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A NEW ADAPTED METHOD FOR SCREENING PHASEOLUS GENOTYPES FOR TOLERANCE TO LOW TEMPERATURE

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ABSTRACT

The selection and characterization of 620 bean forms, from the genbank- Sadovo- Bulgaria, from ssp. volubillis & ssp. nanus was achieved. The studied genotypes are from Europe, North and South America, Africa & Asia. The study aimed to indicate the cool tolerant forms by using a new and original screening method. The photosynthetic intensity/through 14 CO_2 /the activity of catalaze /gasometerically/ and peroxidase /colorimetricaly/ and the plastid pigment contents/ spectrophotometrically, of different genotypes snap bean with varied cool tolerance was studied. The genotypes which studied have widely differed in the peroxidase activity. The genotypes with highest cool tolerance are characterized with lower peroxidase activity, while the genotypes with moderate tolerance genotypes are characterized with increased enzyme activity- 588, 667, 845 E60s/g respectively. With the genotypes which have higher cool tolerance there is a tendency toward to increased plastid contents and catalase activity, but the differences are not so significant. The conclusion is that the peroxidase can be used as cool tolerance criterion.

***Key Words**: Phaseolus genotypes, cool tolerance, screening method, plastid content, s peroxidase activity, catalase activity.*

PHASEOLUS GENOTIPLERİNİN DÜŞÜK SICAKLIK TOLERANS DÜZEYLERİNİN BELİRLENMESİ İÇİN UYARLANMIŞ YENİ BİR YÖNTEM

ÖZET

Bulgaristan'ın Sadovo- gen bankasından sağlanan ssp. volubillis & ssp. nanus türünden toplam 620 fasulye genotipinin karakterizasyonu ve seçimi yapılmıştır. Üzerinde çalışılan genotiplerin orijini Avrupa, Kuzey Amerika, Güney Amerika, Afrika ve Asya'dır. Çalışmanın amacı yeni ve orijinal tarama metoduyla serin iklime tolere edebilen formların belirlenmesidir. Soğuğa toleransları farklı çeşitli fasulye genotiplerinde fotosentetik yoğunluğu / 14 CO2 yoluyla, katalaze aktivitesi / gazometerik yöntemle, peroksidaz / colorimetrik yöntemle, plastid pigment içeriği / spektrofotometrik yöntemle çalışılmıştır. Üzerinde çalışılan genotipler peroksidaz aktivitesi bakımından geniş bir farklılık göstermişlerdir. Soğuğu en yüksek düzeyde tolere eden bu genotipler düşük peroksidaz aktivitesine sahiplerken, soğuğu orta derecede tolere eden genotipler enzim aktivitesindeki artışa göre sırasıyla 588, 667, 845 E60 s/g olarak belirlenmişlerdir. Soğuğa daha yüksek toleransa sahip genotiplerde plastit içeriği ve katalaz aktivitesinde artış yönünde bir eğilim görülmekle birlikte farklılık çok önemli bulunmamıştır. Bu sonuçlara göre peroksidaz soğuğa tolerans kriteri olarak kullanılabilir.

***Anahtar Kelimeler**: Fasulye genotipleri, soğuk toleransı, tarama metodu, plastid içeriği, peroksidaz aktivitesi, katalaz aktivitesi.*

INTRODUCTION

Phaseolus (Bean, Wild Bean) is a genus in the family Fabaceae of about fifty plant species, all native to Americas. Most prominent among these is the common bean, *P. vulgaris*, which today is cultivated worldwide in tropical, semitropical and temperate climates. *Phaseolus* species are used as food plants (Debouck et al. 1993). The cool responses (Kemp, 1973; Farlow, 1981; Dickson and Boettger, 1984; Dickson, 1986; Holubowicz and Dickson, 1989), genetic (Dickson and Thode, 1985; Dickson, 1986; Dickson and Petzoldt, 1987; Bonner, 1988; Debouck et al. 1993; Sonnante et al. 1994) and measuring methods (Van Dobben, 1962; Austin and Maclean, 1972; Robson, 1973; Hardwick and Andrews,1980; Holubowicz and Dickson, 1989; Bender et al. 1989) of *Phaseolus* species have been studying many researches in last decades. In this study the characters of cool tolerance of collected genotypes in gen bank-Sadovo-Bulgaria were studied for grade.

MATERIAL AND METHODS

By laboratory studies on the selection and characterization of 620 bean forms, from the gen bank-Sadovo-Bulgaria, from ssp. volubilis & ssp. nanus was achieved. The studied genotypes are from Europe, North and South America, Africa & Asia. The study aimed to indicate the cool tolerant forms by using a new and original screening method. The photosynthetic intensity /through 14 CO_2/ the activity of catalaze /gasometerically/ and peroxides /colorimetricaly/ and the plastid pigment contents /spectrophotometrically/, of different genotypes snap bean with varied cool tolerance was studied.

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RESULTS AND DISCUSSION

Physiological studies

The data of the photosynthetic intensity investigations are given in Table 1, It was established, as general tendency, that with the increase of the tolerance to low temperature the activity of the photosynthesis decreases. The intensity of the photosynthesis in samples with different tolerance /sensitivity/ to low temperatures may be due to presumes that the increase the tolerance to low temperature to some extent decreases the capacity of the samples to regulate the photosynthetic process when the temperature goes up suddenly.

Activity of catalase and peroxidase

The data of the catalase activity investigations in the representative samples having different low temperature respectively of first, second and third group are given in table 1. Variation of the enzyme activity during the different phases of investigation in the different samples is found. A more clear interaction between the tolerance (sensitivity) of the samples to low temperatures is found in regard of the peroxidase activity.

The investigations carried out the activity of the enzymes catalase and peroxidase indicate that the peroxidase activity is closely related with the tolerance (sensitivity) of the samples to low temperatures and due to this fact it can be used as a criterion for the diagnostician of the samples in respect of their direct methods in this respect, i.e., as a complementary indirect method.

Table 1- Activity of catalase & peroxidase

Group	Variety	Origin	25°C (K)	25°C Indvance 3m 46°C	% (k)	**Catalase** $cm^3 0_2$/1 g fr.w.		**Peroxidase** E60s/1g fr.w.	
						3-4 leaf	6-7 leaf	3-4 leaf	6-7leaf
I	413	Maroc	13.9	1.9	13.7	26.2	18.5	115.8	595.5
I	90E247	Bulgaria	6.8	0.9	13.2	28.0	30.4	110.6	580.8
I	87201083	Turkey	22.1	3.8	17.2	12.4	11.1	100.2	580.8
I	Gold Green	Germany	14.2	3.0	21.1	13.0	14.7	103.4	585.0
I	988	Hungary	12.2	1.5	12.3	20.0	17.4	102.4	-
I	90E121	Bulgaria	13.0	2.2	16.9	21.0	17.7	115.0	680.0
II	87201477	Afghanistan	9.0	2.1	23.3	21.5	9.6	108.6	640.5
II	8720180	Turkey	6.9	1.1	15.9	16.2	20.4	110.6	693.5
III	90E245	Bulgaria	15.2	2.5	16.4	28.5	22.0	150.0	830.0
III	90E659	Bulgaria	16.9	3.6	21.3	23.0	8.4	146.0	860.0

Contents of plastid pigments

The data of the contents of the plastid pigments indicate that there are certain differences between the plants from the samples belonging to different groups, as well as between the samples belonging to one and the same group. What is impressive, as can be seen from (Table 2) is the lack of connection between the contents of the plastid pigments and the net productivity of the photosynthesis, a fact which is accordance with the data in the specialized literature. No connection is established between the contents of the dry matter and the water- retentive capacity of the leaves on the one hand, and concentration of the plastid pigments in the other hand, with the exception of connection of chlorophyll "b" with the water retentive capacity. Water - retentive capacity and content of dry matter. The water - retentive capacity depends on the physiologo - biochemical peculiarities of the leaves as well as on their anatomical structure. The data of this index are given on (Fig. 1, 2, 3). In spite of the great importance of the contents of the water-retentive capacity for the passing of the physiological processes in the plants, no clear connection is established between these indexes and the tolerance of the samples from the different groups.

Conclusion

Some physiological manifestations from different groups of selected perspective materials were studied: the photosynthesis intensity and the net productivity of the photosynthesis; the activity of the enzymes catalase and peroxidase; the water retentive capacity of the leaves; and the content of the plastid pigments. No connection is established between the photosynthesis; the content of the plastid pigments the water retentive capacity, the activity of the catalase and the tolerance of the samples to low temperatures. Such relation is found with regard to the peroxidase activity only, which in the most resistant samples (from group I) is averagely 40% lower.

Our method is differing from Holubowicz and Dickson (1989), and Quagliotti and Gennari (1987) that they were evaluate the genotypes by exposure low temperature conditions, and also differing genetic control of low temperature tolerance that was indicated by Toshio Otubo et al. (1996).

Table 2. Contents of plastid pigment in leaves

Variety	Chlorophyll a mg.g. 1 fr.w.	Chlorophyll b mg.g. 1 fr.w.	Carotinoids mg.g.-1 fr.w.	Dry weight %	*A.S (cm^2)	**W.r.c g/h	*** NPPh
I group							
413	1.7764	1.0297	0.8208	16.70	24.64	9	0.372
Gold Green	1.1300	0.6200	0.5300	24.44	29.91	2	1.770
Helda	1.2054	0.6402	0.5552	27.57	15.60	6	1.876
90E121	1.1543	0.6469	0.5119	22.36	20.04	3.5	0.875
988	1.0979	0.5923	0.5358	17.82	60.19	9	0.326
987	1.8196	1.0197	0.8153	19.72	24.64	4	1.346
Rondina	1.6427	1.0559	0.7949	19.12	16.952	9	1.006
Belidar	1.4744	0.8985	0.6887	16.42	16.906	10	0.657
90E247	1.3290	0.7594	0.6450	17.39	13.793	6	1.483
Echo	1.5833	0.9800	0.7701	18.03	15.776	9	0.140
Jolidar	1.9073	1.1136	0.9263	16.47	15.728	7	1.747
II group							
8720180	1.4809	0.9526	0.7526	22.13	24.90	7	1.407
87201477	1.2851	0.8090	0.6620	20.88	20.96	-	0.882
Xera	1.9373	1.0440	0.8793	19.22	20.88	6	0.479
85201009	1.5128	1.1182	0.7506	17.88	18.30	10	0.216
8520162	1.6376	1.3017	0.7996	18.02	13.54	15	1.116
1143	1.0006	0.6216	0.5069	14.16	15.31	7	1.102
1151	1.5116	0.9059	0.7272	15.75	12.950	4	2.719
III group							
90E99	1.1806	0.7290	0.4698	24.55	37.920	8	0.708
87201072	1.4024	1.0976	0.7201	16.74	49.720	9	0.324
90E273	1.3200	0.8000	0.5800	21.40	27.330	6	1.245
90E253	1.4899	0.8636	0.5837	22.36	37.973	7	0.306
89E503	1.4403	0.8020	0.5822	21.41	33.440	4.5	0.547
Trakiicki	1.2948	0.7633	0.5850	22.72	31.930	9	1.717
90e659	1.2837	0.7440	0.6102	17.56	21.960	15	0.859
1047	1.0899	0.7089	0.4850	17.31	13.417	-	2.414
87201052	1.8549	1.6302	0.9232	18.41	39.050	5	0.492
Masai	1.8378	1.1266	0.8453	18.84	17.725	6	1.528
Delinel	1.9210	1.0721	0.8872	18.84	18.852	3	0.437
Forum	1.6092	1.1235	0.7791	18.28	16.720	9	1.450
1092	1.5528	0.8670	0.6965	20.94	15.930	9	0.968
1140	1.3937	0.8687	0.7060	18.61	11.355	8	0.211
Roma II	1.4711	0.9298	0.7260	21.57	15.772	6	0.553
Verona	1.7587	1.2066	0.8140	17.69	15.691	4	1.896
85201010	1.8781	1.6864	0.9292	17.76	14.512	15	0.529
90E245	1.1991	0.7575	0.5829	18.80	40.750	-	0.874

assimilative surface.water-retentive capacity.***Net productivity of the photosynthesis*

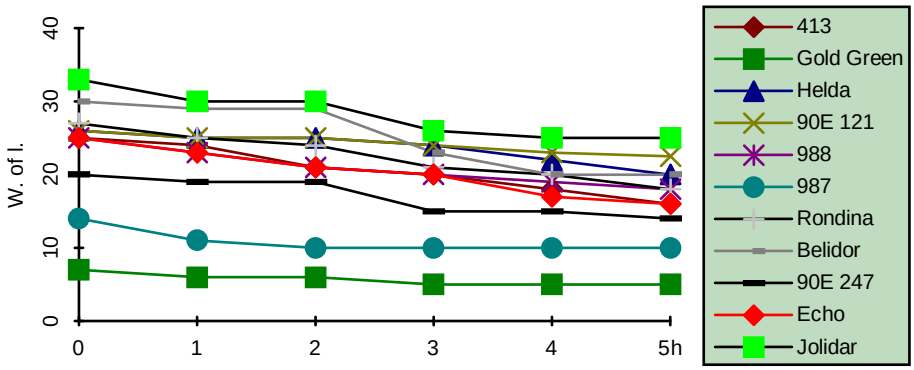

Fig 1. Dynamics of water -retentive capacity of leaves-I group

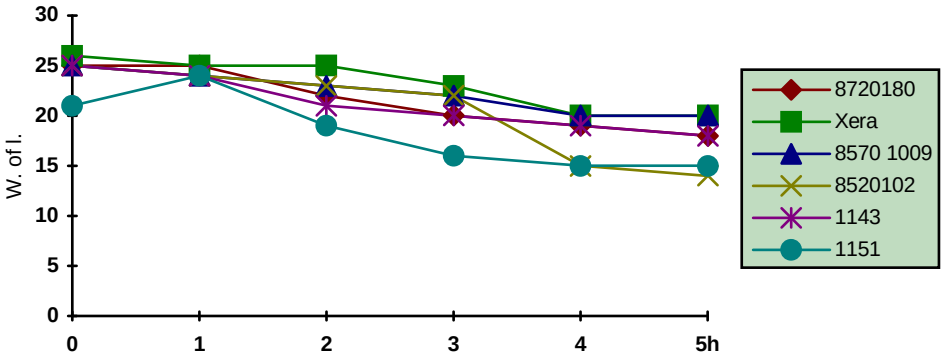

Fig 2. Dynamics of water -retentive capacity of leaves-II group

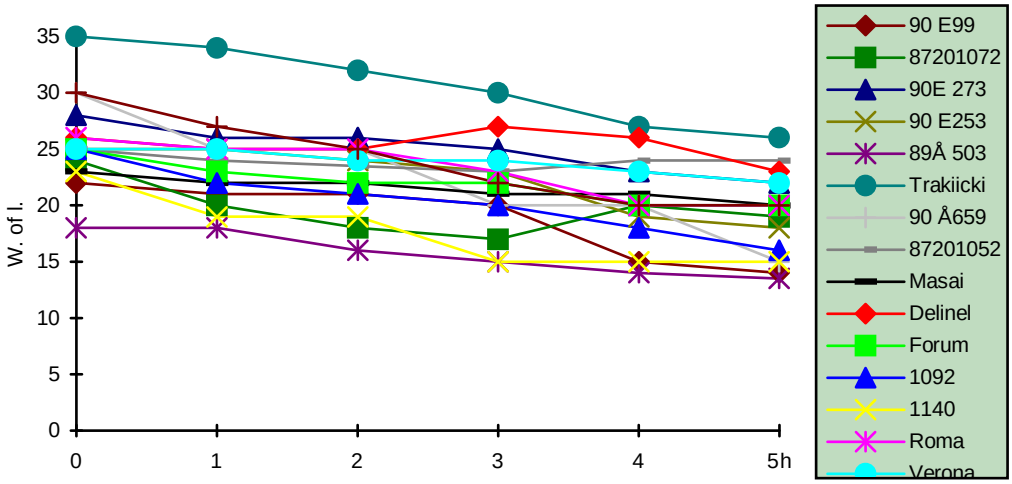

Fig 3. Dynamics of water -retentive capacity of leaves-III group

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