

The tolerance of the some registered chickpea (*Cicer arietinum* L.) Varieties against ascochyta blight (*Ascochyta rabiei*) in the Eastern-Mediterranean region

Abstract

This research was conducted to evaluate the disease tolerance/resistance of 34 registered chickpea (*Cicer arietinum* L.) varieties in the disease nurseries under winter climatic conditions of Eastern-Mediterranean region located at the Eastern Mediterranean Research Institute, Adana. During 2014-2015 sowing season, four different disease nurseries for 4 different path types were established with the registered chickpea varieties for regular observations on tolerance of the varieties. In trials, 34 registered chickpea varieties were evaluated and compared to Ascochyta blight disease sensitive control variety 'Canitez'. In this study, artificially inoculated disease nurseries were established in Adana location which includes four different Ascochyta blight pathotypes that were identified in the Turkish legume plantation areas. The disease observations were performed on the day 7, day 14 and day 21 based on 1-9 disease scale to identify and evaluate the suitability of the registered varieties to the regional conditions and also to the winter sowing conditions.

From the disease nurseries established by the artificial inoculation of four different pathotypes, the lowest scores were obtained from the applications of Pathotype 1 while the highest scores were recorded from the applications of Pathotype 4.

Keywords: chickpea, registered varieties, ascochyta blight

Introduction

Chickpea (*Cicer arietinum* L.) is the fourth most important legume plant worldwide in terms of production. In Turkey, the chickpea production was 630.000 tonnes with the sowing area of 517. 785 ha while the grain yield was 122.00 kg/da.¹ One of the most important biotic factors that limiting the yield and the quality of the chickpea is Ascochyta blight (*Ascochyta rabiei* (*pass.*) *Labr.*). Ascochyta blight disease was reported from all chickpea growing areas and the pathogen population causing this disease shows high level of variation.² It is an important problem for cultivation of chickpea especially under rainy and temperate conditions.^{3,4} It is the major constraint for the chickpea cultivation all over the world as well as in Turkey and the most effective disease management strategy is using disease resistant/tolerant varieties⁵

This disease was reported from 31 different countries where it causes up to 5-50% yield losses depending on environmental factors and 100% yield loss under favorable conditions for disease development.⁶ Since, the causal agent of the disease can be carried by seed, planting non-contaminated seed is very important.⁷⁻⁹

National and international breeding programs are carrying out successful studies to develop resistant varieties. Resistance sources have been determined during those studies and their transfer, using conventional breeding techniques, to genotypes where resistance is desired was attempted.¹⁰⁻¹² stated that the wild relatives of chickpea should be investigated for the source of resistance and numerous resistance breeding programs in the world also screened wild *Cicer* species as they are thought to have important sources of resistance.

The purpose of the resistance breeding studies is to develop disease-tolerant, high-yielding varieties, and in this study, it was

aimed to determine the reaction of certified chickpea varieties against Ascochyta blight disease under the climatic conditions of Eastern-Mediterranean region, as well as adaptation of genotypes to winter conditions and develop list of recommended varieties for chickpea growers.

Material and methods

Ascochyta rabiei pathotypes

Legume crop cultivation areas of Turkey were screened for the respective disease, collected samples were examined in the laboratory to characterize *A. rabiei* population. As a result, four pathotypes of Ascochyta blight were determined.^{12,13} Stated that for resistance breeding of chickpea against Ascochyta blight, the wild *Cicer* species should be investigated for such purpose as they are thought to have important resistance sources (Table 1).

Table 1 Error! Main Document Only.: Differential cultivar set and their reactions to *A. rabiei* pathotypes

Chickpea Geno types	Chickpea differential set for identification of Ascochyta blight pathotypes			
	Patho typeI	Patho typeII	Patho typeIII	Patho typeIV
ILC1929	S	R	R	R
ILC 482	S	S	R	R
ILC 3279	S	S	S	R
ICC12001	S	S	S	S

Characterization of *A. rabiei* pathotypes allows to test certified varieties against these pathotypes by artificial inoculation under field conditions. In this study, an attempt was made to determine the

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tolerance of registered cultivars against 4 pathotypes of ascochyta blight in Turkey to determine the tolerance of the registered cultivars against the four pathotypes of Ascochyta blight disease in Turkey. Economic losses will be prevented by determining the tolerance of varieties against pathotypes for their growing areas.

Disease inoculations

Disease nurseries were established as 2 rows X 2m long, 0.45m row spacing consisting of 34 varieties, and 1 sensitive control to test all Ascochyta pathotypes. Line and varieties in disease nurseries were inoculated using an artificial inoculation technique with *A. rabiei* pathotypes collected from chickpea growing areas of Turkey. Four different disease gardens were over irrigated using a pulverizer, and disease scorings were performed on the 7th day, 14th day, and 21st day after inoculation. Response of chickpea lines against *A. rabiei* pathotypes was determined based on scoring.

Disease development on chickpea plants infected with *A. rabiei* pathotypes were evaluated according to a scale of 1-9.^{14,15} According to this scale; 1: Healthy plant without symptom; 2: Plants with small lesions; 3: Lesions are present (10% of the plant), wide enough to be easily noticed, but the plant is green; 4: Lesions in the plant are large and easily noticeable, regression in plant growth; 5: Lesions are covering the trunk (25% of the plant), lesion formation on leaves; 6: Yellowing of the plant shoot tips backward, breakage in the stem; 7: Severe symptom formation in the plant (50% of the plant), the onset

of death, at least 3 healthy and green leaves on the plant; 8: Severe symptom formation in the plant, yellowing in the whole plant, growth retardation, breakage in the trunk; 9: Dead plant without green parts.

Result and discussion

It was aimed to determine the tolerance/resistance of certified varieties against pathotypes of *A. rabiei* in Eastern-Mediterranean region based on phenotypic scorings. Results of the current study encourages the development of a recommendation list of certified varieties for different agro-climatic regions that could minimize economical yield losses in the respective regions.

Climatic Conditions of the Fields, during the 2014-2015 growing season, there was sufficient rainfall for the development of the plants. However, the table 2 shows that the low amount of precipitation in December and January in 2015 (50.05 and 56.39 mm, respectively) was observed compared to the average of the same months in previous years (118.1 and 111.7 mm, respectively). During March, April and May which coincide to the flowering and pod tying period of chickpea, due to the high and irregular distribution of rainfall in 2015 (115,81-7,88-81,02 mm, respectively) compared to average of previous years (67,9-51,4-46,7 mm, respectively), the chickpea plants were exposed to abiotic stress conditions that lead to increase in the intensity of Ascochyta blight disease. Temperature and humidity were in coherence with previous years (Table 2).

Table 2 Rainfall, average temperature and total relative humidity values of Adana province for the growing period of 2014-2015

Month	Rainfall (mm)		Average temperature Co		Average humidity (%)	
	Previous year's average	2014-2015	Previous year's average	2014-2015	Previous year's average	2014-2015
November	67,2	36,06	15,3	14,76	63	54,8
December	118,1	50,05	11,1	13,0	66	71,6
January	111,7	56,39	9,7	8,9	66	66,3
February	92,8	90,68	10,4	10,9	66	70,1
March	67,9	115,81	13,3	13,9	66	64,6
April	51,4	7,88	17,5	15,8	69	62,5
May	46,7	81,02	21,7	21,7	67	64,3
June	22,4	0	25,6	24,2	66	69,1
July	5,4	0	27,7	28,0	68	69,3

Reaction of Tested Varieties, Chickpea varieties grown in 4 disease nurseries was inoculated with 4 pathotype to determine the intensity of Ascochyta blight disease. The disease scorings were performed 3 times on the 7th day, 14th day and 21st day after inoculation using

scale of 1-9 and results are presented in the Table 3 and Table 4.¹⁶⁻¹⁸ reported that Ascochyta blight disease creates major problems for chickpea cultivation and causes yield losses in our country.

Table 3 Results from disease nurseries which inoculated with pathotype I and pathotype II

Disease garden inoculated with Pathotype I						Disease garden inoculated with Pathotype II					
Row NO	Genotype/Variety	Origin	7th day	14th day	21 th day	Row NO	Genotype/Variety	Origin	7th day	14th day	21 th day
1	Gökçe	Ankara	2	7	7	1	Gökçe	Ankara	4	7	8
2	Uzunlu	Ankara	5	8	8	2	Uzunlu	Ankara	8	9	9
3	Er	Ankara	2	6	7	3	Er	Ankara	3	6	8
4	Akçin	Ankara	4	7	7	4	Akçin	Ankara	7	8	8
5	Dikbaş	Ankara	2	6	7	5	Dikbaş	Ankara	3	7	8
6	Canitez	Control	4	8	8	6	Canitez	Control	6	8	8
7	Küsmen	Ankara	4	7	9	7	Küsmen	Ankara	5	8	8
8	Eser	A.Ü	2	6	6	8	Eser	A.Ü	3	7	7
9	Ilgaz	ITAŞ		5	5	9	Ilgaz	ITAŞ		6	7
10	Taeksağel	TAEK -Ank	7	8	6	10	Taeksağel	TAEK -Ank	6	7	7
11	Damla	Samsun	3	6	5	11	Damla	Samsun		5	9
12	canitez	Control	5	8	6	12	canitez	Control	5	7	7
13	Gülümser	Samsun	2	6	6	13	Gülümser	Samsun	2	6	7

Table Continued...

Disease garden inoculated with Pathotype I						Disease garden inoculated with Pathotype II					
Row NO	Genotype/Variety	Origin	7th day	14th day	21 th day	Row NO	Genotype/Variety	Origin	7th day	14th day	21 th day
14	Çağatay	Samsun	3	5	5	14	Çağatay	Samsun	2	5	6
15	Sezenbey	Samsun	2	4	7	15	Sezenbey	Samsun	3	7	6
16	Zuhal	Samsun	2	4	6	16	Zuhal	Samsun	3	7	7
17	Aksu	Maraş	3	5	4	17	Aksu	Maraş	2	6	6
18	Canitez	Control	4	6	8	18	Canitez	Control	5	8	8
19	Ilc 482	Diyarbakır	3	6	8	19	Ilc 482	Diyarbakır	3	8	8
20	Diyar 95	Diyarbakır		5	7	20	Diyar 95	Diyarbakır	2	7	8
21	Arda	Diyarbakır		4	5	21	Arda	Diyarbakır		6	5
22	Canitez	Control		5	8	22	Canitez	Control	5	8	8
23	Yaşa	Eskişehir		4	6	23	Yaşa	Eskişehir	3	6	8
24	Canitez	Eskişehir	5	7	8	24	Canitez	Eskişehir	3	8	8
25	Işık	Eskişehir	5	7	8	25	Işık	Eskişehir	6	8	9
26	Hisar	Eskişehir	4	4	8	26	Hisar	Eskişehir	7	7	8
27	Azkan	Eskişehir	2	5	5	27	Azkan	Eskişehir	3	6	7
28	Çakır	Eskişehir	3	5	6	28	Çakır	Eskişehir	3	6	8
29	Akça	Eskişehir	3	8	8	29	Akça	Eskişehir	3	6	8
30	Canitez	Control	6	8	8	30	Canitez	Control	6	8	9
31	Aziziye	Erzurum	5	4	8	31	Aziziye	Erzurum	4	7	8
32	İnci	Adana	2	5	5	32	İnci	Adana		6	7
33	Hasanbey	Adana	2	4	6	33	Hasanbey	Adana		6	7
34	Seçkin	Adana	2	6	5	34	Seçkin	Adana		5	6
35	İzmir 92	İzmir	4	7	6	35	İzmir 92	İzmir	4	8	9
36	Canitez	Control	5	7	8	36	Canitez	Control	5	8	9
37	Menemen	İzmir	4	8	6	37	Menemen	İzmir	5	7	8
38	Aydın	İzmir	6	5	8	38	Aydın	İzmir	3	6	7
39	Sarı	İzmir	3	7	5	39	Sarı	İzmir	7	9	9
40	Cevdetbey	İzmir	5	7	7	40	Cevdetbey	İzmir	4	7	8

I: Resistant, 9: Susceptible

Table 4 Results from disease nurseries inoculated with pathotype III and pathotype IV

Disease garden inoculated with Pathotype III						Disease garden inoculated with Pathotype IV					
Row NO	Genotype/Variety	Origin	7th day	14th day	21 th day	Row NO	Genotype/Variety	Origin	7th day	14th day	21 th day
1	Gökçe	Ankara		5	7	1	Gökçe	Ankara	2	6	8
2	Uzunlu	Ankara	3	6	7	2	Uzunlu	Ankara	5	8	8
3	Er	Ankara		6	8	3	Er	Ankara	6	7	8
4	Akçin	Ankara	3	7	7	4	Akçin	Ankara	4	8	8
5	Dikbaş	Ankara	2	6	8	5	Dikbaş	Ankara	5	8	8
6	Canitez	Control	2	7	7	6	Canitez	Control		7	7
7	Küsme	Ankara		6	7	7	Küsme	Ankara	3	8	8
8	Eser	A.Ü		5	6	8	Eser	A.Ü		7	7
9	İlgaz	ITAŞ		4	5	9	İlgaz	ITAŞ		6	6
10	Taeksağel	TAEK-Ank		6	5	10	Taeksağel	TAEK-Ank	7	8	8
11	Damla	Samsun		5	5	11	Damla	Samsun	3	7	6
12	Canitez	Control		8	5	12	Canitez	Control	3	6	7
13	Gülümser	Samsun		7	5	13	Gülümser	Samsun	2	7	6
14	Çağatay	Samsun		7	5	14	Çağatay	Samsun		6	5
15	Sezenbey	Samsun		6	5	15	Sezenbey	Samsun		6	5
16	Zuhal	Samsun		6	5	16	Zuhal	Samsun		6	5
17	Aksu	Maraş		6	5	17	Aksu	Maraş		7	5
18	Canitez	Control		6	5	18	Canitez	Control		6	7
19	Ilc 482	Diyarbakır	6	5	7	19	Ilc 482	Diyarbakır		7	7
20	Diyar 95	Diyarbakır		5	6	20	Diyar 95	Diyarbakır		5	6
21	Arda	Diyarbakır		5	5	21	Arda	Diyarbakır		5	6
22	Canitez	Eskişehir		8	9	22	Canitez	Eskişehir	3	6	8
23	Yaşa	Eskişehir	7	6	6	23	Yaşa	Eskişehir		5	6
24	Canitez	Eskişehir	4	7	8	24	Canitez	Eskişehir		6	7
25	Işık	Eskişehir	5	7	8	25	Işık	Eskişehir	4	7	7
26	Hisar	Eskişehir	6	7	8	26	Hisar	Eskişehir	5	8	8

Table Continued....

Disease garden inoculated with Pathotype III						Disease garden inoculated with Pathotype IV					
Row NO	Genotype/Variety	Origin	7th day	14th day	21th day	Row NO	Genotype/Variety	Origin	7th day	14th day	21th day
27	Azkan	Eskişehir		5	5	27	Azkan	Eskişehir		6	8
28	Çakır	Eskişehir		6	5	28	Çakır	Eskişehir		7	6
29	Akça	Eskişehir	4	6	6	29	Akça	Eskişehir		6	7
30	Canitez	Control	6	7	8	30	Canitez	Control	3	6	8
31	Aziziye	Erzurum		7	9	31	Aziziye	Erzurum	3	7	8
32	İnci	Adana		6	5	32	İnci	Adana		5	5
33	Hasanbey	Adana		5	5	33	Hasanbey	Adana		5	6
34	Seçkin	Adana		5	5	34	Seçkin	Adana		5	5
35	İzmir 92	İzmir	4	7	6	35	İzmir 92	İzmir		7	7
36	Canitez	Control	2	6	7	36	Canitez	Control		8	8
37	Menemen	İzmir	2	6	6	37	Menemen	İzmir		6	7
38	Aydın	İzmir		5	5	38	Aydın	İzmir		6	6
39	Sarı	İzmir	7	8	9	39	Sarı	İzmir	5	7	8
40	Cevdetbey	İzmir	5	7	8	40	Cevdetbey	İzmir	4	7	8

I: Resistant, 9: Susceptible

The results of the scoring of four different disease nurseries namely “registered cultivars disease nurseries I-II-III-IV” after artificial inoculation of 4 different pathotypes carried out in the Adana location are given in (Table 3 and Table 4).

Ascochyta blight disease scorings were performed in four disease nurseries with four pathotypes in the field conditions (Table 3 and Table 4). Ascochyta disease was prevalent at flowering and pod filling stages in Aegean, Mediterranean and Bosphorus regions; however, the crop was severely affected before flowering, as *D. rabiei* is a polycyclic disease and pycnosporos formed in plant tissue result into secondary infections. Moreover, cool-humid air conditions, rain splash and wind incite spread of the disease via pycnosporos during vegetative growth in the field.^{19,20}

The scores for the pathotype I and the pathotype II are shown in the (Table 3), and the disease observations for the pathotype III and the pathotype IV are shown in the Table 4. Four pathotypes were prepared separately in the laboratory and artificial inoculation was performed in four different disease nurseries. For the successful disease development in disease nurseries, plants were over irrigated using sprayer every day. After artificial inoculation, the disease scorings were obtained according to the 1-9 scale on the 7th, 14th and 21st days. When the results are examined, the lowest scores among the four pathotype applications were observed for the Pathotype-I application and the highest scores were obtained for Pathotype-IV applications. This shows that the Pathotype IV is the most aggressive and virulent over the four Ascochyta pathotypes.²¹ Reported that chickpea genotypes reacted differently to blight disease caused by Ascochyta rabiei.²² Explained that there are similarities and differences between Ascochyta spp., which is the disease agent of legumes, and that MAT analyzes are important in determining this.²³ Reported that chlorophyll a and chlorophyll b production were significantly reduced in moderately or severely diseased leaves.

Conclusion

In summer plantings or late plantings, yield losses are experienced since the development periods of the plants coincide with the dry periods when the precipitation decreases. Annual yield losses caused by Ascochyta blight disease during winter farming of chickpea can be prevented using tolerant varieties such as İnci, Hasanbey, Seçkin, Çagatay, Sezenbey, Zuhul, Aksu, Diyar95, Arda, Yaşa, Menemen, and Aydın tested during the current study.

In this study, tolerance to four different pathotypes of Ascochyta blight disease of registered chickpea (*Cicer aritinum* L.) varieties were investigated under climatic conditions of Eastern-Mediterranean region. It was observed that the virulence tends to increase from Pathotype-I to Pathotype-IV of the Ascochyta blight. In this study, the varieties of İnci, Hasanbey and Seçkin which are widely grown in Eastern-Mediterranean region, were performed good and in addition to this, the performances of Çagatay, Sezenbey, Zuhul, Aksu, Diyar95, Arda, Yaşa, Menemen and Aydın varieties were found to be at an acceptable level and tolerant in the region.

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Conflicts of interest

The author states there are no conflicts of interest.

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