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IDENTIFICATION OF BEAN GENOTYPES FROM TURKEY RESISTANCE TO COMMON BACTERIAL BLIGHT AND HALO BLIGHT DISEASES

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Abstract. Bean diseases caused by different pathogens reduce important yield and quality of beans in different bean growing regions in both Turkey and the other bean producing countries. In the present study, bacterial pathogens in the species of *Pseudomonas savastanoi* pv. *phaseolicola* (Burkholder) Garden et al. and *Xanthomonas axonopodis* pv. *Phaseoli* (Smith) Vauterin et al. causing economically important disease on bean plants growing in the commercial fields of Erzurum and Erzincan provinces located in the Eastern Anatolia region of Turkey has been isolated and identified. Totally thirty-six bean genotypes and two commercial cultivars commonly grown in the region have been screened for resistance to these pathogens both in greenhouse and field condition during 2001–2002. Disease severity in the field condition reduced seed quality and quantity of bean. Among the thirty-eight genotypes tested, only 36K was found to be resistant to both of the pathogens.

Key words: *Phaseolus vulgaris, Pseudomonas savastanoi* pv. *phaseolicola* (Burkholder) Garden et al., *Xanthomonas axonopodis* pv. *Phaseoli* (Smith) Vauterin et al.

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is one of the most important agricultural crops in Turkey [Kahveci and Maden 1994]. Currently, Turkey is one of the most important bean (dry and green) producing country in the world with production of totally 813.000 tonnes [FAO 2010]. It is traditionally a basic food crop in many developing countries, and it supply a major plant protein source for peoples living in rural and urban areas [Dursun et al. 2002, Islam et al. 2002]. It is also a good source of sugar, minerals

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and vitamins [Larralde and Martinez 1991]. In addition, legumes such as beans play an important role in the crop rotation system by providing nitrogen to successive crop without the added expense of supplemental fertilizer. They use the atmospheric form of nitrogen (N_2) for growth and development. Most other plants require soil nitrogen in either the nitrate (NO_3^-) or ammonium (NH_4^+) form [Delahaut and Newenhouse 1997].

Among the many diseases affecting bean plants, common bacterial blight (CBB), caused by *Xanthomonas axonopodis* pv. *Phaseoli* (Smith) Vauterin et al. and halo blight caused by *Pseudomonas savastanoi* pv. *phaseolicola* (Burkholder) Garden et al. (Psp) are most destructive bean diseases when environmental conditions are favorable for these pathogens [Ariyaratne et al. 1998, Dursun et al. 2002]. Common blight may be highly destructive during extended periods of warm and humid weather, resulting in yield and seed quality losses. Halo blight is favored by cool and wet weather at the beginning of the growing season. These pathogens are reported average 43% yield losses under experimental conditions [Fourie 2002]. Seed transmission plays a significant role in the development of an epidemic common bacterial blight and halo blight [Schaad et al. 1995, Yu et al. 1998]. These seed borne pathogens can reduce yield under epidemic conditions differing somewhat in geographic regions. In Turkey, although a zero tolerance for Psp and Xcp is used in seed certification, seed production is not large enough to meet farmers demand [Benlioğlu et al. 1994]. Recommended control measures are: use of disease-free seed and transplants, suitable rotations, deep plowing of plant debris and use of resistant cultivars [Coyne and Schuster 1983, Schuster et al. 1983, Zaiter et al. 1989]. There is no satisfactory chemical control for common bacterial blight [Ariyaratne et al. 1998, Rodrigues et al. 1999, Dursun et al. 2002]. However, partial control of halo blight has been reported with copper-based sprays. Antibiotics should not be applied to leaves because resistant mutants of the pathogens may develop [Saettler 1989, Franc 1998]. Thus, genetic resistance is the most effective method of control against Xcp and Psp [Opio et al. 1996, Yu et al. 1998, Singh and Munoz 1999, Park et al. 1999, Miklas et al. 2003, Fourie et al. 2005]. Some bean cultivars/lines are known resistant to common bacterial blight and halo blight [Arnaud-Santana et al. 1994, Ariyaratne et al. 1999, Valladares-Sanches et al. 1983]. Because some sources of resistance to Xcp have been reported in tepary bean *(Phaseolus acutifolius)* and in common bean *(Phaseolus vulgaris)* cultivars [Coyne and Schuster 1974, Coyne et al. 1983, Zaiter and Coyne 1984, Hagedorn and Inglis 1986, Zaiter et al. 1989, Freytag 1989, Saettler 1989, Michaels 1992, Zapata 1997, Singh and Munoz 1999, Urrea et al. 1999, Tampakaki et al. 2002].

Halo and common blights are two bacterial diseases causing serious decrease in yield and quality of bean production in Turkey. There have no much resistance bean cultivars grown in Turkey against Xcp. Also a few bean cultivars in Turkey have been reported to be resistant and/or slightly resistant to the halo blight disease, but none of them was found to be resistant to CBB [Dursun et al. 2002]. Thus, the aim of the current study was to evaluate thirty-six bean genotypes and two commercial cultivars, used as control, commonly grown in Erzurum and Erzincan for resistance to Xcp and Psp under both greenhouse and field conditions.

MATERIAL AND METHOD

Plant material. Thirty-six bean genotypes (36K, 105, 114, 124, 127, 132, 171, 195, 218, 251, 288, 339, 412, 420, 435, 458, 460, 462, 471, 473, 480, 483, 484, 510, 517, 518, 520, 527, 555, 563, 565, 568, 569, 579, 598 and 4F-2928) and two well known commercial cultivars (Aras 98 and Yakutiye 98) were collected from different parts of Erzurum and Erzincan.

Preparation of inoculum. Psp and Xcp strains were used to prepare inoculum. Isolates for inoculation were cultured on YDC (Yeast Calcium Carbonate Agar) for 48h at 27°C. The bacterial colonies were transferred in to flasks containing liquid medium (Nutrient Broth). Then these were incubated at shaker (150 rpm·min^{-1}) for 24 hours. A hundered ml of this suspension was diluted in 900 ml of water to give a concentration of $10^8 \times 1$ ml^{-1}.

Greenhouse experiment. An experiment was conducted under greenhouse conditions in order to evaluate bean genotypes/cultivars for resistance to Xcp and Psp in completely randomized design with four replications. Three seeds were sown in each 20 cm diameter plastic pot containing sterile soil. Experiment was repeated twice for each genotypes/cultivars. A mixture of bacterial suspension was sprayed on plants that have four leaves. One-week interval, spray treatment was applied twice. Plants were incubated in the greenhouse for symptom development. Pathogenecity was evaluated 20 days after inoculation. Disease development was rated according to the following scale: 1 = symptomless; 2 = a few necrotic spots; 3 = more than spots, some coalescing; 4 = severe spot and leaf defoliation; and 5 = plant dead.

Field experiment. Field experiment was conducted in order to evaluate bean (*Phaseolus vulgaris* L.) genotypes/cultivars for resistance to Xcp and Psp on the experimental farm of Atatürk University in Erzurum in Eastern Anatolia (29°55' N and 41°16' E with an altitude at 1850 m a.s.l) in completely randomized split-plot designs with three replications in 2001 and 2002. The main-plot units consisted of two treatments [pathogen (Xcp or Psp) and control (no pathogen spray)]. Bean genotypes/cultivars formed the sub-plot units. Research region has an average temperature and total rainfall of 5.7°C and 439.6 mm (tab. 1) and vegetation period in the region is restricted between May and October. The second year of experiment received higher and more even distribution of rainfall in the growing months of May, June, July, August and September while in the first year precipitation was lower with dry conditions prevailing in June, August and September. The experimental soil was a sandy loam with organic matter content ranging between 1.68 and 1.93%, and lime content between 0.34 and 0.66% (pH = 6.34–6.54). Available P_2O_5 content ranged between 87 and 119 kg·ha^{-1} and K_2O content between 1422 and 1730 kg·ha^{-1}. Each genotype/cultivar was sown by hand in sub-plots having 1 row of 5 m length with 40 cm inter-sub-plot spacing on 15 May 2001 and 18 May 2002. Thus, each genotype/cultivar row formed the sub-plot unit and hundred seeds were sown in each sub-plot row. There were a total of 38 sub-plot units within each main plot. Pathogens (Xcp and Psp) were sprayed with a hand-pressurized knapsack sprayer fitted with a single flat-fan nozzle on plants with four leaves at 300 L·ha^{-1} application volume. One-week interval, spray treatment was applied three times. Water was sprayed in the control treatment. Plots were irrigated three times starting from the be-

ginning of June until 4 weeks prior to harvest. Weeding was done by hoe if required. In the field experiment, disease development was rated according to the above scale. At the maturity stage, sub-plots were harvested by hand and seed yield ($g \cdot m^{-2}$) was determined after cleaning the seeds.

Table 1. Climatic data on the experimental site

Climatic factors	Years	Months					Total/Average	
		May	June	July	August	September	growth season	annual
Total rainfall (mm)	2001	63.2	14.6	36.9	1.9	3.8	120.4	424.3
	2002	73.1	74.0	39.1	54.6	52.9	295.4	484.5
	1929–1998	73.6	51.1	29.0	18.4			439.6
Average air temperature (°C)	2001	9.8	14.4	19.5	19.8	14.3	15.6	5.2
	2002	9.8	14.3	18.3	16.6	13.6	14.5	4.1
	1929–1998	10.7	15.0	19.2	19.4			5.7

Statistical analysis. The data were subjected to analysis of variance using MSTATC statistical program. Means values were separated according to Least Significant Differences test (LSD) at $P = 0.05$.

RESULT AND DISCUSSION

Resistance reactions of bean cultivars/genotypes to Xcp and Psp were detected under both greenhouse and field conditions. The susceptible genotypes developed characteristic symptoms of bacterial halo blight and common blight diseases. No symptoms were observed on the control plants.

Greenhouse experiment. Greenhouse experiment of 2001 year suggested that among thirty-eight genotypes tested, two (36K and 579 genotypes) were highly resistant, seven (127, 132, 195, 435, 473, 518 and 569 genotypes) were resistant, twenty-four and Yakutiye-98 cultivars were tolerant, three (105, 462 and 563genotypes) and Aras-98 cultivars were susceptible to Psp. The results obtained from resistance tests of 2002 year under greenhouse conditions showed that three genotypes (36K, 195 and 569) were highly resistant, seven genotypes (114, 132, 218, 288, 471, 518 and 579) were resistant, twenty-six genotypes and two cultivars (Aras-98 and Yakutiye-98) were tolerant to same disease (tab. 2). Bean genotypes/cultivars showed similar sensitivity reactions ($r = 0.90^{***}$) against bacterial halo blight disease in both years (tab. 2).

In this study, we also evaluated reactions of bean cultivars/genotypes against common bacterial blight disease under greenhouse conditions. Pathogenicity results of 2001 year revealed that 2 genotypes (36K and 195) were resistant, 34 genotypes and registered cultivars (Aras-98 and Yakutiye-98) were tolerant to Xcp. Disease severity average of 2002 year for Xcp showed that Yakutiye-98 and 35 genotypes were tolerant and

Table 2. Average disease severity of bean cultivars/genotypes in relation to *Pseudomonas savastanoi* pv. *phaseolicola* (Burkholder) Garden et al. and *Xanthomonas axonopodis* pv. *Phaseoli* (Smith) Vauterin et al. inoculations under greenhouse conditions

Pseudomonas savastanoi pv. phaseolicola				*Xanthomonas axonopodis* pv. *phaseoli*			
year				year			
2001		2002		2001		2002	
genotypes	DS	genotypes	DS	genotypes	DS	genotypes	DS
36 K	1.00	36 K	1.00	36 K	1.75	36 K	2.00
579	1.00	195	1.00	195	1.87	124	2.12
195	1.12	569	1.00	124	2.00	412	2.12
569	1.50	579	1.12	288	2.00	579	2.12
435	1.50	518	1.62	171	2.12	171	2.25
518	1.75	132	1.62	518	2.12	473	2.25
127	1.87	288	1.75	435	2.12	339	2.25
132	1.87	114	1.87	579	2.12	251	2.25
473	1.87	471	1.87	218	2.25	458	2.25
339	2.00	218	1.87	520	2.25	518	2.25
288	2.00	127	2.00	555	2.25	555	2.37
218	2.12	565	2.00	598	2.25	565	2.37
471	2.12	435	2.12	473	2.37	435	2.37
565	2.12	473	2.25	132	2.37	598	2.37
568	2.12	251	2.25	339	2.37	462	2.37
517	2.25	598	2.25	114	2.37	127	2.37
520	2.25	510	2.37	569	2.37	480	2.37
251	2.25	517	2.37	458	2.37	218	2.37
124	2.37	527	2.37	462	2.37	510	2.37
484	2.37	555	2.37	471	2.37	460	2.37
510	2.37	339	2.37	483	2.50	520	2.50
555	2.37	484	2.37	484	2.50	114	2.50
Yakutiye-98	2.37	Yakutiye-98	2.37	105	2.50	563	2.50
171	2.50	483	2.50	527	2.50	569	2.50
458	2.50	520	2.50	568	2.50	132	2.50
114	2.50	568	2.50	251	2.50	105	2.50
4F-2928	2.50	4F-2928	2.50	460	2.50	420	2.50
480	2.50	412	2.50	480	2.50	483	2.50
527	2.50	420	2.50	Yakutiye-98	2.50	484	2.50
598	2.50	458	2.50	127	2.62	471	2.62
412	2.62	480	2.50	563	2.62	195	2.75
460	2.75	171	2.62	412	2.75	288	2.75
420	2.87	460	2.62	420	2.75	527	2.75
483	2.87	Aras-98	2.62	510	2.75	4F-2928	2.75
105	3.00	105	2.75	4F-2928	2.75	568	2.87
462	3.00	124	2.75	517	2.87	Yakutiye-98	2.87
563	3.00	462	2.87	565	2.87	517	3.00
Aras-98	3.00	563	2.87	Aras-98	2.87	Aras-98	3.00
LSD	0.33	LSD	0.41	LSD	0.37	LSD	0.34

Table 3. Average disease severity and yield of bean cultivars/genotypes in relation to *Pseudomonas savastanoi* pv. *phaseolicola* and *Xanthomonas axonopodis* pv. *phaseoli* inoculations under field conditions

Pseudomonas savastanoi pv. *phaseolicola*						*Xanthomonas axonopodis* pv. *phaseoli*					
year						year					
2001			2002			2001			2002		
genotypes	DS	seed yield	genotype	DS	seed yield	genotypes	DS	seed yield	genotypes	DS	seed yield
36 K	1.04	209.8	36 K	1.08	218.5	36 K	1.19	154.2	36 K	1.42	183.0
569	1.14	189.6	569	1.60	179.6	569	1.62	170.9	569	1.72	172.2
132	1.56	172.2	132	1.64	178.8	555	1.62	139.9	565	1.86	157.2
127	1.64	189.3	555	1.80	171.8	565	1.68	138.9	510	1.95	152.4
339	1.65	155.0	195	1.82	191.9	510	1.79	129.4	555	1.98	160.7
195	1.68	187.3	127	1.84	169.8	412	1.87	132.7	288	2.11	151.5
579	1.71	179.7	339	1.88	139.1	124	1.89	92.1	412	2.23	161.5
510	1.72	206.7	420	2.04	154.6	568	1.92	118.0	105	2.24	154.9
565	1.73	212.5	518	2.06	157.3	195	1.92	130.9	Yakutiye-98	2.25	140.8
Aras-98	1.75	124.2	412	2.09	173.7	132	1.95	138.0	598	2.27	139.1
518	1.80	165.9	105	2.09	195.4	114	1.95	138.9	132	2.28	133.8
105	1.84	193.0	598	2.09	176.3	288	1.96	134.7	579	2.32	137.2
412	1.91	170.7	Aras-98	2.10	149.3	579	1.98	127.4	520	2.33	154.8
420	1.92	159.2	565	2.18	183.0	420	1.99	108.3	Aras-98	2.35	136.5
218	1.94	176.3	288	2.28	170.0	105	2.00	138.9	127	2.35	140.8
517	1.95	191.3	460	2.31	133.6	473	2.01	102.7	420	2.36	117.1
598	1.95	178.4	517	2.33	180.4	339	2.04	133.1	339	2.38	154.4

460	1.96	161.6	568	2.38	167.2	462	2.06	98.3	195	2.40	136.3
114	1.98	164.0	218	2.39	186.8	520	2.06	139.4	114	2.41	148.4
555	2.02	180.6	483	2.42	150.4	Yakutiye-98	2.12	134.2	218	2.46	142.7
473	2.08	201.0	473	2.44	202.2	598	2.12	129.6	517	2.48	150.6
288	2.09	166.9	579	2.45	175.5	127	2.13	112.9	568	2.49	130.5
520	2.13	158.0	Yakutiye-98	2.47	174.1	Aras-98	2.16	117.2	251	2.50	149.9
483	2.21	146.0	171	2.50	95.1	218	2.17	128.4	518	2.51	134.7
Yakutiye-98	2.22	137.7	480	2.50	120.2	527	2.22	120.2	480	2.52	137.9
568	2.26	156.8	563	2.51	108.4	483	2.23	105.8	484	2.54	115.0
480	2.29	129.4	462	2.56	117.1	471	2.26	102.4	527	2.56	122.5
4F-2928	2.29	99.9	520	2.60	158.2	4F-2928	2.30	106.9	471	2.60	120.9
527	2.30	163.4	435	2.63	145.9	517	2.31	136.0	483	2.64	117.8
171	2.32	94.3	114	2.64	175.2	518	2.33	118.0	473	2.66	113.3
462	2.38	142.8	510	2.66	191.4	458	2.36	85.1	171	2.78	118.4
251	2.39	132.8	4F-2928	2.66	105.0	484	2.37	102.4	4F-2928	2.82	103.4
471	2.42	97.9	251	2.67	130.2	251	2.44	125.9	460	2.83	90.4
563	2.43	105.6	527	2.68	164.9	460	2.46	92.6	124	2.90	100.3
435	2.45	139.3	484	2.76	105.4	480	2.47	118.0	462	2.95	113.3
484	2.48	116.0	124	2.77	107.8	171	2.54	120.8	435	3.00	102.8
124	2.55	96.0	471	2.88	100.9	563	2.77	106.2	458	3.00	90.9
458	2.61	107.6	458	2.88	97.3	435	2.79	96.9	563	3.00	106.4
LSD	0.18	14.6	LSD	0.27	21.0	LSD	0.29	17.4	LSD	0.19	10.9

Aras-98 and 517 exhibited susceptible reactions (tab. 2). Correlation coefficient ($r = 0.91^{***}$) indicated that bean genotypes/cultivars showed similar sensitivity reactions against Xcp in both years.

Field experiment. Resistance reactions of bean genotypes against Xcp and Psp were also detected under field conditions. At the first growing season of experiment, 36K was found to be highly resistant to Psp. Aras 98 and 17 genotypes (105, 114, 127, 132, 195, 218, 339, 412, 420, 460,510, 517,518, 565, 569, 579 and 598) were resistant whereas Yakutiye 98 and 18 genotypes were tolerant (Table 3). According to data obtained from second growing season, 36K also exhibited effective resistance to Psp. Six genotypes (127, 132, 195, 339, 555 and 569) showed resistance, Yakutiye 98, Aras 98 and 29 genotypes were tolerant (tab. 3). The average disease severity of genotypes/cultivars was significantly correlated ($r = 0.86^{***}$) between years (fig. 1a). Furthermore, the seed yields of these genotypes/cultivars were negatively correlated with the severity of disease. In general, the severely infected genotypes had the lowest seed yields in both years (fig. 1b, c).

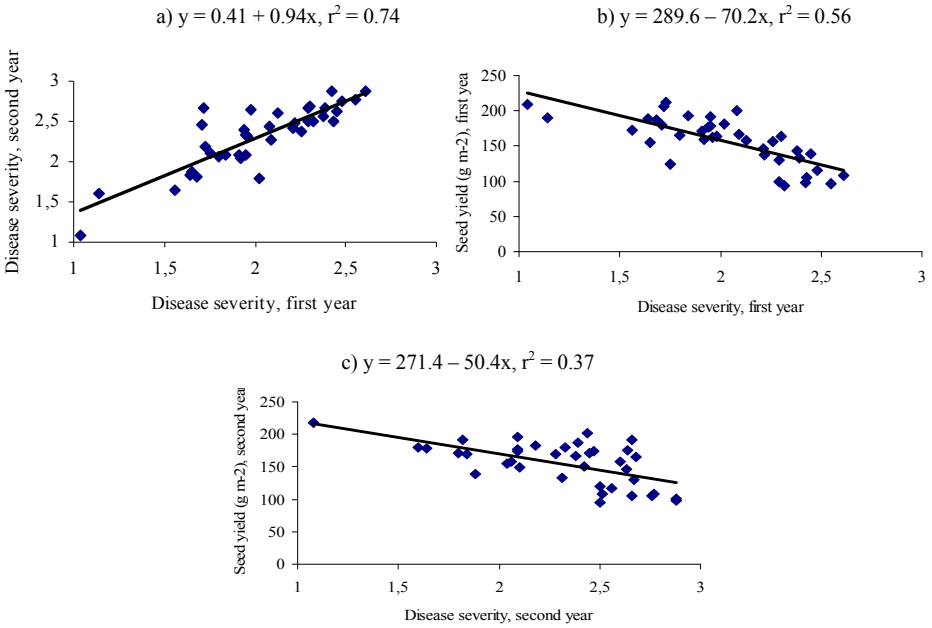

Fig. 1. a) Relationship of disease severity of Psp between years in the field experiment; b, c) Relationships of disease severity of Psp and seed yield in the field experiment

At the first growing season of field experiment, the results obtained from resistance test against Xcp indicated that 36K was highly resistant. 13 genotypes including 114, 124, 132, 195, 288, 412, 420, 510, 555, 565, 568, 569 and 579 were classed as resistant. Yakutiye 98, Aras 98 and 22 genotypes were determined as tolerant (tab. 2). At the second growing season of field experiment, 5 genotypes (36K, 510, 555, 565 and 569)

were resistant, whereas Yakutiye 98, Aras 98 and 28 genotypes were tolerant and three genotypes (435, 458 and 563) were susceptible to Xcp (tab. 3). Correlation analyses indicated that genotypes exhibited similar reactions to Xcp ($r = 0.81^{***}$) in both year (fig. 2a). Also, there was negative correlation between severity of disease and seed yield in the field conditions in both years ($r = -0.62^{***}$ and $r = -0.89^{***}$, respectively) (fig. 2b, c).

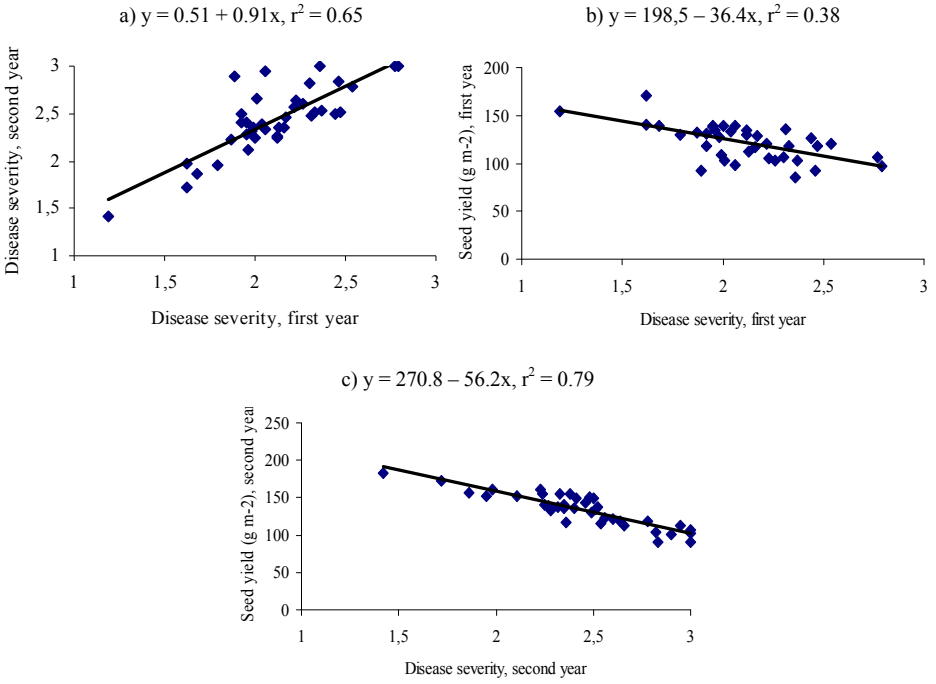

Fig. 2. a) Relationship of disease severity of Xcp between years in the field experiment; b, c) Relationships of disease severity of Xcp with seed yield in the field experiment

In the present study, 36 genotypes (36K, 105, 114, 124, 127, 132, 171, 195, 218, 251, 288, 339, 412, 420, 435, 458, 460, 462, 471, 473, 480, 483, 484, 510, 517, 518, 520, 527, 555, 563, 565, 568, 569, 579, 598, 4F-2928) and 2 cultivars (Aras-98, Yakutiye-98) growing in the commercial fields of Erzurum and Erzincan in the Eastern Anatolia region tested the first time for resistance to Xcp and Psp in greenhouse and field condition during 2001–2002. There were positive interaction between severity of disease and yield against Xcp and Psp in the field and greenhouse conditions. Only 36K among 36 bean genotypes tested was found to be highly resistant against to both of the pathogens. Different reactions were observed on the other bean genotypes for same diseases and grouped as resistant, tolerant and susceptible.

In previous studies, bean genotypes were tested resistance reactions to Xcp and Psp in Turkey and different parts of world and differential interactions between bean genotypes and isolates of the Xcp and Psp. Other studies [Schuster and Coyne 1981, Aggour et al. 1988, Saettler 1989, Benlioğlu et al. 1994, Bozkurt and Soylu 2001, Dursun et al. 2002] have found that bean cultivars and genotypes were as highly resistant, moderate resistant, resistant, tolerant and susceptible. But, none of the tested bean genotypes are commercially grown in Eastern Anatolia Region. Thus, the result of this study indicates that, 36K can be used as genetic source resistance for a effective method of control against Xcp and Psp. In earlier studies, it was determined that these disease causes significant losses in both yiled and seed quality [Mills and Silbernagel 1985, Lelliott and Stead 1987, Hall 1994, Agrios 1997, Dursun et al. 2002, Fourie 2002]. In our study, we have found that the most severely infected genotypes tended to have the greatest loss in seed yield and seed quality. Two of the most important diseases that effect on bean yields is common bacterial blight caused by *Xanthomonas axonopodis* pv. *phaseoli and* halo blight by *Pseudomonas savastanoi* pv. *phaseolicola* [Rodrigues et al. 1999]. Both of them are also very important because of seed transmission, inefficient chemical control. Therefore, an integrated disease management system, which includes resistant bean cultivars, should apply for common and halo blight diseases. [Rodrigues et al. 1999, Fourie 2002]. Future success in control of bacterial blight will depend on a thorough understanding of the problem and conscientious application of control strategies in bean production [Opio et al., 1996, Mabagala 1997]. The main difficulties for obtaining resistance to Xcp and Psp are different leaf and pod response reactions and pathogenic variation within the pathogen population [Coyne and Schuster 1974, Valladares-Sanches et al. 1979, Saettler 1989, Zaiter et al. 1989, Opio et al. 1996, Mabagala 1997, Rodrigues et al. 1999]. In this study, we did not search correlation between leaf and pod reaction about disease severity. But, selection for resistance should be determined correlation in both pods and leaves for disease severity.

CONCLUSSION

In this study, high variability has been observed in the diseases resistance among bean genotypes. Particularly the genotype 36K was found more promising against Xcp and Psp. This genotype multiplied and preserved in bean collection for subsequent breeding work. In near future studies are needed to determine resistance mechanism of 36K genotype. This genotype will be important resistance source in breeding studies to obtain resistance bean cultivars commercially growing in the Turkey and the other bean growing countries. In this way, productive and resistant bean cultivars can be get for long-term control of bacterial diseases.

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IDENTYFIKACJA ODORNOŚCI GENOTYPÓW FASOLI Z TURCJI NA ZGORZEL BAKTERYNJĄ I ZARAZĘ

Streszczenie. Choroby fasoli spowodowane różnymi patogenami zmniejszają plon i jakość fasoli w różnych regionach, gdzie uprawia się tę roślinę, zarówno w Turcji, jak i innych krajach produkujących fasolę. W niniejszym badaniu wyizolowano i zidentyfikowano patogeny bakteryjne u gatunku *Pseudomonas savastanoi* pv. *phaseolicola* (Burkholder) Garden et al. and *Xanthomonas axonopodis* pv. *Phaseoli* (Smith) Vauterin et al. powodującego ekonomicznie ważną chorobę roślin fasoli rosnących na polach komercyjnych w prowincjach Erzurum i Erzincan znajdujących się w regionie Wschodniej Anatolii w Turcji. Przebadano ogółem trzydzieści sześć genotypów fasoli oraz dwie odmiany powszechnie uprawiane w tym regionie w latach 2002–2002 pod kątem ich odporności na te patogeny, zarówno w warunkach szklarniowych, jak i polowych. Nasilenie choroby w warunkach polowych zmniejszyło jakość i ilość nasion fasoli. Pośród trzydziestu ośmiu zbadanych genotypów, stwierdzono, że tylko 36K jest odporny na obydwa patogeny.

Słowa kluczowe: *Phaseolus vulgaris, Pseudomonas savastanoi* pv. *phaseolicola* (Burkholder) Garden et al., *Xanthomonas axonopodis* pv. *Phaseoli* (Smith) Vauterin et al.

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