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Response of chickpea genotypes against *Ascochyta* blight disease

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Abstract

Blight is the becoming the serious threat in changing climate. To improve the per capita income and to overcome the production losses the evaluation of the blight resistant genotypes is the major herder for the breeders. To overcome this problem study was conducted to develop the *Ascochyta* blight resistant genotype. Evaluation of chickpea genotypes against blight (*Ascochyta rabiei* (Pass) Lab) is an effective method to check the level of resistance and susceptibility. In this study, 40 chickpea genotypes/varieties were screened out by the artificial inoculation at the research area of Arid Zone Research Institute, Bhakkar. Out of 40 genotypes, 8, 20, 2, 6, 4 were classified as highly susceptible, susceptible, moderately susceptible, moderately resistant and resistant respectively. Six entries (TG1401, CM54/05, TG1411, TG1413, CH888/06 and D088-11) exhibited moderately resistant behavior against Ascochyta blight. Four entries (09AG006, D08025, CH16/06 and D072-09) classified as resistant genotypes.

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Introduction

Chickpea (*Cicer arietinum* L.) is commonly known as Bengal gram, gram and considered to be the third most important grain legume in the world after dry beans and pea, being widely grown in subtropical and warm-temperate regions (Bakhsh *et al.,* 2007; Mansfeld, 2008). Chickpea is not only an important source of human food (Malik *et al*., 2011) and animal feed, but also fixes nitrogen, which helps in the management of soil fertility, particularly in dry land areas (Sharma and Jodha, 1984; Islam *et al*., 2011).chickpea is a rich source of energy, minerals and vitamins. India and Pakistan are major chickpea producing countries based on its area under cultivation and grain production. Pakistan ranks second to India in terms of acreage under chickpea and are cultivated on an area of 985 thousand hectares and contributes the production of 673 thousand tones (Economic Survey of Pakistan 2012-13).

Average yield of chickpea (550 kg/ha) in Pakistan is lower than its actual yield potential (Malik, 1984).*Ascochyta rabiei* (pass.) is one of the major factors limiting grain yield in chickpea. This disease has been reported in Pakistan and also in different chickpea growing countries of the world (Nene *et al*., 1996).

Blight usually appears in February-March in Pakistan and affects all plant parts. The disease expresses itself as circular spots on leaves and pods and as elongated lesions on petioles and stem. Gram blight (AB), caused by *Ascochyta rabiei* (Pass.) Lab. is an important foliar disease of chickpea (*Cicer arietinum* L.) worldwide that causes grain yield and quality losses up to 100% (Pande *et al*., 2005). Although blight can be effectively controlled by the foliar application and seed dressing of fungicides, the use of disease free seed and destruction of diseased plant debris (Malik *et al*., 1991; Rauf *et al*., 1996). Generally these approaches are not feasible and economical. Hence, resistant or tolerant varieties of chickpea may be the most effective tool to control gram blight (Ilyas *et al*., 2007).

The genetic bases of disease resistance against blight in chickpea could be the best possible solution of the problem. Therefore, there is a dire need for the identification of durable resistant genotypes and incorporation of their resistance genes into commercial cultivars. For the reason, the present study was designed to screen out chickpea cultivars/lines collected from Arid Zone Research Institute (AZRI), Bhakkar.

Materials and methods

The present research work was carried out in the experimental area of the Arid Zone Research Institute, Bhakkar during crop season 2017-18. Forty chickpea genotypes developed at Arid Zone Research Institute, Bhakkar were evaluated for disease resistance against *Ascochyta rabiei*.

Isolation of A. rabiei and Mass culture preparation

Chickpea pods severely infected by Ascochyta blight was collected from field of chickpea were refrigerated at 5-8^{o}C. The isolation procedure carried out was adopted by (Ghazanfar *et al*., 2010). The culture of *A. rabiei* was purified through spore streak method on chickpea seed agar medium and maintained at 5 ^{o}C. Mass culture of the fungus was prepared by the method described by (Ghazanfar *et al*., 2010).

Inoculation of nursery

Forty desi and kabuli chickpea genotypes/varieties were screened out against chickpea blight under randomized complete lock design at the research area of Arid Zone Research Institute, Bhakkar. Disease was developed through artificial inoculation by maintaining humidity at 80% by applying fresh water during afternoon and evening. Genotypes were sown in two rows with four meter length keeping row to row and plant to plant spacing 30 cm & 15 cm, respectively.

A susceptible check variety Punjab-1 was planted after every two genotypes as a spreader. At booting stage, the nursery was daily sprayed with spore suspension of *A. rabiei* (1x 105 spores /ml). The spray of spore suspension was continued till the susceptible check

Punjab-1 become fully susceptible. Fresh water was daily sprayed on daily basis to develop Ascochyta disease.

Disease rating

Data were taken by applying two scales;9 point scale used was modified (Pande *et al.*, 2011) and 1 -10 rating scale (Gowen *et al.*, 1989). According to Pande *et al.*, 2011 scale comprised of 1 –9 ratings (modified from Jan and Wiese, 1991); 1=no visible symptoms; 2=minute lesions prominent on the apical stem; 3=lesions up to 5 mm in size and slight drooping of apical stem; 4=lesions obvious on all plant parts and clear drooping of apical stem; 5=lesions on all plants parts, 6=lesions as in 5, dry branches common, some plants killed; 7=lesions as in 5, defoliation, broken, dry branches very common, up to 25% of plants killed; 8= symptoms as in 7 but up to 50% of the plants killed and 9= symptoms as in 7 but up to 100% of the plants killed.

The genotypes were further categorized for their reaction to Ascochyta blight infection on the basis of Gowen *et al.*, (1989) scale, according to this scale; 1 - <2= Highly resistant(HR); 2- <4= resistant (R); 4 <6=moderately resistant (MR); 6- <7= moderately susceptible (MS); 7-<9= susceptible (S); and 9-10=highly susceptible (HS).

Results and discussion

Forty chickpea genotypes comprising (Desi and Kabuli) were studied and results revealed that tested material showed variable response against the *Ascochyta* blight (Table 1).

Table 1. Disease reaction of different genotypes as a result of screening against *Ascochyta* blight.

S.No.	Genotypes	Disease Rating	% Av. Severity	Reaction
1	TG1402	9	63.25	HS
2	TG1403	9	57.55	HS
3	TG1401	4	16.35	MR
4	09AG006	3	9.75	R
5	TG1414	7	46.5	S
6	TG1415	7	40	S
7	D08025	3	7	R
8	CH16/06	3	10	R
9	CM54/05	4	13.75	MR
10	TG1411	4	12	MR
11	TG1405	9	66.5	HS
12	TG1406	9	62.75	HS
13	TG1416	9	70	HS
14	TG1404	7	43.5	S
15	TG1407	7	45	S
16	TG1408	7	47.75	S
17	CH53/07	6	40	S
18	TG1413	4	17.5	MR
19	CH888/06	4	11.75	MR
20	TG1410	7	48	S
21	TG1423	6	33.5	MS
22	TG1424	7	42.7	S
23	TG1425	7	40	S
24	TG1420	9	66.5	HS
25	TG1417	9	77.5	HS
26	D088-11	4	11.5	MR
27	CM770/06	7	46	S
28	K7005	7	40.75	S
29	TG1430	7	45	S
30	TG1427	7	41.25	S
31	TG1426	7	43	S
32	CH87/06	9	68	HS
33	TG1409	7	43.25	S
34	TG1412	7	48	S
35	T1418	6	30.75	MS
36	TG1419	7	50	S
37	TG1421	7	48.9	S
38	TG1428	7	45	S
39	TG1429	7	41.25	S
40	D072-09	3	8.5	R
41	Punjab-1	9	83.75	HS

Eight entries were categorized as highly susceptible where 20 entries were classified as susceptible while six genotypes showed moderately disease reaction. Four entries were kept in resistant classification.

Disease behavior of all the genotypes is represented in Table 1. The average maximum disease severity (up to 83.75%) was recorded in Punjab-1.The genotypes / varieties which showed highly susceptible disease reactions were TG1402, TG1403, TG1405, TG1406, TG1416, TG1417, TG1420, CH87/06 and Punjab-1 (check). On the other hand, the tested lines with susceptible level of reactions were TG1404, TG1407, TG1408, TG1409, TG1410, TG1412, TG1414, TG1415, TG1419, TG1421, TG1424, TG1425, TG1426, TG1427, TG1428, TG1429, TG1430, CH53/07, CM770/06 and K7005. Two inbred strains (TG1418 and TG1423) showed moderately susceptible behavior. Whereas, the entries TG1401, CM54/05, TG1411, TG1413, CH888/06 and D088-11 expressed moderately resistant behave against Ascochyta blight. Out of forty genotypes studied, four genotypes (09AG006, D08025, CH16/06 and D072-09) showed resistant type of response against blight (Table 1).

While screening, it was observed that most of the entries were susceptible to highly susceptible. This represents that most of the genotypes did not have resistance genes. These results also correlate with the Iqbal *et al.*, (2010) who studied one hundred and forty five genotypes against Ascochyta blight and wilt diseases and most them expressed susceptible to highly susceptible reaction. Similarly, Bokhari *et al.*, (2011) evaluated the resistance level of ten cultivars of gram and observed that maximum number of varieties were susceptible under field conditions. Although, those genotypes can be released for commercial cultivation which have resistant genes (Nasir *et al.*, 2000). A comprehensive study on the number of genes possessing resistance against chickpea blight, their nature, and diversity is essential for exploiting a particular resistance source in chickpea breeding programme (Ilyas *et al.*, 2007). Resistance against chickpea light is controlled by single dominant gene or recessive gene (Singh and Reddy, 1991). Ali *et al.* (2011) conducted molecular marker study and represented that resistance in chickpea is due to presence of three independently segregating dominant genes and a recessive gene. Various Quantitative Trait loci (QTL) also contributed towards inheritance of blight resistance (Collard *et al.*, 2003). Different bio-chemicals and physiological characters of varieties also control the resistance against blight in chickpea cultivars. Randhawa *et al.* (2009) studied the role of glandular hairs density, population and size of stomata aperture in chickpea cultivars against Ascochyta blight. It was observed that these characters played comprehensive role in varieties resistance.

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.*, 1 984). Resistant lines to the local pathogen have been reported in India (Singh *et al.*, 1988) and in Pakistan (Iqbal *et al.*, 1989). High level of AB resistance has also been identified among wild Cicer species. Resistance against AB has been identified in *C. judiacum*, *C. pinnatifidum*, *C. echinospermum* and *C. reticulatum* (Singh *et al.*, 1981; Singh and Reddy 1991; Collard *et al.*, 2001; Pande *et al.*, 2005, 2006). Ascochyta blight resistance is a complex venture controlled by various different resistant sources comprises of resistance genes. Under such condition, introducing diverse résistance genes into varieties may assist in developing resistance stability in commercially grown varieties.

Conclusion

The study concludes that none of the lines/varieties was observed as highly resistant which indicated that immunity in chickpea against blight is rather scarce. Sources of resistance identified during this study, can further be used in breeding programmes for the development of disease resistant commercial cultivars after determining their genetics. Most of the genotypes were susceptible to highly susceptible against chickpea blight indicating scarcity of resistance. To develop resistance, therefore, an

intensive screening of chickpea germplasm is required to be conducted.

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