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Investigation of Yield and Stability of Superior Clones Selected from Some Hybrid Potato (*Solanum Tuberosum* L.) Genotypes

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Abstract: This study was conducted in 2010-2011 growing seasons at Tokat-Niksar, Tokat-Kazova and Tokat-Artova locations. In present experiments, 58 promising clones with superior characteristics selected from hybrid families originated from International Potato Center (CIP) were investigated for yield and yield-related parameters. Of these clones, 25 have light-yellow, 16 have dark-yellow, 9 have cream and 8 have white flesh color. For each flesh color, 9 different standard cultivars were also used in present experiments. Experiments at each location were grouped based on flesh colors and conducted in randomized blocks design with 3 replications. Total tuber yield per decare of the clones with different flesh colors were determined. Experimental data were subjected to analysis of variance in accordance with the relevant experimental design. Means were compared with the use of Duncan's test. Clone stability was determined based on regression coefficients as specified by Finlay and Wilkinson (1963). As the average of three locations, cream-A7/12 (8212.4 kg/da), light-yellow-A6/71 (7592.6 kg/da), white-T5/4 (6505.9 kg/da) and dark-yellow-A3/15 (6490.9 kg/da) clones had the greatest tuber yields. According to adaptation classes, Artova and partially Kazova were classified as "well" environment and Niksar was classified as "poor" environment. In Artova location, the greatest tuber yield was obtained from cream-A7/12 (12545.2 kg/da) clone, respectively followed by light-yellow-A3/167, white-T5/4 and dark-yellow-A3/15 clones. In Kazova location, light-yellow-A6/71 (9696.5 kg/da) clone had high tuber yield and it was followed by white-A5/70, cream-A7/12 and dark-yellow-A3/15 clones. In Niksar location, light-yellow-T6/28 (4786.7 kg/da) clone had the greatest tuber yield and it was respectively followed by cream-A7/12, dark-yellow-A3/142 and white-A13/1 clones. In terms of stability, light-yellow flesh color A6/103 and A3/234 clones and dark-yellow flesh color A3/142 and A3/110 clones were found to be more stable than the other clones.

Keywords: Clonal selection, Potato, Potato breeding, *Solanum tuberosum*, Stability.

Bazı Melez Patates (*Solanum Tuberosum* L.) Genotiplerinden Seçilen Üstün Özellikli Klonların Verim ve Stabilite Bakımından İncelenmesi

Öz: Bu çalışma 2010-2011 yıllarında Tokat-Niksar, Tokat-Kazova ve Tokat-Artova yörelerinde yürütülmüştür. Araştırmada Uluslararası Patates Araştırma Merkezi (CIP) kökenli melez ailelerinden üstün özellik gösteren 58 ümitvar klon verim ve verimle ilgili özellikler bakımından incelenmiştir. Bu klonların 25'i açık sarı, 16'sı koyu sarı, 9'u krem ve 8'i ise beyaz yumru iç renklidir. Araştırmada her bir iç renginden ayrı ayrı olmak üzere 9 farklı standart çeşit kullanılmıştır. Denemeler her lokasyonda iç renklerine göre gruplandırılarak Tesadüf Blokları deneme desenine göre üç tekerrürlü olarak yürütülmüştür. Araştırmada iç renklere göre ayrı ayrı tasnif edilmiş klonların dekara yumru verimleri belirlenmiştir. Elde edilen bulgular, denemenin kuruluş desenine uygun olarak varyans analizlerine tabi tutularak, ortalamalar Duncan testine göre karşılaştırılmıştır. Ayrıca klonların stabilite durumları Finlay ve Wilkinson (1963)'ün belirttiği regresyon katsayısına göre belirlenmiştir. Araştırmadan elde edilen sonuçlara göre, üç lokasyonun ortalaması dikkate alındığında, krem-A7/12 (8212,4 kg/da), açık sarı-A6/71 (7592,6 kg/da), beyaz-T5/4 (6505,9 kg/da) ve koyu sarı-A3/15 (6490,9 kg/da) klonlarından en yüksek yumru verimleri alınmıştır. Adaptasyon sınıflarına göre Artova ve kısmen Kazova iyi çevre, Niksar ise kötü çevre sınıfında yer almıştır. Artova'da en yüksek dekara yumru veren klon krem-A7/12 (12545,2 kg/da), bunu açık sarı-A3/167, beyaz-T5/4 ve koyu sarı-A3/15 izlemiştir. Kazova'da açık sarı-A6/71 (9696,5 kg/da) klonu yüksek verimli olup, bunu beyaz-A5/70, krem-A7/12 ve koyu sarı-A3/15 izlemiştir. Niksar'da ise açık sarı-T6/28 (4786,7 kg/da) en yüksek verimli, bunu sırasıyla krem-A7/12, koyu sarı-A3/142 ve beyaz-A13/1 klonları izlemiştir. Stabilite yönünden açık sarı iç

rengine sahip klonlardan A6/103 ve A3/234 klonları ile koyu sarı iç renkli A3/142 ve A3/110 klonları diğer klonlara göre daha stabil olmuşlardır.

Anahtar Kelimeler: Klonal seleksiyon, Patates, Patates ıslahı, *Solanum tuberosum,* Stabilite

1. Introduction

Potato is originated from high altitudes of Andes in South America and spread from there to Europe and various part of the world. Such a spread changed the world history, saved the Northern Europe experiencing severe famine from extinction in 1770s, prospered these countries and enabled them to establish today's nations (McNeil 1999). Potato belongs to *Solanaceae* family and it is a heterozygote tetraploid culture crop (2n=4x=48) commercially cultured worldwide. After wheat, maize and rice, potato is an important source of nutrient used in human nutrition (Yıldırım and Yıldırım, 2002).

Following the register, new cultivars developed by plant breeders are served to producers and producers grow the cultivar or cultivars with desired characteristics. The primary characteristics set forth by dormant or recessive genes genetically characterizing a cultivar include plant type, flowering and ripening durations, seed and fruit color, resistance to cold, drought, lodging, pests and diseases, chemical composition (starch ratio, protein ratio, etc.), yield and the other characteristics. The primary role of plant breeder is to develop and register the cultivars containing the genes expressing the desired ones of these characteristics (Kurt 2004).

In many countries, local organizations (universities, research stations and private companies) and sometimes local farmers select or develop cultivars to meet the needs of local growers and users (consumers and processing industry). Some of these cultivars are highly popular and largely grown, some others are grown in a small-scale (Struik and Wiersema, 1999). Genotype x environment interactions are important for evaluation of genetics stability under different locations (Kang and Magari 1996).

Today's commercial cultivars have emerged through long-running breeding processes up to 15 years. Selection and assessments are conducted not only by breeding organizations, but also by commercial farmers. Farmers' experience on these cultivars provides significant contributions to perspectives of the breeders because of the tests under practical farming tests (Struik and Wiersema 1999).

The objectives of the present study were set as to select the clones with superior characteristics from hybrid families of International Potato Center (CIP) to number and preserve selected clones, compare the total tuber yields of promising clones with four different flesh colors at different locations and with standard cultivars and to put forth their stabilities.

2. Material and Method

This study was conducted in 2010-2011 vegetation seasons under Tokat-Niksar, Tokat-Kazova and Tokat-Artova conditions. Coordinates and altitudes of the experimental sites were determined with the aid of a GPS device. Tokat-Niksar experimental sites are located between 40.58° north latitudes and 36.89° east longitudes with an altitude of 276 m in the first year and between 40.53° north latitudes and 36.93° east longitudes with an altitude of 291 m in the second year. Tokat-Kazova experimental site is located between 40.33° north latitudes and 36.36° east longitudes with an altitude of 571 m. Artova-Taşpınar experimental site is located between 40.13° north latitudes and 36.33° east longitudes with an altitude of 1189 m.

Soil samples were taken from the experimental sites and analyzed at soil laboratories of Tokat Gaziosmanpasa University Agricultural Faculty. Analysis results are provided in Table 1. Experimental soils exhibited some differences in different years.

According to Table 1, experimental soils all with pH values of between 7.69 – 8.29 were defined as slightly alkaline (Richards 1954;

Ulgen and Yurtsever1974; Aydeniz and Brohi 1991).

Table 1. Pysical and chemical characteristics of the experimental soils
Çizelge 1. *Araştırma alanlarından alınan topakların bazı fiziksel ve kimyasal özellikleri*

Characteristics	Niksar		Kazova		Artova	
	2010	2011	2010	2011	2010	2011
pH	8.07	8.01	8.26	8.29	7.77	7.69
Clay (%)	48.20	37.60	30.70	28.38	22.91	22.91
Sand (%)	21.70	16.40	34.20	36.12	51.26	70.94
Silt (%)	30.10	46.00	35.10	35.50	25.83	25.83
$CaCO_3$ (%)	51.60	21.00	22.94	21.42	8.13	4.70
P_2O_5 (kg/da)	15.20	13.10	6.93	7.06	7.30	2.52
K_2O (kg/da)	116.52	197.50	129.49	127.87	47.71	86.90
O.M. (%)	3.56	3.03	2.02	2.61	2.29	2.12

Experimental site in Niksar had the greatest clay content in 2010. Second year of the Niksar and both years of Kazova fields had ideal soil texture of clay-loam. Although organic matter content of Turkish soils is generally below 2%, organic matter content of present experimental sites was all above 2%. Turkish soils are generally sufficient in potassium. According to FAO (1990), experimental soils were all found to be sufficient in potassium. In terms of salinity levels, Niksar soils were highly saline in the first year and moderately saline in the second year. Kazova and Artova soils were slightly saline (Aydeniz and Brohi 1991).

Monthly average temperature, monthly total precipitation and long-term averages of Niksar, Kazova and Artova locations are provided in Table 2. According to Table 2, annual average temperature of Niksar location was 14.7˚C in 2011 and this value was quite close to long-term average. Monthly average temperature of 2010 (19.9˚C) was quite greater than both monthly average temperature of 2011 (14.7˚C) and long-term average (14.0°C). Monthly average temperature throughout potato growing season (February – August) was 21.7°C in 2010 and 17.0°C in 2011. Long-term average temperature of same period was 16.2°C. It could be stated that in Niksar, February – August period was hotter and more humid in 2010 and 2011 as compared to long-term averages (Table 2). In Tokat-Kazova location, annual average temperatures of 2010 and 2011 (14.9°C and 12.0°C) were greater than long-term average temperature. Annual total precipitations of 2010 and 2011 (518.2 and 472.2 mm) were also greater than the long-term average of annual total precipitation (405.6 mm).

Table 2. Climate data for experimental locations
Çizelge2. *Deneme alanlarının iklim verileri*

NİKSAR						
Months	**Average Temperature (°C)**			**Total Precipitation (mm)**		
	2010	**2011**	**Long-term**	**2010**	**2011**	**Long-term**
January	10.20	9.80	3.90	54.00	30.00	48.80
February	14.00	6.20	5.50	48.00	28.50	39.90
March	13.70	9.10	9.10	57.00	106.50	43.20
April	12.70	12.80	14.00	89.00	110.00	67.20
May	23.20	18.00	17.50	48.00	133.00	63.50
June	27.90	22.30	20.80	150.00	94.00	45.40
July	29.30	26.50	23.30	1.00	15.00	17.00
August	30.90	24.20	23.10	0.00	12.00	9.10
September	27.40	20.40	20.00	37.00	8.00	22.90
October	18.90	14.10	15.10	165.00	60.00	49.20
November	17.10	6.50	9.90	5.00	50.60	57.90
December	13.90	6.40	6.00	34.00	46.50	61.50
Aver./ Total	**19.90**	**14.70**	**14.00**	**688.00**	**694.10**	**525.60**
KAZOVA						
	Average Temperature (˚C)			**Total Precipitation (mm)**		
	2010	**2011**	**Long-term**	**2010**	**2011**	**Long-term**
January	5.10	2.30	1.10	77.00	23.20	36.70
February	8.50	3.60	2.40	54.10	22.40	32.30
March	8.90	6.70	6.60	58.80	69.50	38.10
April	12.00	10.90	11.80	64.60	73.50	56.10
May	17.90	15.50	15.10	45.30	59.10	57.00
June	22.30	19.50	18.30	59.80	76.40	35.80
July	25.00	24.20	20.70	6.40	37.90	10.00
August	26.30	22.00	20.50	0.00	16.50	6.60
September	21.80	18.70	16.40	3.40	16.80	16.60
October	13.10	13.10	11.80	109.20	24.00	33.50
November	10.00	3.30	6.40	4.10	29.50	42.00
December	7.30	4.10	3.00	35.50	23.40	40.90
Aver./ Total	**14.90**	**12.00**	**11.20**	**518.20**	**472.20**	**405.60**
ARTOVA						
	Average Temperature (˚C)			**Total Precipitation (mm)**		
	2010	**2011**	**Long-term**	**2010**	**2011**	**Long-term**
January	1.60	-0.60	-3.20	105.00	50.00	51.60
February	4.30	-0.30	-1.50	60.00	33.00	39.20
March	6.60	3.40	2.80	78.00	60.00	45.20
April	8.70	7.80	8.50	67.00	70.50	63.40
May	18.00	11.90	12.50	49.00	80.00	65.00
June	18.60	15.80	15.70	81.00	57.00	38.10
July	20.60	20.60	17.90	0.00	17.50	8.90
August	22.10	18.40	18.00	0.00	8.00	3.10
September	18.80	14.70	14.40	5.00	16.00	11.50
October	10.20	9.20	9.40	127.00	18.00	38.00
November	8.60	0.40	3.90	15.00	21.00	47.00
December	4.90	1.60	-0.70	78.00	118.00	53.1
Aver./ Total	**11.90**	**8.60**	**8.10**	**665.00**	**549.00**	**464.10**

Table 3. 58 clones used in experiments and their pedigrees

Çizelge 3. *Denemede kullanılan 58 adet klon ve pedigrileri*

Order No	Clone Name	Pedigree (Hybrid family)	Flesh Color
1	*A1/58*	*Serrana x 104.12LB*	*WHITE*
2	*T5/32*	*Serrana x DTO-33*	
3	*T5/4*	*Serrana x DTO-33*	
4	*A5/70*	*Serrana x DTO-33*	
5	*A5/6*	*Serrana x DTO-33*	
6	*A8/34*	*Serrana x TPS-113*	
7	*A13/3*	*Pentland Crown x TS-2*	
8	*A13/1*	*Pentland Crown x TS-2*	
9	*A3/116*	*Serrana x TS-9*	*CREAM*
10	*A4/9*	*Granola x TS-2*	
11	*A5/60*	*Serrana x DTO-33*	
12	*A5/98*	*Serrana x DTO-33*	
13	*T5/14*	*Serrana x DTO-33*	
14	*A6/76*	*Serrana x LT-7*	
15	*A7/12*	*Serrana x TS-4*	
16	*A10/15*	*MF-1 x LT-7*	
17	*T11/10*	*Granola x Huincul*	
18	*T1/26*	*Serrana x 104.12LB*	*LIGHT YELLOW*
19	*A1/9*	*Serrana x 104.12LB*	
20	*A2/127*	*MF-1 x TS-4*	
21	*A2/99*	*MF-1 x TS-4*	
22	*A3/177*	*Serrana x TS-9*	
23	*A3/29*	*Serrana x TS-9*	
24	*A3/337*	*Serrana x TS-9*	
25	*A3/275*	*Serrana x TS-9*	
26	*A3/234*	*Serrana x TS-9*	
27	*A3/37*	*Serrana x TS-9*	
28	*A3/167*	*Serrana x TS-9*	
29	*A3/189*	*Serrana x TS-9*	
30	*A3/26*	*Serrana x TS-9*	*LIGHT YELLOW*
31	*A3/321*	*Serrana x TS-9*	
32	*A3/164*	*Serrana x TS-9*	
33	*T4/4**	*Granola x TS-2*	
34	*T6/3*	*Serrana x LT-7*	
35	*A6/119*	*Serrana x LT-7*	
36	*T6/17*	*Serrana x LT-7*	
37	*A6/71*	*Serrana x LT-7*	
38	*A6/103*	*Serrana x LT-7*	
39	*T6/28*	*Serrana x LT-7*	
40	*A8/11*	*Serrana x TPS-113*	
41	*T9/11*	*Serrana x TPS-67*	
42	A12/5	Achrina X LT-7	
43	*A2/11*	*MF-1 x TS-4*	*DARK YELLOW*
44	*A2/73*	*MF-1 x TS-4*	
45	*A3/110*	*Serrana x TS-9*	
46	*A3/223*	*Serrana x TS-9*	
47	*A3/368*	*Serrana x TS-9*	
48	*A3/351*	*Serrana x TS-9*	
49	*A3/142*	*Serrana x TS-9*	
50	*A3/15*	*Serrana x TS-9*	
51	*A3/346*	*Serrana x TS-9*	
52	*A3/108*	*Serrana x TS-9*	
53	*A3/74*	*Serrana x TS-9*	
54	*A3/206*	*Serrana x TS-9*	
55	*A9/8*	*Serrana x TPS-67*	
56	*T9/13*	*Serrana x TPS-67*	
57	*A9/4*	*Serrana x TPS-67*	
58	*T10/8*	*MF-1 x LT-7*	

In Tokat-Artova location, monthly average temperature throughout potato growing season (May – October) was 18.1°C in 2010 and 15.1˚C in 2011. Long-term average temperature of the same months was 14.7°C. In Tokat-Artova location, annual total precipitation was recorded as 665.0 mm in 2010, 549.0 mm in 2011 and long-term average for annual total precipitation was recorded as 464.1 mm

Experimental materials were composed of 58 promising clones selected at the end of a TÜBİTAK-TOVAG project (106 O 626 numbered) entitled as "Selection of New Clones from Some Potato Hybrids and Molecular Characterization of Başçiftlik Local Potato Cultivar" initiated in 2007 and 9 standard cultivars (Agata, Marabel, Agria, Marfona, Granola, Lady Claire, Başçiftlik Beyazı, Slaney and Hermes) (Table 3).

Research material is composed of 58 clones with superior characteristics obtained from Serrana x 104.12LB; MF-1 x TS-4; Serrana x TS-9; Granola x TS-2; Serrana x DTO-33; Serrana x LT-7; Serrana x TS-4; Serrana x TPS-113; Serrana x TPS-67; MF-1 x LT-7; Pentland Crown x TS-2; Granola x Huincul and Achrina x LT-7 potato hybrids supplied from International Potato Center (CIP). These 58 clones were assessed under 4 groups in terms of flesh color: white (8 clones), cream (9 clones), light yellow (25 clones) and dark yellow (16 clones). Experiments were conducted in randomized blocks design with 3 replication at 3 different locations (Tokat-Niksar, Tokat-Kazova, Tokat-Artova). Clones of each flesh color were experimented together with the standard cultivars with the same flesh color. Experimental plots had 2 plant rows of 6 m long and each row had 20 tubers. Seed material was produced in Artova and stored at dark at 4ºC temperature and 85-90% relative humidity. Sowing was performed on 14 March 2010 and 5 March 2011 in Tokat-Niksar location; on 19 April 2010 and 22 April 2011 in Tokat-Kazova location; on 11 May 2010 and 17 May 2011 in Tokat-Artova location. Sowing density was arranged as 70 x 30 cm. About 12 kg/da NPK was applied at sowing and 8 kg/da N was

applied at the beginning tuber formation during the earthing period (Tugay et al. 1995). Irrigations were practiced through drip irrigation as necessitate. Relevant cultural and chemical treatments were practiced for pests and disease control.

2.1. Variance Analysis

Experimental data were subjected to analysis of variance over combined years, environments and genotypes in accordance with the randomized blocks design separately for each flesh color group (white, cream, light yellow and dark yellow). Significant means were compared with the use of Duncan's multiple range test (Yurtsever 1984; Düzgüneş et al. 1987).

2.2. Stability Analysis

Stability parameters were determined for significant genotype x environment interactions. Initially, two-way tables including genotype and environments were separately prepared for each flesh color group as follows (Lin et al. 1986).

Table 4. Two-way table prepared for genotype x environment interactions.
Çizelge 4. *Genotip ve çevre interaksiyonları için düzenlenen iki yanlı çizelge*

Genotypes	E_1	E_j	$E_ç$	Genotype Average	Genotype Effect (g_{ii})
G_1	x_{11}	X_{1j}	$x_{1ç}$	$\overline{X}_{1.}$	$\overline{X}_{1.} - \overline{X}_{..}$
G_i	x_{i1}	x_{ij}	$x_{iç}$	$\overline{X}_{i.}$	$\overline{X}_{i.} - \overline{X}_{..}$
G_g	x_{g1}	x_{gj}	$x_{gç}$	$\overline{X}_{g.}$	$\overline{X}_{g.} - \overline{X}_{..}$
Environment Average	$\overline{X}_{.1}$	$\overline{X}_{.j}$	$\overline{X}_{.ç}$	$\overline{X}_{..}$ general average	
Environment Effect ($Ç_J$)	$\overline{X}_{.1} - \overline{X}_{..}$	$\overline{X}_{.j} - \overline{X}_{..}$	$\overline{X}_{.ç} - \overline{X}_{..}$		

where;

X_{ij} = Replicate average of i^{th} genotype in j^{th} environment.

$\overline{X}_{..}$ = General average of genotypes in all environments.

g_i = Effect of i^{th} genotype.

$ç_j$ = Effect of j^{th} genotype.

$(gç)ij$ = Interaction of i^{th} genotype with j^{th} environment estimated by $\overline{X}_{ij} - \overline{X}_{i.} - \overline{X}_{.j} + \overline{X}$

Following stability parameters were calculated with the aid of above table: According to Finlay and Wilkinson (1963), regression of genotype values of each genotype in different environments over environment averages was calculated.

$b_i = \sum_j^a 1(X_{iJ} - \overline{X}_{i.})(\overline{X}_{.j} - \overline{X}_{..}) / \sum_j^a (\overline{X}_{.j} - \overline{X}_{..})^2$

(i = genotypes)

(j = environments)

$(X_{iJ} - \overline{X}_{i.})$ = The difference l 1 1 l between phenotype value of i^{th} genotype and genotype average over all environments.

$(\overline{X}_{.j} - \overline{X}_{..})$ = Effect of j^{th} environment.

(b_i): Finlay and Wilkinson regression coefficient.

q: Number of environments.

Based on these parameters, a stable genotype has;

- Greater genotype average than the general average,
- Regression coefficient equal to 1,
- Variance over environments, in other words, variance of deviation from the regression of zero or close to zero.

Following the identification of stability parameters, graphic method of Finlay and Wilkinson (1963), developed with the use of trail average and regression coefficient, was used and adaptation classes of the genotypes were identified as specified in Figure 1. Confidence limit for general average of trial and regression line (b=1) was determined with the use of $G.S. = \overline{X} + t.S_{\overline{X}}$ formula.

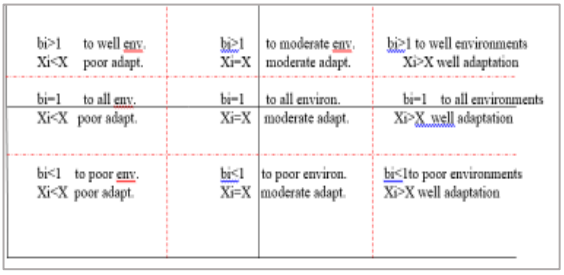

Figure 1. Mathematical and oral expression of genotypic adaptation
Şekil 1. *Genotipik adaptasyonun matematiksel ve sözel izahı*

4. Results and Discussion

4.1. Total Tuber Yield

In terms of the differences in total tuber yields of the clones and cultivars, locations and years were found to be significant. While year x clone and cultivar interactions were insignificant for only dark yellow color ones of Artova, the other flesh colors and the other locations were found to be significant. Year x location x clone and cultivar triple interactions were found to be significant for four flesh colors of entire clones and cultivars (Table 5).

4.1.1. Genotype–Environment Relationships

As can be inferred from Table 5, for white flesh color ones, the greatest total tuber yield per decare was obtained from A13/1 clone in both years of Niksar, from A5/70 clone in both years of Kazova and from T5/4 clone in both years of Artova. In 2010 of Niksar location, total tuber yields of the clones varied between 1195.8 – 3038.6 kg/da with an average value of 1836.1 kg/da. A13/1 and T5/4 clones had greater total tuber yields than Basciftlik Beyazi, but total tuber yields of the other clones were lower than Basciftlik Beyazi. In 2011 of Niksar location, total tuber yields of the clones varied between 1655.3 – 3023.5 kg/da with an average value of 2549.55 kg/da which was lower than Basciftlik Beyazi (3103.7 kg/da).

As it was in the other locations, the second year of the experiments had greater tuber yields than the first year in Kazova location. Total tuber yields varied between 1700.5 – 7206.4 kg/da in 2010 and between 2341.1 – 9563.2 kg/da in 2011. In both years, the greatest tuber yield was obtained from A5/70 clone.

In Artova location, tuber yields of white flesh color clones varied between 3089.1 – 9929.1 kg/da in the first year and between 3030.9 – 10003.1 kg/da in the second year. Average tuber yield of the clones in both years was lower than the tuber yield of Basciftlik Beyazi. The greatest tuber yield was obtained from T5/4 clone in both years.

For white flesh color clones and cultivars, the greatest total tuber yield was obtained from Artova location (6070.64 kg/da) and it was respectively followed by Kazova (5659.32 kg/da) and Niksar (2239.56 kg/da) locations.

As the average of three locations and two years, the greatest total tuber yield (6505.8 kg/da) was obtained from T5/4 clone, followed by A13/1 clone (6500.5 kg/da). Average of clones was calculated as 4618.09 kg/da. Basciftlik Beyazi had a greater total tuber yield (4963.7 kg/da) than the average of clones (Table 5).

Total tuber yields of cream flesh color clones and cultivars are provided in Table 6. In 2010 of Niksar location, tuber yields of the clones varied between 1128.4-4266.3 kg/da with an average value of 2303.39 kg/da and the greatest tuber yield was obtained from A7/12 clones. In 2011 of Niksar location, total tuber yields of the clones varied between 1625.7-4529.4 kg/da with an average value of 2897.78 kg/da. The first year in Kazova location, the greatest tuber yield was measured as 7242.8 kg/da. Clone average (5030.82 kg/da) was quite close to but lower than the tuber yield of Slaney cultivar (5737.6 kg/da). Tuber yields of cream flesh color clones varied between 4447.4-9721.9 kg/da in the second year.

In Artova location, as it was in Niksar and Kazova locations, A7/12 clone had the greatest total tuber yield (12884.5-12205.7 kg/da) in both years. it was respectively followed by T11/10 clone and A5/60 clone in both years. In the first year of Artova location, average total tuber yield of the clones was 7964.01 kg/da and tuber yield of standard Slaney cultivar was 6603.4 kg/da. In 2011 of Artova location,

average total tuber yield of the clones was 8267.04 kg/da and tuber yield of standard Slaney cultivar was 7241.7 kg/da.

As the average of three locations and two years, A7/12 clone had the greatest total tuber yield and it was followed by T11/10 and T5/14 clones. Total tuber yield average of the clones was calculated as 5511.8 kg/da.

For cream flesh color clones and cultivar, the greatest total tuber yield was obtained from Artova location (7996.25 kg/da) and it was respectively followed by Kazova (5822.47 kg/da) and Niksar (2586.01 kg/da) locations.

Total tuber yield per decare of light-yellow flesh color clones and cultivars are provided in Table 7. In 2010 of Niksar location, total tuber yields of light-yellow flesh color clones varied between 1324.9 – 4803.5 kg/da with an average value of 2429.36 kg/da and the greatest values from T6/28, A12/5 and T4/4 clones. Tuber yield average of registered cultivars (2656.72 kg/da) was greater than the average of clones (2429.36 kg/da). As it was in the first year, in 2011 of Niksar location, the greatest total tuber yield was obtained from T6/28 clone (4769.9 kg/da) and it was followed by A6/103 (4639.2 kg/da) and T4/4 (4011.8 kg/da) clones. Average of clones (3010.19 kg/da) was greater than average of standard cultivars (2691.88 kg/da).

In the first year of Kazova location, total tuber yields of light-yellow flesh color clones varied between 3094.1 – 8977.1 kg/da with an average value of 4902.08 kg/da. In the second year of the same location, total tuber yields of the clones varied between 3620.6 – 11782.8 kg/da with an average value of 6634.51 kg/da, which was about 35.0% greater than the first year.

Table 5. Total tuber yields of white flesh color clones and cultivar in experimental locations (kg/da)
Çizelge 5. *İç rengi beyaz olan klonların ve çeşitin denemenin yürütüldüğü yerlerdeki toplam yumru verimleri (kg/da)*

Clones	**Niksar**		**Kazova**		**Artova**		**Genotype Average**	**Genotype Effect**	**bi**
	2010	**2011**	**2010**	**2011**	**2010**	**2011**			
A1/58	1491.9 cd*	2252.0 bc**	1700.5 e**	2341.7 f**	3089.1 c**	3030.9 c**	2317.7	- 2338.8	0.23
T5/32	1450.1 cd	1655.3 c	2586.2 de	4061.3 e	5335.9 b	4443.6 bc	3255.4	-1401.1	0.74
T5/4	2424.0 ab	2913.3 ab	5130.8 bc	8634.8 ab	9929.1 a	10003.1 a	6505.8	1849.4	1.66
A5/70	1508.0 cd	2669.5 ab	7206.4 a	9563.2 a	5857.5 b	5001.9 b	5301.1	644.6	1.26
A5/6	1894.3 bcd	2856.5 ab	6025.1 ab	6668.5 c	6459.5 b	6053.7 b	4992.9	336.4	1.02
A8/34	1686.2 bcd	2708.0 ab	4223.6 c	4971.0 de	5152.4 b	6085.6 b	4137.8	-518.67	0.80
A13/3	1195.8 d	2318.3 bc	3695.7 cd	6419.5 cd	4759.8 bc	5211.9 b	3933.5	-722.9	0.95
A13/1	3038.6 a	3023.5 a	6236.4 ab	8817.0 a	8964.4 a	8923.0 a	6500.5	1843.9	1.44
Clone Average	**1836.11**	**2549.55**	**4600.59**	**6434.63**	**6193.46**	**6094.2**	**4618.09**		
Başçiftlik Beyazı	2122.4 bc	3103.7 a	6278.4 ab	7307.6 bc	4913.7 b	6056.3 b	4963.7	307.2	0.91
Environment Average	**1867.92**	**2611.12**	**4787.01**	**6531.62**	**6051.27**	**6089.99**	**General Average**		
General Average	***2239.56 C+***		***5659.32 B***		***6070.64 A***		**4656.5**		
Environment Effect	**-2788.6**	**-2045.4**	**130.5**	**1875.1**	**1394.8**	**1433.5**	**4656.5**	**1.00**	
							Confidence Limits		
LSD (Genotype)	**690.20**	**591.71**	**1400.01**	**1336.62**	**1493.59**	**1628.94**	**± 1075.7**	**± 0.32**	
LSD (location): **302.26**									

**: The means indicated with the same letters in the same column are not significantly different (P<0,01).
*: The means indicated with the same letters in the same column are not significantly different (P<0,05).
+: The means indicated with the same letters in the same row are not significantly different (P<0,01)

In the first year of Artova location, the greatest total tuber yield was obtained from A3/167 clone (10201.5 kg/da) and it was flowed by A6/71 clone (9889.3 kg/da). Average of clones was 6802.39 kg/da and this value was about 75% greater than the average of cultivars. Among the cultivars, the greatest total tuber yield was obtained from Lady Claire cultivar (4335.6 kg/da), followed by Marfona cultivar. In the second year of Artova location, total tuber yields varied between 3998.1 – 11286.3 kg/da with an average value of 7128.26 kg/da. The

greatest tuber yields were respectively obtained from A1/9, A3/167, A6/71 and T6/28 clones.

Table 6. Total tuber yields of cream flesh color clones and cultivar in experimental locations (kg/da)
Çizelge 6. *İç rengi krem olan klonların ve çeşitin denemenin yürütüldüğü yerlerdeki toplam yumru verimleri (kg/da)*

Clones	Niksar		Kazova		Artova		Genotype Average	Genotype Effect	bi
	2010	2011	2010	2011	2010	2011			
A3/116	1899.5 de**	2436.5 def**	4848.0 bc**	7207.7 b**	6001.7 de**	5787.4 ef**	4696.8	- 771.5	0.76
A4/9	2122.9 cd	1625.7 f	4535.0 bcd	4671.1 c	4447.4 e	4565.3 f	3661.2	-1807.1	0.49
A5/60	1850.7 de	2999.3 bcd	5153.9 bc	5490.9 bc	9500.4 bc	8738.0 bc	5622.2	153.9	1.18
A5/98	2663.4 bc	2774.6 cde	3148.5 d	4999.4 c	6712.8 d	7499.5 de	4633.0	-835.3	0.80
T5/14	2308.6 bcd	3660.4 b	5215.1 bc	9677.7 a	6627.7 d	9401.4 bc	6148.5	680.2	1.06
A6/76	1857.5 de	3363.7 bc	3764.0 cd	6170.0 bc	7671.6 cd	8248.8 cd	5179.3	-289.0	1.00
A7/12	4266.3 a	4529.4 a	5666.4 b	9721.9 a	12884.5 a	12205.7 a	8212.4	2744.1	1.50
A10/15	1228.4 e	2362.9 def	5703.7 b	4773.1 c	7755.7 cd	7702.7 cd	4921.1	-547.2	1.04
T11/10	2533.2 bcd	2327.5 def	7242.8 a	6762.6 b	10074.3 b	10254.6 b	6532.5	1064.2	1.36
Clone Average	**2303.39**	**2897.78**	**5030.82**	**6607.71**	**7964.01**	**8267.04**	**5511.8**		
Slaney	2948.9 b	1960.5 ef	5737.6 b	5964.6 bc	6603.4 de	7241.7 de	5076.1	-392.19	0.81
Environment Average	**2367.94**	**2804.05**	**5101.50**	**6543.40**	**7827.95**	**8164.51**	**General Average**		
General Average	**2586.01 C+**		**5822.70 B**		**7996.25 A**		**5468.32**		
Environment Effect	**-3100.3**	**-2664.3**	**-366.81**	**1075.6**	**2359.6**	**2696.2**	**5468.32**	**1.00**	
							Confidence Limits		
LSD Genotype	**663.52**	**748.20**	**1372.05**	**1550.32**	**1881.65**	**1651.83**	**± 899.88**	**± 0.21**	
LSD (Location): **285.66**									

**: The means indicated with the same letters in the same column are not significantly different (P<0.01).
+: The means indicated with the same letters in the same row are not significantly different (P<0.01).
+ : The means indicated with the same letters in the same row are not significantly different (P<0.01).

The light-yellow flesh color clones and cultivars had the greatest tuber yields in Artova location and it was followed by Kazova and Niksar locations. Present clones and cultivars had greater total tuber yields in the second year than in the first year. When the years and locations were assessed together for light-yellow flesh color clones and cultivars, the greatest total tuber yield (7592.6 kg/da) was obtained from A6/71 clone. It was respectively followed by T6/28 clones (7171.6 kg/da) and A6/103 clone (6681.5 kg/da).

It is remarkable that these 3 clones belonged to the same hybrid family (*Serrana x LT-7*). In terms of total tuber yields of the standard cultivars, Hermes cultivar had the first place, Lady Claire had the second and Marabel had the third place. Average of clones (5151,14 kg/da) was greater than the average of cultivars (3632.34 kg/da). General average of clones and cultivar was identified as 4898.02 kg/da.

Total tuber yield averages of 16 clones and 2 standard cultivars with dark-yellow flesh color are provided in Table 8. In the first year (2010) of Niksar location, the greatest total tuber yields of dark-yellow flesh color clones were obtained from A3/142 (3373.3 kg/da) and A3/206 (3337.3 kg/da) clones. In the second year (2011) of Niksar location, the greatest value was obtained from A3/110 clone (3607.7 kg/da). Average of clones was 2447.05 kg/da in the first year and 2650.31 kg/da in the second year. These values were greater than the average of cultivars in both years. Among the standard cultivars, Granola exhibited better tuber yield performance than Agria cultivar in both year.

Among the dark-yellow flesh color clones, only A2/73 had the greatest total tuber yield in Kazova location, but all the other clones had the greatest tuber yields in Artova location. The greatest total tuber yield averages of both the clones and the standard cultivars were observed in Artova location.

Considering the average of three locations and two years, A3/15 clone made a peak with 6490.9 kg/da and it was respectively followed by T10/8 (5984.3 kg/da) and A3/368 (5917.0 kg/da) clones. Average of clones (4918.98 kg/da) was greater than the average of standard cultivars (4177.45 kg/da).

Table 7. Total tuber yields of light-yellow flesh color clones and cultivars in experimental locations (kg/da)

Çizelge 7. *İç rengi açık sarı olan klonların ve çeşitlerin denemenin yürütüldüğü yerlerdeki toplam yumru verimleri (kg/da)*

Clones	Niksar		Kazova		Artova		Genotype Average	Genotype Effect	bi
	2010	2011	2010	2011	2010	2011			
T1/26	2659.9 b-g**	3535.8 c-g**	5287.6 d-g**	6578.2 e-j**	7012.9 c-h**	5998.6 g-k**	5178.8	280.8	0.93
A1/9	2117.7 d-k	2871.5 f-l	3515.0 hij	4989.1 k-o	8552.8 abc	11286.3 a	5555.4	657.4	1.65
A2/127	1360.3 k	2319.9 i-m	3973.6 g-j	7447.4 d-g	6376.7 d-j	6180.1 f-k	4609.7	-288.3	1.30
A2/99	1541.8 ijk	3212.5 c-h	4686.0 f-i	7647.5 c-f	6645.1 c-i	4622.3 klm	4725.9	-172.1	1.04
A3/177	1324.9 k	1993.6 lm	3506.7 hij	3620.6 pq	4030.4 k-n	6298.4 f-k	3462.4	-1435.6	0.85
A3/29	2402.0 b-j	2704.2 g-m	4214.1 g-j	6732.6 e-i	7507.2 c-g	7640.7 c-g	5200.1	302.1	1.30
A3/337	2379.7 c-j	2634.8 h-m	4311.8 g-j	7092.5 e-h	5777.7 g-l	5924.3 g-k	4686.8	-211.2	1.01
A3/275	1875.6 g-k	2159.5 j-m	3241.3 ij	6177.0 g-k	5797.3 g-l	6455.1 e-j	4284.3	-613.7	1.13
A3/234	3062.1 b-e	3687.0 c-f	4834.5 e-h	6924.9 e-i	8295.9 bcd	8083.9 cde	5814.7	916.7	1.21
A3/37	1408.1 jk	1840.8 m	3976.7 g-j	6359.4 f-j	4834.6 i-n	5626.3 h-l	4007.7	-890.4	1.07
A3/167	2823.7 b-g	2650.0 h-m	6051.9 def	5868.0 h-l	10201.5 a	10961.1 a	6426.0	1528.0	1.74
A3/189	2411.8 b-i	2477.1 h-m	4517.1 g-j	6658.3 e-j	5646.2 g-m	6821.5 d-i	4755.3	-142.7	1.07
A3/26	1658.6 h-k	2921.0 e-k	4311.1 g-j	5686.9 i-n	6093.9 e-k	7002.1 d-h	4612.3	-285.7	1.11
A3/321	2405.8 b-j	3812.9 cd	4474.1 g-j	5753.5 i-m	5171.9 h-n	5062.9 i-m	4446.9	-451.1	0.61
A3/164	2073.3 e-k	2581.6 h-m	3250.2 ij	6618.6 e-j	7389.1 c-g	8313.4 cd	5037.7	139.7	1.41
T4/4	3353.0 bc	4011.8 abc	6229.3 cde	8738.4 bc	6559.1 c-i	6299.0 f-k	5865.1	967.1	0.93
T6/3	1906.9 f-k	3121.9 d-i	4519.1 g-j	5384.3 j-o	3555.0 mn	3998.1 lm	3747.6	-1150.5	0.49
A6/119	2815.5 b-g	1926.0 m	6262.0 bcd	8924.9 b	7922.6 c-f	8959.5 bc	6135.1	1237.1	1.67
T6/17	2895.2 b-f	3005.5 d-j	4622.1 f-i	7727.2 b-e	6341.4 d-j	5554.7 h-l	5024.4	126.4	0.95
A6/71	2470.6 b-i	3752.7 cde	7610.1 b	11782.8 a	9889.3 ab	10049.6 ab	7592.5	2694.5	2.01
A6/103	3114.5 bcd	4639.2 ab	7552.6 bc	8509.0 bcd	8110.4 b-e	8163.0 cde	6681.5	1783.5	1.19
T6/28	4803.5 a	4769.9 a	8977.1 a	6863.6 e-i	8451.0 abc	9164.6 bc	7171.6	2273.6	0.92
A8/11	2131.6 d-k	2884.1 f-k	3094.1 j	4518.3 m-p	6798.5 c-i	7813.3 c-f	4540.0	-358.0	1.10
T9/11	2370.1 c-j	2875.3 f-l	4792.3 fgh	4496.6 m-p	5906.1 f-l	5638.1 h-l	4346.4	-551.6	0.75
A12/5	3367.8 b	2866.2 f-l	4741.7 f-i	4763.2 l-p	7193.1 c-h	6289.7 f-k	4870.3	-27.7	0.80
Clone Average	**2429.36**	**3010.19**	**4902.08**	**6634.51**	**6802.39**	**7128.26**	**5151.14**		
Hermes	3231.4 bc	3998.9 abc	4149.1 g-j	4990.3 k-o	3858.4 lmn	4041.1 lm	24269.2	-853.1	0.19
Marabel	1588.9 ijk	2186.7 j-m	6320.0 bcd	4201.4 op	3832.0 lmn	4038.0 lm	22167.0	-1203.5	0.57
Agata	2945.2 b-e	2539.9 h-m	3890.0 g-j	4361.7 nop	3351.2 n	3740.7 m	20828.7	-1426.6	0.28
L.Claire	2656.8 b-h	2635.6 h-m	4643.8 f-i	4644.2 l-p	4335.6 j-n	4803.1 j-m	23719.1	-944.8	0.52
Marfona	2861.3 b-g	2098.3 klm	3061.0 i	2591.3 q	3983.3 k-n	3391.2 m	17986.4	-1900.3	0.22
Cultivar Average	**2656.72**	**2691.88**	**4412.78**	**4157.78**	**3872.10**	**4002.82**	**3632.34**		
Env. Average	**2467.25**	**2957.14**	**4820.53**	**6221.72**	**6314.01**	**6607.36**	**General Average**		
Env. Effect	**-2430.8**	**-1940.9**	**-77.5**	**1323.7**	**1416.0**	**1709.4**	**4898.02**	**1.00**	
General Average	**2712.22C+**		**5521.15B**		**6460.70A**		**4898.02 Confidence Limits**		
***LSD* Genotype**	**819.68**	**722.83**	**1240.76**	**1102.55**	**1737.63**	**1450.73**	**±416.30**	**±0.17**	
***LSD (location):*168.02**									

**: The means indicated with the same letters in the same column are not significantly different (P<0.01).

+ : The means indicated with the same letters in the same row are not significantly different (P<0.01).

+: The means indicated with the same letters in the same row are not significantly different (P<0.01).

In potatoes, tuber yield is a joint function of number of tuber per plant and average tuber weight (Ozkaynak and Samanci 2005), thus the factors effective in these traits are also effective in total tuber yield.

Total tuber yield is an important selection criterion. High and stable yield levels are desired in potato tubers. Total tuber yield is the leading parameter for identification of the ideal cultivar (Hoopes and Plaisted 1987; Struik and Wiersema 1999).

In potato farming, tuber yield with the greatest impact on profitability of the production is a quantitative trait mostly designated by several genes encoded in plant chromosomes and influenced by climate and soil conditions, utilized inputs, growing techniques and several other factors (Burton 1989). Among these factors, potato plant is quite sensitive to changes in climate parameters, thus the same cultivars may exhibit large differences both in plant growth and development and in tuber yields

under different climate conditions (Burton 1989; Vander Zaag et al. 1990). Therefore, it is highly significant to identify the practices yielding the most economical and the greatest yields under different climate conditions (Allen and Scott 1992).

Table 8. Total tuber yields of dark-yellow flesh color clones and cultivars in experimental locations (kg/da)

Çizelge 8. *İç rengi koyu sarı olan klonların ve çeşitlerin denemenin yürütüldüğü yerlerdeki toplam yumru verimleri (kg/da)*

Clones	Niksar		Kazova		Artova		Genotype Average	Genotype Effect	bi
	2010	2011	2010	2011	2010	2011			
A2/11	1959.1 cde**	3020.5 a-d**	4811.8 c-g**	6850.7 b-e**	6146.9 de**	6381.2 c-g**	4861.7	25.05	1.03
A2/73	2370.2 bcd	2919.2 a-e	4781.8 c-h	6950.9 a-e	4001.1 f	4945.2 ghi	4328.1	-508.5	0.67
A3/110	2539.0 a-d	3607.7 a	4216.6 e-h	5900.2 d-g	6349.5 cde	7468.7 a-e	5013.6	177.0	0.94
A3/223	2598.8 abc	2003.3 ef	4834.4 c-f	6469.6 b-f	5528.2 def	6148.1 d-h	4597.1	-239.5	0.97
A3/368	2301.0 bcd	2271.6 def	6351.4 abc	8299.7 a	7679.5 abc	8598.9 abc	5917.0	1080.4	1.56
A3/351	2431.0 a-d	2599.3 b-e	3933.0 e-h	6170.9 c-g	5556.3 def	7365.1 b-f	4675.9	-160.7	1.02
A3/142	3373.3 a	3375.7 ab	6010.6 bcd	5343.7 fgh	6444.3 cde	7701.7 a-d	5374.9	538.3	0.88
A3/15	2095.0 b-e	2769.0 a-e	7828.3 a	7336.0 a-d	9485.4 a	9431.4 a	6490.9	1654.2	1.71
A3/346	2310.5 bcd	2376.8 cde	6576.0 ab	7831.7 ab	8064.1 abc	7258.7 b-f	5736.3	899.7	1.39
A3/108	1250.8 e	1333.3 f	3517.4 fgh	3491.5 ij	3610.5 f	4250.8 hi	2909.1	-1927.5	0.68
A3/74	2853.0 abc	2314.2 c-f	5982.6 bcd	5604.0 e-h	6104.2 cde	6701.9 c-g	4926.7	90.05	0.97
A3/206	3337.3 a	2234.1 def	3112.4 h	2995.8 j	4602.1 ef	5311.3 f-i	3598.8	-1237.8	0.43
A9/8	2308.6 bcd	3267.4 abc	3141.1 gh	4722.6 ghi	7255.6 bcd	6780.6 c-g	4579.3	-257.3	0.91
T9/13	2865.9 abc	2886.2 a-e	4571.3 d-h	4293.3 hij	6842.7 bcd	8447.0 abc	4984.4	147.8	1.04
A9/4	2992.9 ab	3133.5 a-d	4895.9 c-f	6169.1 c-g	4548.2 ef	6614.5 c-g	4725.7	-110.9	0.74
T10/8	1566.4 de	2293.1 c-f	6788.6 ab	7419.1 abc	8598.7 ab	9239.4 ab	5984.2	1147.6	1.75
Clone Average	**2447.05**	**2650.31**	**5084.58**	**5990.55**	**6301.08**	**7040.28**	**4918.98**		
Agria	2097.0 b-e	2341.9 cde	6078.6 bcd	5742.4 e-h	4634.6 ef	5475.6 e-i	4395.0	-441.6	0.84
Granola	2267.0 bcd	2931.0 a-e	5407.3 b-e	4913.0 ghi	4430.3 ef	3810.6 i	3959.9	-876.7	0.47
Cultivar Average	**2182.0**	**2636.45**	**5742.95**	**5327.70**	**4532.45**	**4643.10**	**4177.45**		
Environment Average	**2417.60**	**2648.77**	**5157.73**	**5916.90**	**6104.57**	**6773.93**	**General Average**		
Env. Effect	**-2419.0**	**-2187.8**	**321.1**	**1080.3**	**1268.0**	**1937.3**	**4836.58**	**1.00**	
General Average	**2533.20 C+**		**5537.33 B**		**6439.27 A**		**4836,58 Confidence Limits**		
***LSD* Genotype**	**840.24**	**840.17**	**1423.23**	**1274.68**	**1724.95**	**1822.53**	**± 435.13**	**± 0.19**	
LSD (location): **223.78**									

**: The means indicated with the same letters in the same column are not significantly different (P<0,01).

+: The means indicated with the same letters in the same row are not significantly different (P<0,01).

+ : The means indicated with the same letters in the same row are not significantly different (P<0,01).

Present findings on total tuber yields of the clones with four different flesh colors comply with the findings of Yılmaz et al. (2009, 2010). Vayda (1994) indicated that different environmental stress conditions reduced total and marketable tuber yields, high temperature, drought and cold stress conditions throughout the growing season reduced photosynthetic activity and inhibited the initiation of stolon and tuber formation in potato farming. Kawakami (2003) conducted field experiments with early and late potato cultivars and indicated that early cultivars exhibited a weaker vegetative development and thus had lower yields than the late cultivars.

Deblonde and Ledent (2001) indicated that drought and high temperatures reduced tuber weight and yields. Lower tuber yields of all flesh color genotypes in Niksar location than the other locations is mostly due to higher temperatures and shorter vegetation duration of Niksar location. The soil temperatures over 20°C negatively influence tuber growth, short-day and relatively low temperatures stimulate tuber formation (Caylak 2002). Therefore, low total tuber yields in 2010 of Niksar location were attributed to increased vegetative growth of potato plants at high temperatures, delay in

tuber development, increased respiration and transpiration and resultant decrease in photosynthetic activity, thus decreased tuber size (Hammes and Jager 1990).

4.1.2. Genotype Stability

The two-way table for genotype and environment data generated for the calculation of various stability parameters related to total tuber yield and the regression coefficients (bi values) calculated in the light of these data as indicated by Finlay and Wilkinson are presented in Table 5.

Regression coefficients varied between 0.23-1.66. Confidence interval of regression coefficient was 0.68<bi<1.32. Accordingly, T5/32, A5/70, A5/6, A8/34, A13/3 clones and Basciftlik Beyazi cultivar were within this interval.

The adaptation classes of clones and cultivars generated based on averages (Table 5) and regression coefficients are presented in Figure 2.

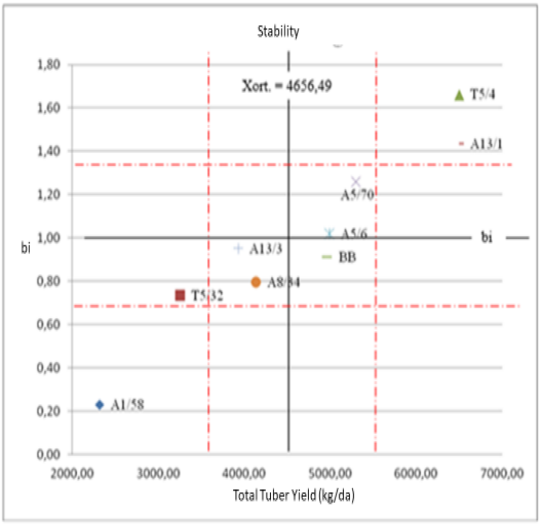

Figure 2. Adaptation classes for total tuber yields (kg/da) of white flesh color clones and cultivars grown at different locations

Şekil 2. *Farklı çevrelerde yetiştirilen beyaz iç rengine sahip klon ve çeşitlerin toplam yumru verimlerine (kg/da) ait adaptasyon sınıfları*

T5/4 and A13/1 clones exhibited well adaptation to well environments, A1/58 clone exhibited poor adaptation to poor environments and T5/32 clone exhibited poor adaptation to all environments.

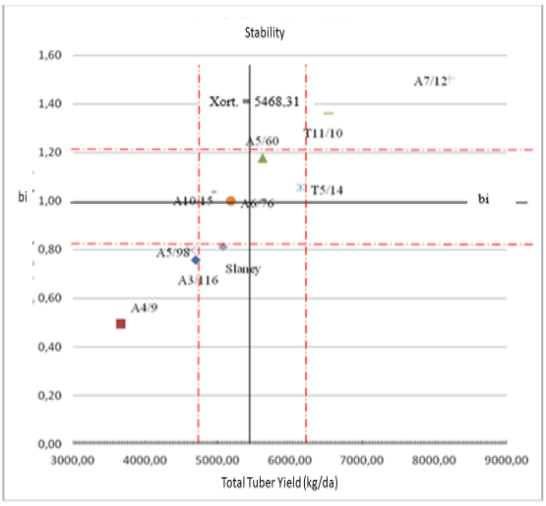

Figure 3. Adaptation classes for total tuber yields (kg/da) of cream flesh color clones and cultivars grown at different locations

Şekil 3. *Farklı çevrelerde yetiştirilen krem iç rengine sahip klon ve çeşitlerin toplam yumru verimlerine (kg/da) ait adaptasyon sınıfları*

Two-way table for total tuber yield (kg/da) of cream flesh color clones and cultivars at experimental locations and bi values are provided in Table 6.

Regression coefficients for total tuber yields of cream flesh color clones and cultivars varied between 0.49-1.50. Combined confidence interval for cultivar averages of relevant parameter was 4568.42< X<6368.19. Except for A7/12 and T11/10 clones, the other genotypes were within this interval. Confidence interval for regression coefficient was 0.79<bi<1.21 and A5/60, A5/98, T5/14, A6/76, A10/15 clones and Slaney cultivar were within this interval (Table 6).

As can be inferred from Figure 3, A5/60, A10/15, A6/76 and T5/14 clones and Slaney cultivar with general averages within the spacified confidence interval and regression coefficients of euqal to or close to 1.00 exhibited moderate adaptation to all environments. A7/12 and T11/10 clones exhibited well adaptation to well environments, A4/9, A5/98 and A3/116 clones exhibited poor adaptation to poor environments.

Figure 4. Adaptation classes for total tuber yields (kg/da) of light-yellow color clones and cultivars grown at different locations

Şekil 4. *Farklı çevrelerde yetiştirilen açık sarı iç rengine sahip klon ve çeşitlerin toplam yumru verimlerine (kg/da) ait adaptasyon sınıfları*

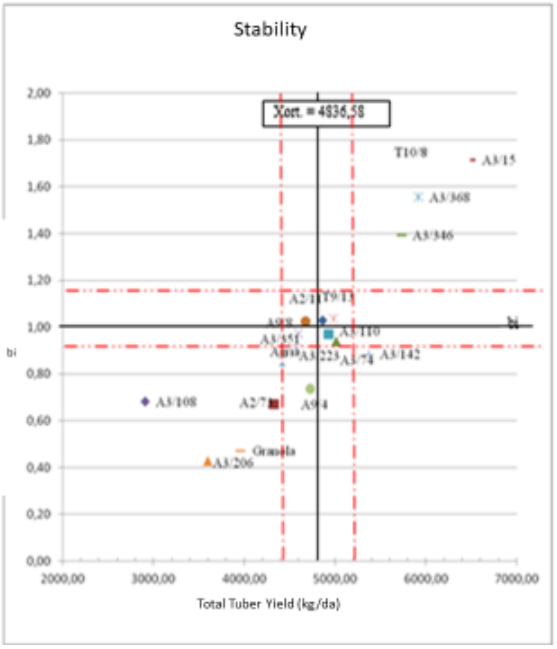

Figure 5. Adaptation classes for total tuber yields (kg/da) of dark-yellow flesh color clones and cultivars grown at different locations

Şekil 5. *Farklı çevrelerde yetiştirilen koyu sarı iç rengine sahip klon ve çeşitlerin toplam yumru verimlerine (kg/da) ait adaptasyon sınıfları*

Two-way table for total tuber yield (kg/da) of light-yellow flesh color clones and cultivars at experimental locations and bi values are provided in Table 7 and the graph generated based on total tuber yield averages and regression coefficients (Finlay and Wilkinson 1963) is presented in Figure 4.

The confidence interval for regression coefficients (bi) for total tuber yields (Table 7 and Figure 4) was 0.92<bi<1.08 and T1/26, A2/99, A3/337, A3/37, A3/189, T4/4 and T6/17 clones were within this interval.According to Finlay and Wilkinson (1963), among 25 clones and 5 cultivars with light-yellow flesh color, A3/337, A3/189, A2/99, T1/26 clones exhibited moderate adaptation to all environments, thus were identified as stable. A8/11, A3/26, A2/127, A3/29 and A3/164 clones had regression coefficients (bi values) greater than 1, thus exhibited moderate adaptation to well environments (Figure 4). A2/127, A3/164, A3/29, A3/26 and A8/11 clones exhibited moderate adaptation to well environments and A1/9, A3/234, A6/103, A6/119, A3/167 and A6/71 clones exhibited well adaptation to well environments. A3/37 clone exhibited poor adaptation to all environments, A3/337, A3/189, A2/99, T1/26 and T6/17 clones exhibited moderate adaptation to all environments. Besides, T4/4 and T6/28 clones exhibited well adaptation to all environments. While A12/5 clone exhibited moderate adaptation to poor environments, standard cultivars all and T6/3, T9/11, A3/321 and A3/177 clones exhibited poor adaptation to poor environments.

Two-way table for total tuber yield of 18 genotypes (16 clones and 2 cultivars with dark-yellow flesh color) and stability parameters are provided in Table 8.

Regression coefficients of the dark-yellow flesh color genotypes varied between 0.47-1.75. Confidence interval for regression coefficients was 0.91<bi<1.09. The T10/8 clone had the greatest regression coefficient and it was followed by A3/15 clone. The lowest regression coefficients were obtained from Granola, A3/206, A2/73 and A3/108 genotypes. Confidence interval for averages was

4401.45<$\bar{X}$<5271.71.

Adaptation classes of the genotypes are presented in Figure 5. Accordingly, A2/11, A9/8, A3/351, T9/13, A3/110, A3/223 and A3/74 clones exhibited moderate adaptation to all environments; A3/368, A3/346, A3/15 and T10/8 clones exhibited well adaptation to well environments; A3/142 clone exhibited well adaptation to poor environments; A9/4 clone exhibited moderate adaptation to poor environments and finally A3/108, A3/206, A2/73 clones and Granola and Agria cultivars exhibited poor adaptation to poor environments.

Among the clones, A6/103, T4/4 and T6/28 had high tuber yields at all environments; T5/4, A13/1, A7/12, T11/10, A6/71, A3/15 and A3/368 clones had high yields (8212.4 kg/da) under well environment conditions.

As to conclude, according to experimental results as the average of three locations, cream-A7/12 (8212.4 kg/da), light-yellow-A6/71 (7592.6 kg/da), white-T5/4 (6505.9 kg/da) and dark-yellow-A3/15 (6490.9 kg/da) clones had the greatest tuber yields. According to adaptation classes, Artova and partially Kazova locations were classified as “well” environment and Niksar was classified as poor environment. In Artova location, cream-A7/12 (12545.2 kg/da) clone had a high tuber yield per decare and it was followed by light-yellow-A3/167, white-T5/4 and dark-yellow-A3/15 clones. In Kazova location, light-yellow-A6/71 (9696.5 kg/da) clone had high tuber yield and it was followed by white-A5/70, cream-A7/12 and dark-yellow-A3/15 clones. In Niksar location, light-yellow-T6/28 (4786.7 kg/da) clone had the highest tuber yield and it was respectively followed by cream-A7/12, dark-yellow-A3/142 and white-A13/1 clones. In terms of stability, light-yellow flesh color A6/103 and A3/234 clones and dark-yellow flesh color A3/142 and A3/110 clones were found to be more stable than the other clones.

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