state and yield losses amounted to 10 to 15 per cent (Khillare et al., 2009).

MATERIALS AND METHODS

Screening of chickpea varieties, cultivars and genotypes

The experiment was conducted in wilt sick plot, Agricultural Research Station Badnapur, VNMKV, Parbhani (M.S.) under field condition, to see the response of different chickpea varieties, cultivars and genotypes against *Fusarium oxysporum* f. sp. *ciceri*. Surface sterilized (0.1% HgCl₂) seeds of all test entries of chickpea were sown (15 October) in wilt sick soil (*Fusarium oxysporum* f. sp. *ciceri*). All test entries alternated with susceptible check JG-62 were planted in two replications

and the length of each row was 5 meter. The observations viz., total number of plants, total number of infected plants and the average of wilt plants in each entry were calculated. The observations on wilt were recorded in percentage of disease incidence was recorded by applying 0-9 point disease rating scale (IIPR, 1999).

Grade for accounting per cent mortality of *Fusarium oxysporum* f. sp. *ciceri*

Grade	Per cent mortality	Disease reactions
0	No disease	Highly resistant (HR)
1	1 to 10	Resistant (R)
2	10.1 to 20	Moderately resistant (MR)
3	20.1 to 30	Moderately susceptible (MS)
4	30.1 to 50	Susceptible (S)
5	50 and above	Highly susceptible (HS)

Table 1. Reaction of chickpea lines to wilt during Rabi 2013-2014

Sr. No.	Entries	Wilt incidence (%)	Disease reaction
Reaction of SMVT (R) chickpea lines to wilt disease			
1	BDNG-2013-1	02.57	Resistant
2	Krupa	01.72	Resistant
3	BDNG-9-3	19.09	Moderately resistant
4	BCP-26	01.92	Resistant
5	BDNG-2003-1	14.58	Moderately resistant
6	SAKI- 9516	05.31	Resistant
7	AKG-1109	01.78	Resistant
8	AKG-1209	07.78	Resistant
9	JAKI- 9218	16.04	Moderately resistant
10	AKG-1108	03.92	Resistant
11	Vijay	07.14	Resistant
12	PG-0752	05.69	Resistant
13	Vishal	00.00	Highly resistant
14	PG-8108	01.65	Resistant
15	PG-302-10	02.63	Resistant
16	Digvijay	05.92	Resistant
17	JG-62	100.00	Highly susceptible
Reaction of SMVT (I) chickpea lines to wilt disease			
18	BCP-49	00.00	Highly resistant
19	BDNG-2010-1	16.34	Moderately resistant
20	BDNG-801	18.22	Moderately resistant
21	AKG-70	01.78	Resistant
22	AKG-2009	22.25	Moderately resistant
23	AKG-1009	05.61	Resistant
24	JAKI-1218	07.90	Resistant
25	BCP-60	00.00	Highly resistant
Reaction of SMVT (Kabuli) chickpea lines to wilt disease			
26	AKG-1207	89.18	Highly susceptible
27	PKV Kabuli-2	12.69	Moderately resistant
28	AKG-20021 K	06.56	Resistant
29	PKV Kabuli-4	32.40	Moderately susceptible
30	BCPK-1	02.27	Resistant
31	BCPK-2	09.55	Resistant
32	AKG-1205	04.95	Resistant
33	Virat	29.16	Moderately susceptible
34	BCPK-3	13.28	Moderately resistant
35	BDNGK-807	100.00	Highly susceptible
Reaction of BCP chickpea lines to wilt disease			
36	BCP-92	01.92	Resistant
37	BCP-51	02.85	Resistant
38	BCP-24	03.22	Resistant
39	BCP-52	03.43	Resistant
40	BCP-124	04.55	Resistant
41	BCP-21	00.00	Highly resistant
42	BCP-37	01.25	Resistant
43	BCP-61	00.00	Highly resistant
44	BCP-10	00.00	Highly resistant
45	BCP-11	01.42	Resistant
46	BCP-36	03.27	Resistant
47	BCP-48	01.92	Resistant
48	BCP-60	01.56	Resistant
49	BCP-26	07.91	Resistant
50	BCP-28	03.85	Resistant

RESULTS AND DISCUSSION

Rabi 2013-2014: In order to find out the sources of resistance in chickpea for *Fusarium* wilt, fifty and forty eight chickpea genotypes which were collected from Agricultural Research Station, VNMKV, Parbhani were evaluated during Rabi 2013-14 and 2014-15 respectively, both under field conditions by the standard procedure. Results (Table 1) revealed that, during Rabi 2013-2014 at under natural epiphytotics, all the 50 chickpea entries exhibited different reactions against *Fusarium oxysporum* f. sp. *ciceri*. However, six cultivars viz., Vishal, BCP-10, BCP-21, BCP-49, BCP-60 and BCP-61 were found highly resistant with mean disease intensity of 00.00 per cent, thirty one varieties, cultivars, germplasm lines viz., BDNG-2013-1, BCP-26, SAKI- 9516, AKG-1109, AKG-1209, AKG-1108, Vijay, PG-0752, PG-8108, PG-302-10, Digvijay, AKG-70, AKG-1009, JAKI-1218, AKG-20021K, BCPK-1, BCPK-2, BCPK-2, Krupa, BCP-92, BCP-51, BCP-24, BCP-52, BCP-124, BCP-37, BCP-11, BCP-36, BCP-48, BCP-60, BCP-26 and BCP-28 were found moderately resistant with mean disease intensity in the range of 1.25 (BCP-37) to 9.55 (BDNG-797 and BCPK-2) per cent, eight varieties, cultivars, germplasm lines viz., BDNG-9-3, BDNG-2003-1, JAKI-9218, BDNG-2010-1, BDNG-801, AKG-12009, PKV Kabuli-2 and BCPK-3 were found moderately resistant with mean disease intensity in the range of 12.69 (PKV Kabuli-2) to 22.25 (AKG-12009) per cent. Two varieties PKV Kabuli-4 and Virat was found moderately susceptible with mean disease intensity of 32.40 and 29.16 per cent; whereas, JG-62 (100%), BDNGK-807 (100%) and AKG-1207 (89.18%) were found highly susceptible to wilt.

Categorization of chickpea varieties / cultivars, genotypes and germplasm lines

The observations on per cent wilt incidence were recorded at 15 days before harvesting of the crop and test entries of chickpea were graded and categorized as highly resistant (00.00%), resistant (1-10%), moderately resistant (11-25%) moderately susceptible (26-50%), susceptible (51-75%) and highly susceptible (76-100%).

Rabi 2014-2015: Results (Table 3), revealed that, during Rabi 2014-2015 at under natural epiphytotics, all the 48 chickpea entries exhibited different reactions against *Fusarium oxysporum* f. sp. *ciceri*. However, one cultivar PG-8108 was found highly resistant with mean disease intensity of 00.00 per cent, twenty one varieties, cultivars, germplasm lines viz., AKG-1106, AKG-1108, Saki-9516, BCP-26, PG-611-14, BDNG-2013-1, BDNG-2003-1, PG-302-10, BDNG-2010-1, BCP-60, AKG-70, AKG-1303, AKG-1109, PG-8108, BCP-49, Vishal, Virat, PG-0302-10, PG-12110, Digvijay and PG-08108 were found moderately resistant with mean disease intensity in the range of 1.51 (AKG-1303) to 10.34 (BCP-49) per cent, eight varieties, cultivars, germplasms lines viz., P.G. 0302-10, Vishal, Jaki-9218, BDNG-797, AKG-1009, Saki-9501, AKG-1304 K and PG-12313 were found moderately resistant with mean disease intensity in the range of 11.11 (Jaki-9218) to 25.51 (BDNG-797) per cent.

Ten varieties, cultivars, germplasm lines viz., AKG-1306, BDNG-801, Jaki-9218, BDNG-K-799, PKV Kabuli-4, BDNG-798, Krupa, PG-12310, PG-12138 and PG-0611-14 were found

Table 2. Categorization of chickpea cultivars / varieties, genotypes and germplasm lines

Category	Reaction	Average wilt incidence (%)	Varieties / cultivars / genotypes germplasm lines
0	Highly resistant (6)	00.00	Vishal, BCP-10, BCP-21, BCP-49, BCP-60 and BCP-61
1	Resistant (31)	1-10	BDNG-2013-1, BCP-26, SAKI- 9516, AKG- 1109, AKG-1209, AKG-1108, Vijay, PG-0752, PG-8108, PG-302-10, Digvijay, AKG-70, AKG-1009, JAKI-1218, AKG-20021 K, BCPK-1, BCPK-2, BCPK-2, Krupa, BCP-92, BCP-51, BCP-24, BCP-52, BCP-124, BCP-37, BCP-11, BCP-36, BCP-48, BCP-60, BCP-26 and BCP-28
2	Moderately resistant (8)	11-25	BDNG 9-3, BDNG-2003-1, JAKI- 9218, BDNG-2010-1, BDNG- 801, AKG-12009, PKV Kabuli-2 and BCPK-3
3	Moderately susceptible (2)	26-50	PKV Kabuli-4 and Virat
4	Susceptible (none)	51-75	-
5	Highly susceptible (3)	76-100	JG-62, BDNGK-807 and AKG-1207

Table 3. Reaction of chickpea lines to wilt during Rabi 2014-2015

Sr. No.	Entries	Wilt incidence (%)	Disease reaction
Reaction of SMVT (R) chickpea lines to wilt disease			
1	P.G. 0302-10	12.49	Moderately resistant
2	AKG-1106	7.79	Resistant
3	AKG-1103	70.26	Susceptible
4	AKG-1108	8.94	Resistant
5	Saki- 9516	5.82	Resistant
6	PG-8108	00.00	Highly resistant
7	BCP-26	3.88	Resistant
8	Vishal	13.22	Moderately resistant
9	PG-611-14	10.11	Resistant
10	BDNG-2013-1	6.92	Resistant
11	BDNG-2013-2	93.14	Highly susceptible
12	BDNG-2003-1	3.57	Resistant
13	Jaki-9218	11.11	Moderately resistant
14	BDNG-797	25.51	Moderately resistant
15	BDN 9-3	60.85	Susceptible
16	JG-62	100	Highly susceptible
Reaction of SMVT (I) chickpea lines to wilt disease			
17	PG-302-10	10.10	Resistant
18	BDNG-804	95.83	Highly susceptible
19	BDNG-2010-1	1.78	Resistant
20	BCP-60	3.50	Resistant
21	AKG-70	1.61	Resistant
22	AKG-1303	1.51	Resistant
23	AKG-1109	10.00	Resistant
24	AKG-1306	39.41	Moderately susceptible
25	AKG-1009	12.10	Moderately resistant
26	BDNG-801	37.24	Moderately susceptible
27	PG-8108	3.80	Resistant
28	Saki-9501	12.95	Moderately resistant
29	Jaki-9218	34.72	Moderately susceptible
30	BCP-49	10.34	Resistant
31	Vishal	5.77	Resistant
Reaction of SMVT (K) chickpea lines to wilt disease			
32	BDNG K-807	55.03	Susceptible
33	BDNG K-799	43.95	Moderately susceptible
34	AKG-1208 K	63.76	Susceptible
35	AKG-1304 K	24.41	Moderately resistant
36	PKV Kabuli-4	45.97	Moderately susceptible
37	PKV Kabuli-2	56.45	Susceptible
38	BDNG-798	42.29	Moderately susceptible
39	Krupa	30.35	Moderately susceptible
40	Virat	10.83	Resistant
41	PG-12310	32.27	Moderately susceptible
42	PG-12138	41.21	Moderately susceptible
43	PG-12313	11.90	Moderately resistant
Reaction of SMVT (DR/DI/DL) chickpea lines to wilt disease			
44	PG-0302-10	2.38	Resistant
45	PG-12110	2.17	Resistant
46	Digvijay	5.67	Resistant
47	PG-0611-14	43.33	Moderately susceptible
48	PG-08108	2.17	Resistant

Categorization of chickpea varieties / cultivars, genotypes and germplasm lines

Table 4. Categorization of chickpea varieties / cultivars, genotypes and germplasms lines

Category	Reaction	Average wilt incidence (%)	Varieties / cultivars / genotypes germplasms lines
0	Highly resistant (1)	00.00	PG-8108
1	Resistant (21)	1-10	AKG-1106, AKG-1108, Saki- 9516, BCP-26, PG-611-14, BDNG-2013-1, BDNG-2003-1, PG-302-10, BDNG-2010-1, BCP-60, AKG-70, AKG-1303, AKG-1109, PG-8108, BCP-49, Vishal, Virat, PG-0302-10, PG-12110, Digvijay and PG-08108
2	Moderately resistant (8)	11-25	P.G. 0302-10, Vishal, Jaki-9218, BDNG-797, AKG-1009, Saki-9501, AKG-1304 K and PG-12313
3	Moderately susceptible (10)	26-50	AKG-1306, BDNG-801, Jaki-9218, BDNG K-799, PKV Kabuli-4, BDNG-798, Krupa, PG-12310, PG-12138 and PG-0611-14
4	Susceptible (5)	51-75	AKG-1103, B.D.N. 9-3, BDNG-K-807, AKG-1208 K and PKV Kabuli-2
5	Highly susceptible (3)	76-100	JG-62, BDNG-804 and BDNG-2013-2

moderately susceptible with mean disease intensity of 30.35 (Jaki-9218) and 45.97 (PKV Kabuli-4) per cent; whereas, AKG-1103, B.D.N. 9-3, BDNG-K-807, AKG-1208 K and PKV Kabuli-2 were found susceptible with mean disease intensity of 70.26 (AKG-1103) and 56.45 (PKV Kabuli-2) per cent. Three varieties / cultivars, germplasm lines viz., JG-62 (100%), BDNG-804 (95.83%) and BDNG-2013-2 (93.14%), were found highly susceptible to wilt. The disease free lines, resistant lines and moderately resistant lines can be utilized in resistant breeding programme towards incorporation of resistant genes in releasing varieties / hybrids. These results of the chickpea germplasms lines, varieties, cultivars reactions against *Fusarium oxysporum* f. sp. *ciceri* both under natural epiphytotic are on the same line as to that of reported earlier by several workers. Pawar *et al.*, (1993), Zote *et al.*, (1993), Suryawanshi *et al.*, (2003), Chavan, (2004), Honnareddy and Dubey, (2006), Kohire *et al.*, (2006), Trivedi and Gurha (2007), Mulik (2009), Ahmed (2010), Patil (2010), Korde, (2011), Mandhare *et al.*, (2011) and Kumar *et al.*, (2012) gave been screened number of chickpea genotypes and identified promising cultivars in Maharashtra and India.

Acknowledgements

The authors are thankful to Head, Agricultural Research Station Badnapur, VNMKV, Parbhani (M.S.) for funding and providing the valuable suggestions during our research period.

REFERENCES

- Ahmad, M. A. 2010. Variability in *Fusarium oxysporum* f. sp. *ciceri* for chickpea wilt resistance in Pakistan. Ph. D. (Agri.) thesis, (Abs.) submitted to Quaid-i-Azam University, Islamabad, Pakistan.
- Anonymous, 2015. Directorate of Economics and Statistics, Department of Agriculture and Cooperation. Agricultural statistics at a glance. 90-96 pp.
- Butler, E. J. 1918. Fungi and diseases of plants. Book published. (M. C. Saxena, K. B. Singh, edi.), CABI Publishing, CAB Int. Wallingford, UK. 233-270 pp.
- Chavan, T. B. 2004. Studies on *Fusarium oxysporum* f. sp. *ciceri* (Padwick) Snyder and Hansen causing wilt of chickpea (*Cicer arietinum* L.). M. Sc. (Agri.) thesis submitted to Indira Gandhi Agriculture University, Raipur (India).
- Dhar, V. and Gurha, S. N. 1998. Integrated management of chickpea diseases. (Rajeev, K., Upadhyay, K. G., Mukerji, B. P., Chamola and Dubey, O. P. (edi.)), APH Pub. Co., New Delhi. (India). 249 pp.
- Honnareddy, N. and Dubey, S. C. 2006. Pathogenic and molecular characterization of Indian isolates of *Fusarium oxysporum* f. sp. *ciceri* causing chickpea wilt. *Current Sci.* 91 (5): 661-666.
- IIPR, 1999. Proceedings of technical programme for Rabi workshop organization by Indian Institute of Pulse Research Kanpur. 13 pp.
- Jalali, B. L. and Chand, H. 1992. Diseases of Cereals and Pulses. (U. S. Singh, A. N. Mukhopadhyay, J. Kumar, and H. S. Chaube, edi.) Prentice Hall, Englewood Cliffs, NY. 1-429-444.
- Khilare, V. C., Ahmed, R., Chavan, S. S. and Kohire, O. D. 2009. Management of *Fusarium oxysporum* f. sp. *ciceri* by different fungicides. *Bioinfolet* 6: 41-43.
- Kohire, O. D., Shrirame, M. D., Dahiwal, A. L., Shirurkar, P. D. and Vishnupurikar, R. M. 2006. Status of chickpea wilt, dry root rot and stunt in major chickpea growing districts of Marathwada region of Maharashtra. Paper presented in Agro research conservation and management held at Raipur, on 14-15 Dec. 338 pp.
- Korde, M. G. 2011. Studies on *Fusarium* wilt of chickpea caused by *Fusarium oxysporum* f. sp. *ciceri* (Padwick) Snyder and Hansan. M. Sc. (Agri.) thesis submitted to VNMKV, Parbhani (India).
- Kumar, A., Lal, H. C. and Akhtar, J. 2012. Morphological and pathogenic characterization of *Fusarium oxysporum* f. sp. *ciceri* causing wilt of chickpea. *Indian Phytopath.* 65 (1): 64-66.
- Mandhare, V. K., Deshmukh, G. P., Patil, J. V., Kale, A. A. and Chavan, U. D. 2011. Morphological, pathogenic and molecular characterization of *Fusarium oxysporum* f. sp. *ciceri* isolates from Maharashtra, India. *Indonesian J. Agricultural Sci.*, 12 (2): 47-56.
- Mulik, M. B. 2009. Studies on wilt of chickpea incited by *Fusarium oxysporum* f. sp. *ciceri* (Padwick) Snyder and Hansan. M. Sc. (Agri.) thesis submitted to VNMKV, Parbhani (India).
- Nema, K. G. and Khare, M. N. 1973. A conspectus of wilt of Bengal gram in Madhya pradesh. Symposium on wilt problem and breeding for wilt resistance in Bengal gram, Sept. 1973 at Indian Agril. Res. Institute, New Delhi, India. 1-4 pp.
- Nene, Y. L. and Reddy, M. V. 1987. Chickpea diseases and their control. *Phytopathology* 42 : 499-505.
- Patil, V. B. 2010. Studies on survey and management of chickpea wilt in Marathwada region. Ph. D. (Agri.) thesis submitted to VNMKV, Parbhani (India).

- Pawar, K. B., Bendre, N. J., Deshmukh, R. B. and Bhor, S. B. 1993. Field reaction of some chickpea lines to *Fusarium* wilt. *J. Maharashtra Agril. Univ.* 18: 327-328.
- Singh, K. B. and Dahiya, B. S. 1973. Breeding of wilt resistance in chickpea. Symposium on wilt problem and breeding for wilt resistance in Bengal gram. September 1973 at IARI, New Delhi, India, 13-14. pp.
- Suryawanshi, A. V., Mandhare, V. K., Sanap, M. M. and Jamadagni, B. M. 2003. Reaction of chickpea entries to *Fusarium* wilt and gram pod borer. *J. Maharashtra Agric. Univ.* 28 (2): 213-214.
- Trivedi, S. and Gurha, S. N. 2007. Variability in *Fusarium oxysporum* f. sp. *ciceri* isolates from Jhansi district of Bundelkhand, Uttar Pradesh. *J. Mycol. Pl. Pathol.* 37 (2): 324-326.
- Zote, K. K., Pawar, N. B., Zindurde, D. D., Dandnaik, B. P. and Shirshikar S P 1993. Source of resistance to *Fusarium* wilt of chickpea. *International Chickpea Newsletter.* 29: 11-12.
