Eco. Env. & Cons. 30 (4) : 2024; pp. (1776-1779)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i04.051

Screening of Chickpea Varieties for their Resistance Sources Against *Fusarium oxysporum* F. Sp*. Ciceri*s

Mamta Beniwal[1]*, Narayan Lal Meena[2], Pokhar Rawal[3], Ram Narayan Bunkar[4], Smriti Akodiya[1], Kiran Kumawat[1], Shaik Mnnysha[1], Parul Upadhyay[1], Pinki Sharma[1] and Shusilayadav[1]

Department of Plant Pathology, Rajasthan College of Agriculture, MPUAT, Udaipur 313001, Rajasthan, India

(Received 22 May, 2024; Accepted 25 July, 2024)

ABSTRACT

Chickpea (*Cicer arietinum* L.) is a vital leguminous and self-pollinating crop cultivated globally ranking third among the most important leguminous crops. Fusarium wilt caused by the fungus *Fusarium oxysporum* f. sp. *ciceris* is a significant stressor among various biotic and abiotic challenges. A field experiment was conducted during the *Rabi* seasons of 2022-23 and 2023-24 under artificial inoculation conditions at the RCA research farm in Udaipur screening ten chickpea varieties. The experiment was arranged in a randomized block design with three replications for each test line. Results indicated that varietal resistance in field plots is the most economical and environmentally friendly method for controlling the severity of *Fusarium* wilt. Based on the results GNG-2562 variety demonstrated a resistant reaction with a disease incidence of 0-10% for Fusarium. Meanwhile, three varieties GNG-2207, GNG-2144, and GNG-1958 exhibited a moderately resistant reaction with an 11-20 % disease incidence under field conditions. The remaining tested varieties ranged from tolerant to highly susceptible, showing a disease incidence of 21-50%. This screening of varieties will be beneficial for future crop improvement programs.

Key words: *Chickpea, Fusarium,Screening,Varieties, Resistance*

Introduction

Chickpea (*Cicer arietinum* L.) is the most crucial food legume crop in India providing high-quality protein and fibre and aiding soil fertility management especially in rain fed conditions through its root nodules (Singh and Saxena, 1996). In India chickpea production accounts for 45 % of the total pulse production, with a productivity of 1041 Kg/ha in 2018-19 (Nyein *et al*., 2022). The chickpea crop often faces various biotic and abiotic stresses with Fusarium wilt being a significant biotic stress affecting its yield. Fusarium wilt caused by *Fusarium oxysporum* f. sp. *ciceris* is the most destructive soil-borne disease of chickpeas leading to an annual yield loss of 10% (Singh and Dahiya, 1973). Losses from early wilting (within 25 days after sowing) are higher than from late wilting (6 to 8 weeks after sowing). Seeds from late-wilted plants are typically rough lighter and dull compared to those from healthy plants (Nene and Haware, 1980). Yield losses due to Fusarium wilt can range from 10-100% depending on the agro-climatic conditions (Grewal and Pal, 1970).

Managing Fusarium wilt cannot rely on a single control method. Chemical control alone is impractical and uneconomical due to the soil-borne nature of the pathogen. An integrated management approach is most effective, with the use of resistant varieties

(*[1]Ph.D. Research Scholar, [2]Assistant Professor, [3]Assistant Professor,[4]Assistant Professor)

being one of the best economical management practices (Nene and Haware, 1980; Nene and Reddy, 1987). The pathogen can survive as chlamydospores for up to six years in the absence of a host (Haware *et al*., 1996). These conditions pose challenges for farmers and researchers in achieving maximum crop yield. Therefore, this study was undertaken with the hypothesis of identifying resistant chickpea cultivars against wilt disease from diverse genetic resources.

Materials and Methods

The ten chickpea varieties were evaluated for their resistance or susceptibility to *Fusarium oxysporum* f. sp. *ciceris* under field conditions. The varieties, namely GNG-2207, GNG-2513, GNG-2171, GNG-1969, GNG-2562, GNG-1958, IPC-2005-62, BG-4035, GNG-2299, and GNG-2144, were obtained from National Seed Nigam Limited, CSF Suratgarh, Sri Ganganagar (Rajasthan).

Field experiments were carried out during the *Rabi* seasons of 2022-23 and 2023-24 at the RCA farm in Udaipur under controlled inoculation conditions. Pure cultures of *Fusarium oxysporum* f. sp. *ciceris* were propagated on sorghum grains at 28±2°C for 15 days and then mixed with sterilized soil at a ratio of 25g/kg soil. The ten chickpea varieties were tested in a randomized block design with three replications for each variety. Thirty seeds of each variety were sown in rows 3 meters long, spaced at 30 x 10 cm intervals, with a plot size of 3x2 m². A susceptible check (GNG-2513, BG-4035) was planted after every two test entries, while a resistant check (GNG-2562) was sown in the first and last rows of the experimental plot. The number of wilted plants per test line was recorded at 45, 60, and 75 days after sowing.

The percentage of wilt incidence was calculated using a specific formula:

$$\text{Per cent disease incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants observed}} \times 100$$

The genotypes were categorized by using the below 1-5 disease scale based on disease incidence (Anonymous, 2014)

Results and Discussion

All 10 varieties were showed a range of 6.50 -37.14% wilt incidence. To locate sources of host resistance against wilt of chickpea caused by *Fusarium oxysporum* f.sp. *ciceris* pathogen a set of 10 chickpea varieties were screened against chickpea wilt for evaluated varieties showed different reaction to wilt disease in field condition during *Rabi* season 2022-23 and 2023-24 as described in Materials and Methods (Table 1). The experimental data recorded in the year 2022-23 clearly indicated that lowest per cent disease incidence was recorded in the plots treated with in the GNG-2562 exhibited lowest disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 4.18, 5.23 and 6.00, respectively and comes under resistant category, among three varieties GNG-2207, GNG-2144 and GNG-1958 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 11.56, 16.89 and 20.00, 11.89, 16.88 and 18.23, 14.85, 16.17 and 18.50, respectively and comes under moderately resistant category, varieties GNG-1969 and GNG-2171 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 14.00, 18.84 and 20.28, 19.41,25.00 and 29.00, respectively and comes under moderately susceptible category, varieties BG-4035 and GNG-2513 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 28.19, 33.40 and 36.39, 33.00,35.00 and 38.18, respectively and comes under susceptible category, varieties IPC-2005-62 and GNG-2299 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 34.00, 36.20 and 36.28, 35.14, 41.55 and 43.00, respectively and comes under highly susceptible category.

Table 1. Disease Rating Scale

S.No.	Disease incidence	Response
1.	1-10 %	Resistant
2.	10-20 %	Moderately Resistant
3.	21-30 %	Moderately Susceptible
4.	31-50 %	Susceptible
5.	50-100 %	Highly susceptible

The experimental data recorded in the year 2023-24 clearly indicated that lowest per cent disease incidence was recorded in the plots treated with In the GNG-2562 exhibited lowest disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 4.00, 5.25 and 7.00, respectively and comes under resistant category, among three varieties GNG-2207, GNG-2144 and GNG-1958 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 10.87, 17.61 and 19.00, 12.17, 17.00 and 20.89, 14.99,17.50 and 19.44, respectively and comes under

Table 2. Pooled Data (Per cent disease incidence)

S. No.	Genotype	Per cent disease incidence (PDI) @45DAS			Per cent disease incidence (PDI) @60DAS			Per cent disease incidence (PDI) @75DAS			Per cent disease incidence (PDI) at 75 DAS
		2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled	
1	GNG-2207	11.56 (19.88)	10.87 (19.25)	11.22 (19.56)	16.89 (24.27)	17.61 (24.81)	17.25 (24.54)	20.00 (26.57)	19.00 (25.84)	19.50 (26.20)	MR
2	GNG-2513	33.00 (35.06)	34.00 (35.67)	33.50 (35.37)	35.00 (36.27)	35.00 (36.27)	35.00 (36.27)	38.18 (38.16)	39.00 (38.65)	38.59 (38.40)	S
3	GNG-2171	19.41 (26.14)	20.30 (26.78)	19.86 (26.46)	25.00 (30.00)	26.12 (30.74)	25.56 (30.37)	29.00 (32.58)	29.00 (32.58)	29.00 (32.58)	MS
4	GNG-1969	14.00 (21.97)	16.00 (23.58)	15.00 (22.78)	18.84 (25.72)	19.34 (26.09)	19.09 (25.91)	20.28 (26.77)	22.34 (28.21)	21.31 (27.49)	MS
5	GNG-2562	4.18 (11.80)	4.00 (11.54)	4.09 (11.67)	5.23 (13.22)	5.25 (13.25)	5.24 (13.23)	6.00 (14.18)	7.00 (15.34)	6.50 (14.76)	R
6	GNG-1958	14.85 (22.67)	14.99 (22.78)	14.92 (22.72)	16.17 (23.71)	17.50 (24.73)	16.84 (24.22)	18.50 (25.47)	19.44 (26.16)	18.97 (25.82)	MR
7	IPC-2005- 62	34.00 (35.67)	35.00 (36.27)	34.50 (35.97)	36.20 (36.99)	37.00 (37.46)	36.60 (37.23)	36.28 (37.04)	38.00 (38.06)	37.14 (37.55)	HS
8	BG-4035	28.19 (32.07)	27.19 (31.43)	27.69 (31.75)	33.40 (35.30)	32.89 (34.99)	33.15 (35.15)	36.39 (37.10)	37.45 (37.73)	36.92 (37.42)	S
9	GNG-1969	35.14 (36.36)	34.00 (35.67)	34.57 (36.01)	41.55 (40.14)	40.99 (39.81)	41.27 (39.97)	43.00 (40.98)	44.00 (41.55)	43.50 (41.27)	HS
10	GNG-2144	11.89 (20.17)	12.17 (20.42)	12.03 (20.29)	16.88 (24.26)	17.00 (24.35)	16.94 (24.30)	18.23 (25.28)	20.89 (27.20)	19.56 (26.24)	MR
	S.E.m+	1.37	1.36	0.83	1.47	1.47	0.90	1.51	1.53	0.93	
	C.D. at 5%	4.21	4.19	2.39	4.52	4.54	2.58	4.64	4.71	2.66	
	C.V. (%)	7.23	7.15	3.89	7.02	6.97	3.79	6.86	6.80	3.69	

moderately resistant category, varieties GNG-1969 and GNG-2171 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 16.00, 19.34 and 22.34, 20.30,26.12 and 29.00, respectively and comes under moderately susceptible category, varieties BG-4035 and GNG-2513 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 27.19, 32.89 and 37.45, 34.00, 35.00 and 39.00, respectively and comes under susceptible category, varieties IPC-2005-62 and GNG-2299 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 35.00, 37.00 and 38.00, 35.00, 40.99 and 44.00, respectively and comes under highly susceptible category.

Pooled data recorded in the year 2022-23 and 2023-24 clearly indicated that lowest per cent disease incidence was recorded in the plots treated with In the GNG-2562 exhibited lowest disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 4.09, 5.24 and 6.50, respectively and comes under resistant category, among three varieties GNG-2207,GNG-2144 and GNG-1958 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 11.21, 17.25 and 19.05, 12.03,16.94 and 19.56, 14.92, 16.84 and 18.97, respectively and comes under moderately resistant category, varieties GNG-1969 and GNG-2171 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 15.00, 19.09 and 22.31, 19.86, 25.56 and 29.00, respec-

Table 3. Disease Reaction of Varieties

S. No.	Mortality %	Category	No of entries	Details of Entries
1.	0-10%	Resistant	1	GNG-2562
2.	11-20%	Moderately resistant	3	GNG-2207,GNG-2144,GNG-1958
3.	21-30%	Moderately susceptible	2	GNG-1969,GNG-2565
4.	31-50%	susceptible	2	GNG-2513, BG-4035
5.	51-100%	Highly susceptible	2	IPC-2005-62,GNG-2299

tively and comes under moderately susceptible category, varieties BG-4035 and GNG-2513 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 27.69, 33.15 and 36.92, 33.50,35.00 and 38.59 respectively and comes under susceptible category, varieties IPC-2005-62 and GNG-2299 disease incidence at 30, 45 and 75 DAS with per cent disease incidence of 34.50, 36.60 and 37.14, 34.57,41.27 and 43.50, respectively and comes under highly susceptible category.

Similar results were made by Shah *et al.* (2015) who screened 54 chickpea genotypes under field 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.

Conclusion

It was concluded from the present investigation that IPC-2005-62 and GNG-2299 figured highly susceptible varieties, whereas GNG-2562 exhibited resistant reaction with less than 10 per cent disease severity. Sowing of GNG-2562 under Udaipur region of Rajasthan is an ecologically and economically viable option for the management of Fusarium wilt of Chickpea.

Acknowledgement

I would like to express my deepest gratitude to my research guide, Dr. Narayan Lal Meena, for their expertise and insights throughout this study. I am also thankful to Rajasthan College of Agriculture, MPUAT, Udaipur for providing the necessary resources and a conducive environment for my research.

Conflict of Interest- None

References

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 control In: *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 arietinum*) 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. *Pakistan 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.