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Development of resistance in chickpea to *Ascochyta* blight

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Abstract

Three hundred and ninety eight chickpea germplasm accessions were evaluated for blight resistance under greenhouse as well as in field conditions during the winter season of 2003-04. The results revealed that 18 genotypes with disease score 1 to 3 were resistant at seedling stage while 69 were at flowering stage. Fifty three genotypes with disease rating of 4-5 were moderately resistant at seedling stage and 125 at flowering stage, whereas the rests were susceptible. It is proposed that initial screening of chickpea germplasm should be undertaken at seedling stage under greenhouse condition to save time and labour. The genotypes showing resistance at this stage may subsequently be tested against aggressive isolates under field as well as greenhouse conditions at flowering stage. Ultimately, the genotypes with different sources of resistance may be utilized to build pyramid resistance into a single genotype.

Key words: Germplasm, greenhouse, resistant source, screening,

Introduction

Chickpea is an important winter 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 of chickpea (550 kg ha^{-1}) in Pakistan is lower than its actual yield potential (Malik, 1984). Although many factors contribute towards low chickpea production but fungal disease blight caused by *Ascohcyta rabiei* (Pass.) Lab. is the major limiting factor. This disease has been reported in Pakistan as well as in different chickpea growing parts of the world (Nene *et al*., 1996).

Although blight disease can be effectively controlled by the foliar application and seed dressing of fungicides, the use of disease free seeds and destruction of diseased plant debris (Bashir and Ilyas, 1983; Reddy and Kabbabeh, 1984; Reddy and Singh, 1990; Malik *et al*., 1991; Rauf *et al*., 1996). Generally, these approaches are not economical and feasible. However, 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 (Haq *et al*., 1981; Nene and Reddy, 1987; Iqbal *et al*., 1989; 94). Since the host plant resistance provides the cheapest and most practicable control of chickpea blight, the present study was undertaken to evaluate chickpea breeding lines/ germplasm accessions to identify sources of resistance for breeding programme aimed at development of blight resistant varieties.

Matrials and Methods

The experimental material of this study consisted of 398 chickpea genotypes obtained from Plant Genetic Resources Institute, National Agricultural Research Centre, Islamabad.

Screening under greenhouse conditions

Chickpea genotypes were planted in earthen pots (7.5 x 15 cm) filled with sterilized soil and sand mixture (2:1). The pots were placed in glasshouse where suitable required conditions for artificial inoculation and blight development were provided.

Seeds of each accession were surface sterilized by treating with Clorox solution (0.1% available chlorine) for 2 minutes before sowing in disposable pots (7.5 x 15 cm). Each pot was planted with five seeds. A susceptible variety, C 727 was considered as control for comparison. Seedlings were maintained in greenhouse at $20\pm2\ ^0C$ in natural light for 14 days before inoculation. Pots were watered from the top prior to inoculation. Two-week old seedlings were inoculated by spraying aqueous spore suspension having a concentration of 5×10^5 spores/ml. 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). The inoculated seedlings were incubated in

humid chamber for 72 hours in the greenhouse. 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).

Screening under field conditions

Same set of germplasm was screened under field conditions simultaneously during crop season of 2003-04. One row of 4 m length was planted for each genotype with two replications. Susceptible check (C 727) was planted and repeated after every two rows of the germplasm as disease spreader. When the entries were at early flowering stage, they were spray-inoculated with spore suspension of *A. rabiei* @ 5 x 10^5 spores/ml.

The inoculum was applied daily in the evening till the appearance of blight. Regular spray of water to support and maintain relative humidity (RH) more than 90% for development of disease as carried out daily. Data for blight at flowering stage were recorded according to Singh *et al*., 1981.

Results and Discussion

Results of the study presented in Table 1 revealed a definite variation for disease reaction among chickpea genotypes according to 1-9 disease rating. The categorization of genotypes according to their disease responses displayed that 18 genotypes were resistant at seedling stage with disease score of 1 to 3 and 53 genotypes were moderately resistant with disease score at 4 to 5, whereas all others were susceptible with disease score of 6-9 (Fig. 1). In case of screening at vegetative stage, 69 genotypes were found to be resistant, 125 were moderately resistant and all others were susceptible.

In the present investigation, genetic differences were obtained at seedling stage where 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 that show a considerable level of resistance at seedling stage may be retested for their disease reaction at flowering or pod formation stage under field as well as greenhouse conditions to confirm their disease response. A large number of genotypes was found to be susceptible that proved the effectiveness of artificial inoculation conditions for the development of disease.

As some of the lines used in the present study exhibited resistance, it confirmed the previous findings regarding resistance in chickpea to blight by various eminent workers (Singh et *al.*, 1981; Singh *et al*., 1984; Reddy and Singh, 1990; Ilyas *et al*, 1991; Reddy and Singh, 1993; Iqbal *et al.*, 1994).

Development of resistance level in some genotypes at two stages might be due to activation of their resistant genes at different plant stages or because of variation in mode of infection at various stages (Ilyas *et al*., 1991, Reddy and Singh, 1984, 1990). The variation in pathogenicity of the fungus used for screening could be another plausible explanation for change in their behavior to disease reaction. This question is yet to be resolved by conducting more experiments on mode of inheritance and infection of *Ascochyta* blight.

At ICARDA several sources of resistance to *Ascochyta* blight have been reported (Reddy and Singh, 1984; Singh *et al*., 1984). Some of the lines, e.g. ILC-72 and ILC-3279 that showed high level resistance in several other countries were not found highly resistant in India and Pakistan. Therefore, resistant genotypes originated from ICARDA need to be re-tested with aggressive pathotypes of Pakistan before their employment in breeding programme. 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). Resistant lines to the local pathogen have been reported in India (Singh *et al.*, 1988) and in Pakistan (Iqbal *et al*., 1989).

The information on the resistance to *A. rabiei* detected in the present study provided a clear clue that there is sufficient genetic variation in chickpea for this trait that can be exploited for disease control by pyramiding disease resistance.

Table 1: Resistant and moderately resistant (tolerant) chickpea genotypes as a result of screening against *Ascochyta* blight during the Rabi season of 2003-04 under the greenhouse conditions at NARC, Islamabad.

Disease grade	Disease reaction	Seedling	Field
1-3	Resistant	53628, 53225, 53227, 53230, 53231, 53233, 53235, ,53244, 53380,53436, 53643, 54247, 53045, 53217, 53218, 53323, 53651, 53398	53628, 53225, 53227, 53230, 53231, 53233, 53235, 53244, 53380, 53436, 53643, 54247, 53012, 53071, 53229, 53232, 53236, 53251, 53416, 53438, 53617, 53619, 53648, 54226, 54248, 54250, 54252, 54256, 54257, 54261, 53590, 53591, 53592, 53608, 53614, 53234, 53280, 53646, 54243, 53593, 53601, 53602, 53603, 53606, 53607, 53611, 53613, 53615, 53616, 53618, 53620, 53621, 53644, 53243, 53252, 53277, 53281, 53610, 53612, 53622, 53623, 53627, 53629, 53630, 53631, 53632, 53640, 53645, 53650
4-5	Moderately resistant (tolerant)	53012, 53071, 53229, 53232, 53236, 53251, 53416, 53438, 53617, 53619, 53648, 54226, 54248, 54250, 54252, 54256, 54257, 54261, 53590, 53591, 53592, 53608, 53614, 53035, 53047, 53066, 53067, 53116, 53219, 53238, 53286, 53313, 53314, 53345, 53358, 53360, 53405, 53410, 53414, 53415, 53435, 53595, 53641, 53652, 53055, 53096, 53097, 53203, 53282, 53425, 53426, 53271, 53387,	53045, 53217, 53218, 53323, 53651, 53035, 53047, 53066, 53067, 53116, 53219, 53238, 53286, 53313, 53314, 53345, 53358, 53360, 53405, 53410, 53414, 53415, 53435, 53595, 53641, 53652, 53023, 53046, 53068, 53070, 53114, 53118, 53206, 53207, 53208, 53209, 53221, 53224, 53237, 53245, 53246, 53273, 53315, 53335, 53342, 53343, 53344, 53348, 53349, 53350, 53359, 53364, 53365, 53366, 53367, 53382, 53406, 53408, 53409, 53411, 53412, 53430, 53432, 54237, 54251, 54262, 54271, 54441, 53580, 53581, 53582, 53585, 53586, 53587, 53597, 53598, 53599, 53600, 53604, 53605, 53609, 53634, 53635, 53636, 53642, 52648, 53413, 53031, 53119, 53152, 53167, 53202, 53228, 53242, 53247, 53250, 53253, 53254, 53255, 53256, 53258, 53267, 53268, 53269, 53279, 53284, 53285, 53287, 53318, 53319, 53325, 53340, 53341, 53439, 53598, 53624, 53625, 53626, 53633, 53638, 53647, 53649, 52609, 52762, 53278

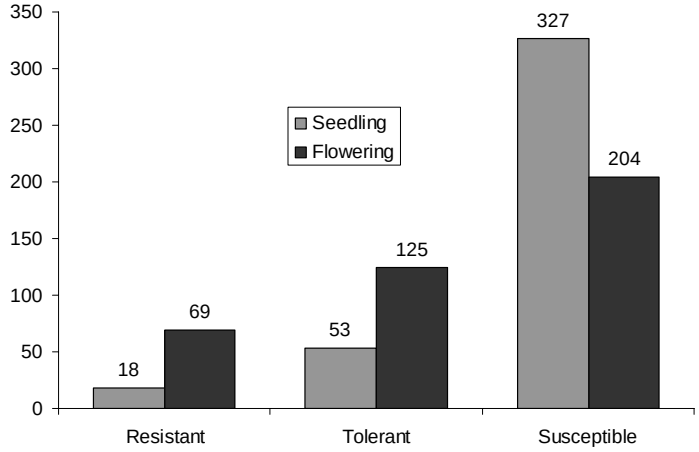

Fig. 1: Chickpea germplasm lines resistant, moderately resistant (tolerant) and susceptible to blight as a result of screening during 2003-04.

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