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Sources of resistance in chickpea germplasm against fusarium wilt

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Abstract

One hundred and ninety six chickpea germplasm lines/cultivars were screened for resistance to with disease caused by *Fusarium oxysporum* f.sp. *ciceri* in a wilt sick plot. None of the test line was found immune or highly resistant. Lines 03001, 03006, 03009, 03012, 03016, 03020 and 03045 obtained from Pluses Research Institute, Faisalabad, found to be resistant while 03024, 03026, 03037, 03041, 03046, 03050, Pb2000 and Pardar-91 were moderately resistant. Flip 97-17^{3}C, Flip 01-38C, Flip 02-39C, Flip 02-40C, Flip 03-36C, Flip 03-45C, Flip 03-53C and Flip 03-141 from ICARDA, Syria were resistant, while 14 lines such as Flip98-37C Flip98-206C, Flip00-17C, Flip01-2C, Flip01-30, Flip 01-34C, Flip 01-37C, Flip01-49C, Flip 01-50C, Flip 03-104C, Flip 03-106C, Flip03-119C, Flip 03-134C, and Flip 03-141C were moderately resistant. Out of 39 test lines 92 A -186 and 93 A -086 from Arid Zone Research Institute were also resistant, with 93 A -304 to be moderately resistant. From Barani Agricultural Research Institute Chakwal only one line 2 KCC-101 was found to be resistant.

Keywords: *Cicer arietinum* L., *Fusarium oxysporum* f. sp. *ciceri* Padwik, germplasm, resistance.

Introduction

Chickpea (*Cicer arietinum* L) is cultivated as a post mon-soon winter crop in barani areas of Pakistan and it ranks second to India in terms of area occupied by it. In Pakistan it is cultivated on an area of about 1028.9 thousands hectares with production of 479.5 thousands tones and yield of 446 Kg/ha (Anon, 2006) as compared to 1767 Kg ha^{-1} in Egypt, 1093 Kg ha^{-1} in Moroco, 1049 Kg ha^{-1} in Iran, 1818 Kg ha^{-1} in Lebanon and 1256 Kg ha^{-1} in Turkey (Saxena and Singh, 1984). Besides other factors responsible for low yield, diseases particularly wilt disease caused by *Fusarium oxysporum* Schlecht. Emend Synd and Hans f. sp. ciceri Padwick plays a major role in reducing chickpea yield in Pakistan (Akhtar, 1955, Haqqani *et al.*, 2000). Fusarium wilt of chickpea has also been reported from Syria, Ethopia, Iran, India and Australia (Shakoor, 1991), Nepal, Burma, Spain, Tunesia, Bengladesh, Malawi, Mexico, Peru and USA (Iqbal *et al*., 2005). The pathogen of the diseases is both seed and soil borne and can survive in soil, even in the absence of its host, for six years (Haware *et al*., 1996, Ayyub *et al*., 2003). The disease occurs at seedling as well as at flowering and pod forming stage (Grewal, 1969; Shakoor, 1991) with more incidence at flowering and podding stage when high temperature (>25ºC) and moisture stress prevails. In Pakistan the disease may cause 10-50 percent crop loss every year (Khan *et al*., 2002). The pathogen is highly variable and consists of several races (Colina *et al*., 1985; Haware and Nene, 1979) and a total of eight races have been reported (Haware and Nene, 1979). Due to prolonged nature of survival of the pathogen, cultural control such as crop-rotation is not feasible and chemical control is costly. The only and the most economical control measure of chickpea wilt is the use of durable and stable host resistance (Govil and Rana, 1994). Evaluation and screening of chickpea material in Fusarium wilt sick plot for the source of resistance against *F. oxysporium* f. *ciceri* has been a regular feature of most chickpea breeding programmes in Pakistan and India (Ahmad and Sherma, 1990; Ayyub *et al*., 2003; Iftikhar *et al*., 1997; Reddy *et al*., 1990; Zote *et al*., 1983 and 1986). An extensive work of screening of chickpea germplasm for wilt resistance is regularly carried by ICRISAT, India where more than 50 resistant chickpea lines have been identified. In Pakistan, Iqbal and his associates (2005) have identified 14 chickpea lines to be resistanct to wilt at seedling stage but no line found to be resistant at reproductive stage. This paper reports the sources of resistance against Fusarium wilt in the chickpea germplasm, originating from national and international research institutes, screened in a wilt sick plot at Pulses Research Institution, Faisalabad.

Materials and Methods

One hundred and ninety six germplasm lines/cultivars of chickpea obtained from national and international research organizations were screened for the sources of resistance against chickpea wilt disease in a wilt sick plot developed by repeated incorporation of various cultures of *Fusarium oxysporum* f. sp. *ciceri* and sowing of susceptible cultivars AUG-424. Each of the test line was sown in a single row subplot of 3 meter length with row to row spacing 60cm and plant to plant distance 15cm. The nursery was raised following general agronomic practices. The data on the numbers of wilted plants in each test line were recorded in seeding as well as adult plant stage and diseases incidence for each test line was calculated by the use of following formula.

$$\text{Disease incidence} = \frac{\text{No. of wilted plant in a test line}}{\text{Total number of plants in test line}} \times 100$$

The level of resistance and/or susceptibility for each line was determined by using 1-9 rating scale of Iqbal et al., (1993) where 1= highly resistant response (0-10% plant wilted), 3= resistant response (11-20% wilted plants), 5= moderately resistant response (21-40% wilted plants), 7= susceptible response (41-60% wilted plants) and 9= highly susceptible response (more than 50% wilted plants).

Results and Discussion

Out of ninety two test lines/cultivars belonging to Pulses Research Institute, Faisalabad seven lines such as 03001, 03006, 03009, 03012, 03016, 03020 and 03045 were found to be resistant (Table1), while 03024, 03026, 03037, 03041, 03046, 03052, Pb - 2000 and Paidar -91 were moderately resistant . Test entries such as 03007, 03010, 03013, 03014, 03019, 03047, 03050, Bittal-98 and C-44 responded moderately susceptible reaction while the remaining test lines displayed susceptible to highly susceptible reaction. Out of 39 test entries originating from ICARDA, Syria eight lines such as Flip 97-173C, Flip01-38C, flip 02-39C, Flip 03-40C, Flip 03-36C, Flip 03-45C, Flip 03-53C, Flip 03-141C, exhibited resistant response while fourteen test lines such as Flip 98-37C, Flip 98-206C, Flip 00-17C, Flip 01-2C, Flip 01-30C, Flip 01-34C, Flip 01-37C, Flip 01-49C, Flip 01-50C, Flip 03-104C, Flip 03-106C, Flip 03-119C, Flip 03-134C, Flip 03-141C displayed moderately resistant response. Five test lines i.e. Flip 01-32C, Flip 01-60C, Flip 01-61C, Flip 02-09C, Flip 02-68C, gave moderately susceptible while the remaining test lines were found to be susceptible or highly susceptible. Out of 39 test lines of chickpea belonging to Arid Zone Research Institutie Bhakkar only two lines such as 92A-186 and 93A-086 were found to respond resistant reaction, one line i.e. 93A-304 was moderately resistant and one line i.e. 93A-021 was found to be moderately susceptible. The remaining bulk was either susceptible or highly susceptible. Out of 26 test line originating from Barani Agri. Research Institution only one line i.e. 2KCC-101 was found to be resistant and none was moderately resistant. A commercial cultivars winhar-2000 was found to be moderately susceptible, while the remaining bulk was susceptible to highly susceptible.

Thus the present screening revealed that the germplasm originating from ICARDA, Syria had high number of resistant (8) and moderately resistant cultivars (14), as compared to germplasm originating from other three local research organizations. The germplasm belonging to Pulses Research Institute, Faisalabad also revealed to possess a high number of resistant (7) and moderately resistant (8) lines, though less than that of ICARDA, Syria. On the other hand the germplasm originating from Arid Zone Research Institute, Bhakkar and Barani Agricultural Research Institute Chakwal were found to be scarce in resistant or moderately resistant sources. The result of our study pointed out that sources of resistance to Fusarium wilt in chickpea germplasm is not uncommon. A number of workers have reported the prevalence of resistance to wilt disease in their chickpea germplasm (Zote *et al*., 1983&1986; Ahmad and Sherman, 1990; Reddy *et al*., 1990; Bakr and Ahmad, 1991; Iqbal *et al*., 1993 & 2005; Shakoor *et al*., 1991; Iftikhar *et al*., 1997; Yu and Sn, 1997; Ayyub *et al*., 2003). The resistant and moderately resistant lines of the germplasm evaluated could further be tested for their yield potential and other desirable agronomic traits if they possess. The test lines with desirable agronomic traits and appreciable yield potential could either be released directly as commercial cultivars or these may be used as source resistant parents to transfer their resistant into commercial cultivars lacking resistance, through conventional breeding procedures. Anyhow, prior to such transfer of their resistance to a commercial cultivar the genetic basis of resistance (vertical or horizontal) must be determined against the virulences of *Fusarum oxysporum* f. sp. *ciceri*. Sindhu *et al*., (1983) reported that resistance of three resistant chickpea lines (1231, 32/35-8/7 and 32/35-32/2) is controlled by a single recessive gene (r&o) while susceptibility conditioned by its dominant allele (Rfo). The scarcity of resistant sources in the germplasm of Arid Zone Research Institute Bhakkar and Barani Research Institute Chakwal calls towards mutation breeding by the use of radiation and chemical mutagens (Haq *et al*., 1981) in order to broad the base of variability in their germplasm.

Table I: Resistance/Susceptibility of Chickpea Cultivars/Lines Against Wilt Disease Caused by *Fusarium oxyporum* f.sp.*ciceri*

Disease Incidence %	**Response**	**Research Organizations**			
		Pulses Research Institute Faisalabad	**ICARDA, Syria**	**Arid Zone Research Institute (AZRI)**	**Barani Agriculture Res.Instt. Chakwal (BARI)**
01-10	Highly Resistant	-	-	-	-
11-20%	Resistant	03001,03006,03009, 03012,03016,03020,03045	FLIP97-173C, FLIP01-38C, FLIP02-39C, FLIP02-40C, FLIP03-36C, FLIP03-45C, FLIP03-53C, FLIP03-141C.	92A-186C, 93A-086.	2KCC101.
21-40%	Moderately Resistant	03024, 03026, 03037, 03041, 03046, 03052, Pb-2000, Paidar-91.	FLIP98-37C, FLIP98-206C, FLIP00-17C, FLIP01-2C, FLIP01-30C, FLIP01-34C, FLIP01-37C, FLIP01-49C, FLIP01-50C, FLIP03-104C, FLIP03-106C, FLIP03-119C, FLIP03-134C, FLIP03-141C.	93A-304,	-
41-60%	Moderately Susceptible	03007,03010,03013, 03014,03019,03047, 03050, Bittal 98, C-44.	FLIP01-32C, FLIP01-60C, FLIP01-61C, FLIP02-09C FLIP02-68C.	93A-021	Winhar-2000
61-80%	Susceptible	03005,03008,03011, 03017, ,03021,03023, 03025,03028,03029, 03033,03034,03038, 03039,03040,03042, 03043, 03044, 03049, 03058.	FLIP00-14C, FLIP01-4C, FLIP01-63C, FLIP01-64C, FLIP02-17C, FLIP02-23C, FLIP02-42C, FLIP02-21C.	92A-117,92A-217, 92A-373,93A-045, 93A-095,93A-203.	2KCC-008, 99CC-005, 99CC-039, Balksar-2000.

81-100%	Highly Susceptible	03002, 03003, 03004, 022, 03027P, 03030. 03031,03032,03035, 03036,03048,03050, 03051,03053,03054, 03055,03057,Pb-9, Noor-91,03304, 9202,9203,9205, 9206,9209,9211, 9212,9214,9215, 9218,9220,9221, 9223,9224,9226, 9227,9229,9230, 9239,9241,9242, 9244,9245,9247, 9248,9250,9251, 9253,9256.	FLIP02-03C, FLIP02-47C, FLIP03-103C, FLIP01-56C,	1A-001,91A-016, 91A-035,91A-039, 91A-120,91A-145, 92A-145,92A-207, 92A-223,92A-242, 92A-260,92A-295, 92A-372,92A-376, 92A-792,93A-011, 93A-023,93A-062, 93A-082,93A-111, 96A-3112,96A-3148, 96A-3189,96A-3208, 96A-4509,96A-4532, 96A-4580,96A-4599, 98a-001.	99CC-015, 99CC-032, 99CC-036, 99CC-037, 99CC-038, 99CC-041, 99CC-042, 99CC-054 2KCC-001, 2KCC-002, 2KCC-003, 2KCC-004, 2KCC-005, 2KCC-007, 2KCC-009, 2KCC-010, 2KCC-011, 2KCC-102, CMN-44019. AUG-424 (chack)

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