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Screening for resistance against *Ascochyta* blight in chickpea

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Abstract

Three hundred and fifty five chickpea germplasm accessions were evaluated for blight resistance at seedling stage under greenhouse conditions during the Rabi season of 2003-04. Fifteen genotypes (NCS9904, CM72XILC3279, NCS9911, Dasht, 30173, KK-12, KK-13, FLIP97-116C, FLIP99-48C, ILC7795, FLIP97-194C, FLIP97-217C, FLIP98-22C, FLIP98-56C and FLIP98-44C) with disease rating 3 were resistant, 81 genotypes were moderately resistant with disease rating 4-5 and 259 were susceptible having disease rating of 6-9. Eight of the resistant genotypes were identified from accessions obtained from International Center of Agricultural Research in Dry Areas, Syria, four from National Agricultural Research Center, Islamabad, two from Gram Research Station, Karak and one from Nuclear Institute for Agriculture & Biology, Faisalabad.

***Key words*:** Germplasm, greenhouse, resistance, screening, *Ascochyta rabiei*, blight

Introduction

Chickpea is an important grain legume sown under rain-fed conditions in Pakistan. It provides a rich and cheap source of vegetable protein for human nutrition (Hulse, 1991). Average yield 615 kg/ha of chickpea in Pakistan (Anonymous, 2003) is very low than its actual yield potential because of fluctuation in environmental conditions (Haqqani *et al*., 2000). Although many factors contribute to low chickpea production but blight caused by *Ascohcyta rabiei* (Pass.) Lab. is the major limiting factor. This disease has been reported in Pakistan as well as in different parts of the world where chickpea is grown (Nene *et al*., 1996).

Blight disease can be effectively controlled by the foliar application and seed dressing of fungicides (Bashir and Ilyas, 1983; Reddy and Kabbabeh, 1984), the use of disease free seeds (Kaiser, 1984) and destruction of plant diseased debris (Chaube and Pandey, 1986), however, these approaches are not feasible. The identification and use of resistant sources against pests and diseases is an important component of genetic improvement programme. Previously a number of chickpea resistant lines/ cultivars have been identified against *Ascochyta* blight at national and international levels (Nene and Reddy, 1987; Samina *et al*., 1996; Iqbal *et al*., 2004). Since the host plant resistance provides the cheapest and most practicable control of chickpea blight, the present study was undertaken to evaluate 355 chickpea breeding lines/ germplasm accessions to identify sources of resistance for breeding programs aimed at development of blight resistant varieties of chickpea.

Matrials and Methods

Three hundred and fifty five chickpea germplasm lines were obtained from National and International Institutes (Table 1). These lines were planted in earthen pots (7.5 x 15 cm) filled with sterilized soil and sand (2:1) mixture. Five seeds of each accession were surface sterilized by treating with Clorox solution (0.1% available chlorine) for 2 minutes before sowing. A susceptible variety "C 727" was kept as control. The pots were kept under greenhouse at $20\pm2\ ^0$C in natural light for 14 days before inoculation. Plants were sprinkled with water prior to inoculation.

The inoculum was prepared from 15 days old culture of *A. rabiei* multiplied on chickpea grains according to the procedure developed by Ilyas and Khan (1986). Two week old seedlings were inoculated by spraying aqueous spore suspension having a concentration of 5×10^5 spores/ml. The inoculated seedlings were incubated in humid chamber for 72 hours in the greenhouse where relative humidity (RH) was maintained more than 90%. Disease observations were taken when susceptible check was completely killed and disease rating was done on 1-9 disease rating scale (Singh *et al*., 1981). The genotypes were grouped into three categories on the basis of disease severity: resistant (1-3 rating),

moderately resistant (4 –5 rating) and susceptible (6-9 rating).

Results and Discussion

Fifteen genotypes were resistant with disease rating of 3 and 81 genotypes were moderately resistant with disease rating of 4-5 (Table 1) whereas 259 were susceptible with disease rating of 6-9.

Out of 15 resistant genotypes, eight genotypes (FLIP97-116C, FLIP99-84C, ILC 7795, FLIP97-191C, FLIP97-217C, FLIP98-22C, FLIP98-56C, FLIP98-44C) were developed by International Centre for Agriculture in Dry Areas (ICARDA) Syria, four genotypes (NCS-9905, NCS-9911, Dasht, CM 72 ILC3279) by National Agricultural Research centre, Islamabad (NARC), two genotypes (KK-12, KK-13) by Gram Research Station (GRS), Karak and one genotype (30173) was developed by Nuclear Institute of Agriculture and Biology (NIAB), Faisalabad (Table 2). This indicates that national and regional agricultural research institutes on chickpea are concentrating on development of blight resistant varieties of chickpea.

In the present investigation quite obvious genetic differences were obtained among genotypes at seedling stage when disease severity was generally very high. Therefore, it is suggested that large number of germplasm lines be initially screened at seedling stage under greenhouse conditions to save time and labour. The genotypes which show a considerable level of resistance at seedling level may be retested for their disease reaction at flowering or pod formation stage under field as well as green house condition to confirm their disease response. A large number of genotypes were found to be susceptible that indicated the effectiveness of artificial inoculation conditions for the development of disease.

Disease resistance of some of the lines (Dasht and ILC 3279) used in the present study confirmed the previous findings regarding resistance in chickpea to blight reported by various eminent workers (Singh *et al.*, 1981; Singh *et al*., 1984; Reddy and Singh, 1990; Reddy and Singh, 1993; Iqbal *et al*., 2002).

Susceptibility of the genotypes towards disease at different plant stages could be either due to the inactivation of genes responsible for resistance in the host plants or due to the mode of infection of the fungus itself (Reddy and Singh, 1990; Ilyas *et al*., 1991). The variation in the level of pathogecity of the fungus could be another reason for differential behavior towards disease. This question is yet to be resolved by conducting more experiments on mode of inheritance and infection of *Ascochyta* blight.

Several resistant lines of chickpea to *Ascochyta* blight have been identified at International Centre for Agricultural Research in Dry Areas (ICARDA), Syria (Reddy and Singh, 1984; Singh *et al*., 1984). Some of the lines, e.g. ILC-72 and ILC-3279, that showed high level of resistance in several countries, were not found highly resistant in Pakistan (Samina *et al*., 1996; Iqbal *et al*. 2004). Therefore, resistant genotypes originated from ICARDA need to be re-tested with aggressive pathotypes of Pakistan before their use in breeding programs. It is now well established that the fungus *A. rabiei* possesses variability and the pathotypes present in Pakistan and India are more aggressive than those prevalent in the Mediterranean region (Singh *et al*., 1984).

The information on the resistance to *A. rabiei* generated in the present study indicated that there is sufficient genetic variation in chickpea for this trait that can be exploited for disease control by building disease resistance pyramids.

Table-1: Number of chickpea accessions obtained from various sources and number of blight resistant/ tolerant lines identified under greenhouse conditions at NARC, Islamabad.

SOURCE	Number of genotypes			
	Total	**Resistant**	**Tolerant**	**Susceptible**
Arid-zone Research Institute (AZRI), Bhakkar	90	0	10	80
Gram Research Station (GRS), Karak	28	2	3	23
National Agricultural Research Centre (NARC), Islamabad	75	4	21	50
Nuclear Institute for Agriculture & Biology (NIAB), Faisalabad	80	1	7	72
International Centre for Agricultural Research in Dry Areas (ICARDA), Syria	82	8	40	34
Total	**355**	**15**	**81**	**259**

Table-2: Chickpea germplasm lines found resistant and moderately resistant (tolerant) to *Ascochyta* blight under the greenhouse conditions at NARC, Islamabad.

Disease grade	Disease reaction	Genotypes
1-3	Resistant	NCS9904, CM72XILC3279, NCS9911, Dasht, 30173, KK-12, KK-13, FLIP97-116C, FLIP99-48C, ILC7795, FLIP97-194C, FLIP97-217C, FLIP98-22C, FLIP98-56C, FLIP98-44C
4-5	Moderately resistant (tolerant)	96A4580, 93A234, 03A008, 02A61017, 03A018, 03A003, 03A002, 92A326, 02AG023, 02AG019, C44XE100YM, 99CC-015, 90261, NCS9903, NCS9905, NCS2001, NCS9903, NCS9914, NCS9905, CM89XParbat, CMC2115, CMC595, Pb-91XICC13508, NCS9917, (ICC11514XILC482)XC44, DashtXC-44, NCS950219, NCS950204, NCS950235, NCS950210, E100YM, 30110, 30113, 30116, 30143, 30144, 30154, 30155, KK-3, KK-4, KK-14, FLIP90-131C, FLIP96-153C, FLIP96-154C, FLIP97-221C, FLIP97-254C, FLIP97-258C, FLIP97-261C, FLIP97-267C, FLIP97-280C, FLIP98-15C, FLIP98-22C, FLIP99-34C, FLIP99-45C, FLIP99-47C, FLIP00-70C, ILC1929, ILC182, ILC5263, ILC7374, FLIP97-110C, FLIP97-116C, FLIP97-121C FLIP97-131C, FLIP97-132C, FLIP97-174, FLIP97-185C, FLIP97-219C, FLIP97-229C, FLIP98-38C, FLIP98-53C, FLIP98-130C, FLIP98-176C, FLIP98-226C, FLIP98-227C, FLIP98-229C, FLIP98-230C, FLIP98-33C, FLIP98-54C, FLIP00-50C, FLIP00-55C
6-9	Susceptible	CM3821/97, CMN257, CMN2385/96, 96A3148, 99CC-005, KC-2140, 99CC-011, CM1852/96, Pb-2000, 98154, 97086, 98004, Bittle-98, Bahawalpur, CC94/99, CC98/99, K-990395, CM2000, FLIP97-172C, FLIP97-179C, 89021XPB91, ICCV97117, E101XPB91, Piadar X Parbat, ICCV97121, ICCV97119, ICCV97126, NCS950259, NCS9906, NCS950209, Bittle 98, CM98, Balkasar, FLIP97-179C, NCS2001, NCS9905, NCS9904, KK-1, C-235, KC-89, 92A048, CM-88, 90395, Parbat, Wanhar, Punjab 2000, C-44, Piadar-91, Punjab-91, C-727, 3A009, 92A117, 96A4504, 93A086, 17A712, 92A217, 93A203, 96A3148, 92A048, 96A2004, 03A006, 95A002, 03A005, 03A004, 95A004, 96A3148, 95A006, 03A005, 95A007, 95A008, 93A111, 96A3849, 96A3112, 96A3249, NCS39K4G, 03A014, 95A010, 92A014, 03A013, 950130, 950156, 96A46229, 96A4599, 96A3148, 92A217, 95A5505, 93A062, PC-2000, 03A007, 03A019, 900156, 02A002, 03A020, 03A015, 03A011, 93127, 91A001, 02A003, 95A098, 03A017, 02A001, 03A001, 95A095, 03A012, 03A010, 03A016, 98K007, 98K004, 02AG028, Noor-91, 95A099, NCS-98K4, 02AG024, 98K012, 02AG025, 01AG014, 02AG012, 02AG015, 02AG013, 02AG021, 02AG014, 02AG026, 02AG014, 02AG022, 02AG011, 02AG018, NCS98K4A, 96A020, 02AG016, 02Ag027, 30101, 30102, 30103, 30104, 30105, 30106, 30107, 30108, 30109, 30111, 30112, 30114, 30115, 30117, 30118, 30119, 30120, 30121, 30122, 30123, 30124, 30125, 30126, 30127, 30128, 30129, 30130, 30131, 30132, 30133, 30134, 30135, 30136, 30137, 30138, 30139, 30140, 30141, 30142, 30145, 30146, 30147, 30148, 30149, 30150, 30151, 30152, 30153, 30156, 30157, 30158, 30159, 30160, 30161, 30162, 30163, 30164, 30165, 30166, 30167, 30168, 30169, 30170, 30171, 30172, 30174, 30175, 30176, 30177, 30178, 30179, 30180, KK-1, KK-2, KK-5, KK-6, KK-7, KK-8, KK-9, KK-10, KK-11, KK-15, KK-16, KK-17, KK-18, KK-19, KK-20, KK-21, KK-22, KK-23, KK-24, KK-25, KK-26, KK-27, KK-28, FLIP85-29C, FLIP92-48C, FLIP92-113C, FLIP97-111C, FLIP97-120C, FLIP97-217C, FLIP97-220C, FLIP98-23C, FLIP98-37C, FLIP98-91C, FLIP 99-26C, FLIP99-46C, FLIP99-73C, FLIP00-63C, FLIP00-65C, FLIP00-66C, FLIP00-67C, FLIP00-69C, FLIP00-71C, FLIP00-72C, FLIP00-73C, UC15, UC27, PCH 15, FLIP 97-85C, FLIP 98-37C, FLIP 98-107C, FLIP 98-128C, FLIP 98-133C, FLIP 98-174C, FLIP 98-231C,FLIP 98-19C, FLIP 00-46C, ILC 263

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