

SCREENING OF CHICKPEA GERMPLASM AGAINST FUSARIUM WILT

Munir Ahmad Chaudhry, Faqir Muhammad and Muhammad Afzal^{*}

ABSTRACT

In this study 414 varieties/germplasm accessions originating from Pulses Research Institute, AARI, Faisalabad, NIAB, Faisalabad, BARI, Chakwal, AZRI, Bhakkar, NARC, Islamabad and ICARDA, Syria were evaluated for fusarium wilt. These were planted in a wilt sick plot developed at Pulses Research Institute, Faisalabad during the year 2002-03 and 2003-04. Each entry was sown in a single 3 meter long and 30 cm apart rows. A highly susceptible variety 97108 was planted as spreader after every two test entries to map the uniformity of infestation in the field. Disease observations were recorded from seedling stage to maturity at 15 days interval and varieties were evaluated following international 1-9 scale. Early wilt was counted two months after sowing and late wilt during last week of April. Thirty five test lines were found resistant, 208 intermediate, 77 susceptible and 94 were highly susceptible. Six promising lines (02007, 02024, 02065, 02095, 03009, 03020) of Pulses Research Institute, Faisalabad and four of AZRI, Bhakkar (98K007, ICCV97038, ICCV37 and 2KCC005) were found resistant. Similarly six lines (9102-13, 9106-37, 9118-30, 9129-2, 9154-18 and 9156-34) originated from ICARDA and six (99CC-036K, 99CC-039K, 2KCC003, 2KCC004, 2KCC008 and 2KCC108) of BARI, Chakwal were found intermediate resistant to chickpea wilt. Among 94 highly susceptible germplasm accessions, the lines included 02031, 02053, 02079, 03022, 03031, 03054, 9120-5 (PRI), 2KCC-002, 2KCC-003, 2KCC-007, 2KCC-009 (BARI), Flip97-59C, Flip97-85C, NCS95-0030, NCS95-K4, NCS95-0201 and NCS98-K4A (ICARDA). The commercial varieties C-44, CM-72, CM-88, Bittal-98, Paidar-91, Winhar-2000 and Punjab-2000 were also found intermediate resistant whereas Karak-98, Balkassar-2000 susceptible and CM-98, Punjab-91 and Noor-91 highly susceptible to fusarium wilt. The varieties 97012 and ILC1929 sown as spreader after every two test entries were rated as highly susceptible in all cases.

KEYWORDS: *Cicer arietinum*; germplasm; Fusarium; disease resistance; Pakistan.

INTRODUCTION

Fusarium wilt caused by *Fusarium oxysporum* f. sp. *ciceri* is a serious and wide spread disease of chickpea (*Cicer arietinum*) in all chickpea growing

^{*}Pulses Research Institute, Ayub Agricultural Research Institute, Faisalabad.

countries. It is reported to cause annual yield losses of 10-15 percent as a regular feature (6). The wilt disease has reduced the share of chickpea from 50 percent in 1950s to 10 percent in 1990s on irrigated lands of Pakistan (4). The disease is seed and soil borne. It can survive in soil even in the absence of a host for three years (1). The disease can occur at all stages of plant growth with more incidence in flowering and podding stage, when temperature is high ($>24^{\circ}\text{C}$) particularly under drought, killing more than 80 percent of the plants in some farmers fields (3). Since the pathogen is soil borne and can survive in the soil for more than 3 years, continuous seed treatment can be useful in controlling soil born infection of the disease in varieties with moderate resistance. However, as chickpea is a barani area crop and is grown under low input conditions, continuous seed treatment is not possible for all the farmers. The ideal and most economical mean of managing the chickpea wilt would be the use of resistant varieties.

Under these circumstances there is a need to exploit genetically host resistance in existing chickpea commercial varieties and germplasm for the identification of resistant sources. Resistance to wilt is race specific and is governed by major resistant genes. Uptill now eight races of the pathogen have been reported (5). The variety scored as resistant in one study might have been categorized as moderate or susceptible in other studies and vice versa (4).

This paper reports results on the screening of chickpea varieties and germplasm accessions in a wilt sick plot for the sources of resistance against wilt.

MATERIALS AND METHODS

Four hundred and fourteen chickpea varieties/germplasm accessions originating from Pulses Research Institute, Faisalabad, NIAB, Faisalabad, BARI, Chakwal, AZRI Bhakkar, NARC, Islamabad and ICARDA, Syria were evaluated for fusarium wilt. These were planted in a wilt sick plot developed at Pulses Research Institute, Faisalabad during the crop year 2002-03 and 2003-04. Ten commercial varieties of both indigenous and Kabuli groups were also included. Each entry was sown in a single 3 meter long and 30cm apart rows. A highly susceptible variety 97108 was planted as spreader after every two test entries to map the uniformity of infestation in the field. The crop was raised with general agronomic practices. Disease observations were recorded from seedling stage to maturity at 15 days interval and the varieties were evaluated on a modified 1-9 scale used by earlier workers (2,

7, 10, 11) in coordination with ICARDA Integrated Gene Management Programme (MP2). Counting of early wilt was made months after sowing and late wilt during last week of April. Data regarding wilt incidence was computed according to the scheme i.e. 0 percent (highly resistant), 1-20 percent incidence (resistant), 21-40 percent incidence (moderately resistant), 41-80 percent (susceptible) and 81-100 percent disease incidence (highly susceptible).

RESULTS AND DISCUSSION

Out of 414 promising lines and 10 commercial varieties no test line or variety was found highly resistant (Table). Thirty five lines were found resistant, 208 intermediate, 77 susceptible and 94 highly susceptible. Promising lines 02007, 02024, 02065, 02095, 03009, 03020 of Pulses Research Institute, Faisalabad and 98K007, ICCV97038, ICCV37, 2KCC005 originated from AZRI, Bhakkar were found resistant. Similarly 9102-13, 9106-37, 9118-30, 9129-2, 9154-18 and 9156-34 originated from ICARDA and 99CC-036K, 99CC-039K, 2KCC003, 2KCC004, 2KCC008 and 2KCC108 of BARI, Chakwal were found intermediate to chickpea wilt.

Table Screening of chickpea varieties/lines for resistance to fusarium wilt (2002-04).

Disease percentage	Name of varieties/lines	Disease reaction
0		Highly resistant
1-20	00125, 01267, 02007, 02020, 02024, 02027, 02053, 02065, 02069, 02078, 02082, 02092, 02094, 02095, 9127-10, 9144-32, 96032, 98K007, ICCV97038, ICCV37, ICCV93138, ICCV97030, ICCV00303, ICCV97309, 22123, 2KCC005, 2KCC101, 03006, 03009, 03012, 03016, 03020, 03001, 93A-086, 2001008.	Resistant
21-40	02001, 02003, 02006, 02009 to 19, 02023 to 26, 02047 to 49, 02035, 02036, 02038, 02042, 02043, 02045, 02051, 02052, 02060, 02064, 02066, 02068, 02070, 02072, 02077, 02081 to 84, 02087 to 92, 2001003, 2001006, 2001031, 2001039, 2001044, 2001053, 2001057, 2001059, 2001061, 2001066, 2001075, 2001080, 2001083, 2001084, 9102-13, 9103-53, 9106-37, 9109-12, 9111-35, 9112-17, 9114-22, 9115-36, 9118-30, 9119-41, 9121-21, 9123-15, 9124-1, 9126-31, 9129-2, 9132-19, 9133-7, 9135-3, 9136-20, 9138-28, 9147-14, 9147-26, 9151-38, 9153-24, 9154-18, 9156-34, 9159-29, ICCV-00101, ICCV-00105, ICCV-00106, ICCV-00108, ICCV-00109, ICCV-00304, ICCV-00305, ICCV-93122, ICCV-96321, ICCV-96327, ICCV-97024, ICCV-9703D1, ICCV-97033, ICCV-97039, ICCV-97314, 900109, 92944, 950101, 950505, 950130, 950156, 91A-039, 92A-	Intermediate resistant

	014, 92A-021, 92A-102, 92A-204, 92A-260, 92A-295, 93A-001, 93A-023, 93A-043, 93A-048, 93A-062, 93A-080, 93A-282, 93A-095, 93A-111, 93A-117, 93A-118, 93A-A122, 93A-234, 93A-242, 93A-500, 94A-086, 96A-2004, 96A-3112, 96A-3148, 96A-3249, 96A-3292, 96A-3347, 96A-3354, 96A-3849, 96A-4504, 96A4522, 96A-4580, 96A-4599, 98K-004, 98K-012, 98K-013, 99A-087, 99A-089, 99A-098, 99A-200, 01A-904, NES98K-A, NES98K-G, NES98K-4E, NES98K-17, 93A086, 01AG014, 900109, 92A242, 92A048, 92A113, 91A200, 92A207, 91A001, 21104, 99A093, 01AG0011, 24159, 22151, 99CC-036K, 2KCC010, 2KCC011, 2KCC103, 2KCC-106, 99CC-037K, 99CC-039K, CMN-440/9-K, SPS-11-K, 2KCC-001, 2KCC003, 2KCC004, 2KCC005, 2KCC007, 2KCC008, 2KCC009, 3KCC103, 2KCC108, 03007, 03010, 03013, 03014, 03019, 03024, 03026, 03037, 03041, 03046, 03047, 03050, 03052, 93A-021, 93A-304, C-44, CM-72, CM-88, Bittal-98, Paidar-91, Winhar.2000, Pb-2000,	
41-80	00208, 02021, 02029, 02030, 02032 to 34, 02054, 02057 to 62, 02067, 02071, 02074, 02075, 02080, 2001017, 2001034, 2001045, 2001088, 30122/18, 900102, 900166, 9117-25, 9141-40, 9142-4, 9145-29, 9150-9, 9157-8, 91A-016, 92A-117, 92A-186, 92A-217, 92A-256, 92A-373, 93A-045, 93A-203, 96A-3774, 98K-001, 92A326, 91A06, 99CC-032-K, 99CC-005 99CC-010, 99CC-011, 99CC-015, 99CC-039, 99CC-041, 99CC-054, 2KCC002, 2KCC008, 2KCC102, 03005, 03008, 03011, 03017, 03021, 03023, 03025, 03028, 03029, 03033, 03034, 03038, 03039, 03040, 03042, 03043, 03044, 03049, 03058, 9208, Karak-98, Balkasar.2000,	Susceptible
81-100	02031, 02053, 02055, 02056, 02079, 02086, 9130-6, 9120-5, 92019, 99CC-005, 99CC-036, 99CC-041, 99CC-042, 03002, 03003, 03022, 03027, 03030, 03031, 03032, 03035, 03036, 03048, 03051, 03053, 03054, 03055, 03056, 03057, 9202, 9203, 9205, 9218, 9220, 2KCC-002, 2KCC-003, 2KCC-004, 2KCC-005, 2KCC-007, 2KCC-009, 91A-001, 91A-035, 91A-120, 91A-145, 92A-145, 92A-207, 92A-223, 92A-242, 92A-372, 92A-376, 92A-792, 93A-011, 93A-111, 96A-3189, 96A-3208, 96A-4509, 96A-4532, 98A-011, 9206, 9209, 9211, 9212, 9214, 9215, 9221, 9223, 9224, 9226, 9227, 9229, 9230, 9232, 9241, 9242, 9244, 9245, 9247, 9248, 9250, 9251, 9253, 9256, ILC-6023, FLIP-97-59C, FLIP97-85C, NCS95-0030, NCS95-K4, NCS95-0261, NCS98-K4A, CMC-55, CM-71/85, CM-98, Pb-91, Noor-91	High susceptible
	Spreader 97012(2002-03) ILC1929 (2003-04)	

Among 94 highly susceptible accessions, 02031, 02053, 02079, 03022, 03031, 03054, 9120-5 (PRI), 2KCC-002, 2KCC-003, 2KCC-007, 2KCC-009 (BARI), Flip97-59C, Flip97-85C, NCS95-0030, NCS95-K4, NCS95-0201 and NCS98-K4A (ICARDA) were of special mention.

Commercial varieties C-44, CM-72, CM-88, Bittal-98, Paidar-91, Winhar-2000 and Punjab-2000 were also found intermediate whereas Karak-98,

Balkassar-2000 as susceptible and CM-98, Punjab-91 and Noor-91 were highly susceptible to fusarium wilt. Varieties 97012 and ILC1929 sown as spreader after every two test entries were rated as highly susceptible in all cases. These results are sported by Weeraratne and Chithral (12) who evaluated 240 chickpea varieties for wilt, colletotrichum blight and alternaria blight and recorded 10-20 percent fusarium wilt incidence in affected lines. Zote *et al.* (13) found no chickpea line immune to fusarium wilt. Govil and Rana (3) evaluated 239 cultivars representing a range of variability among Indian and Iranian germplasm in a wilt sick plot for years. Iqbal *et al.* (7) observed considerable variation among genotypes while evaluating 51 chickpea genotypes against fusarium wilt under artificial disease conditions. Similar study was conducted by Iqbal *et al.* (8) and Ayyub *et al.* (1). Who reported high level of resistance to fusarium wilt in chickpea germplasm originating from different sources.

REFERENCES

1. Ayyub, M. A., S. M. Khan, R. Ahmad and K. Iftikhar. 2003. Screening of chickpea germplasm for the sources of resistance against chickpea wilt (*Fusarium oxysporum* f. sp. Ciceris). Pak. J. Phytopath. 15 (1-2): 25-27.
2. Bakr, M. A and F. Ahmad. 1991. Additional soruces of resistance to wilt and root rot of chickpea in Bangladesh. Int. Chickpea NL. 25:28-29.
3. Govil, J. N. and B. S. Rana. 1994. Stability of host plant resistance to wilt (*Fusarium oxysporum* f.sp. ciceri) in chickpea. Int. J. Trop. Pl. Dis. 2:55-60.
4. Haqqani, A. M., M. A. Zahid and M. R. Malik 2000. Legumes in Pakistan p. 98-128. *In*: Legumes in Rice and Wheat Cropping Systems of the Indo-Gangetic Plains-Constraints and Opportunities. Johansenm, C., J. M. Duxbuury, S. M. Virmani, C. L. L. Gowda, S. Pandes and P. K. Josh (eds.). International Crops Research Institute for the Semi-arid Tropics and Cornel University, Ithaca New York, USA. Pp. 230.
5. Haware, M. P. and Y. L. Nene. 1982. Races of *Fusarium oxysporum* f.sp. ciceri. Plant Diseases. 66:809-810.
6. Haware, M.P., R. M. Jimenez-diaz, K. S. Amin, J. C. Phillips and H. Halila. 1990. Integrated management of wilt and root rots of chickpea p. 129-133. *In*: Chickpea in the Nineties. Proc. Second International Workshop on Chickpea Improvement, Dec. 4-8, 1989. ICRISAT, India.
7. Iqbal, M.J., K. Iftikhar and M.B. Ilyas. 1993. Evaluation of the chickpea germplasm for resistance against wilt disease (*Fusarium oxysporum*) J. Agric. Res. 31 (4): 449-453.

8. Iqbal, M. S., I. K. Haq, A. Baksh, A. Ghafoor and A. M. Haqqani. 2005. Screening of chickpea genotypes for resistance against *Fusarium* wilt. *Mycopath.* 3(1&2):1-5.
9. Jalali, BL and H. Chand. 1992. Chickpea wilt. p. 429-444. *In*: Plant Diseases of International Importance. Vol.1. Diseases of Cereals and Pulses. (Singh, U.S, A. N. Mukhopadhyay, J. Kumar and H. S. Chaube. (eds.) Engleweed Cliffs, New York, USA: Prentice Hall.
10. Kalia, V. and B.R. Verma. 1991. Screening of chickpea varieties for sources of resistance to *Ascochyta* blight. *Int. Chickpea NL.* 25:27-28.
11. Sharma, K.D, W. Chenand and F.J. Muehbauer 2004. A consensus set of differential lines for identifying races of *Fusarium oxysporum* f. sp. *ciceris*. *Int. Chickpea and Pigeonpea NL.* 11:34-36.
12. Weeraratne Geethani, W. A. P. and G. M. W. Chithral 1997. A report on three chickpea diseases in Sri Lanka. *Int. Chickpea and Pigeonpea NL.* 25(4): 18-19.
13. Zote, K.K.,P.V.Khalikar and B.P. Dandnaik. 1983 Source of resistance to chickpea wilt. *Int. Chickpea NL No. 8,23* [Rev. Pl. Path. 63(5):20-95, 1984].