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EARLY GENERATION SELECTION IN DIFFERENT LOCATIONS IN POTATO BREEDING PROGRAM

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ABSTRACT

In variety development studies through hybridization, it is necessary to make hybridization with the parents suitable for the purpose, to obtain the tubers in seedling generation from the hybrid seeds obtained, and then to proceed to the clonal selection process. In this study, it was aimed to select clones suitable for tuber shape, earliness, table and industrial use in different locations in the first clonal generation stage from the variation created by hybridization between some commercially registered potato varieties, local potato varieties and some clones with superior characteristics. The study was conducted with 3316 clones in Artova and Kazova districts in Tokat province in Turkey. In this year, which was the first clonal selection stage, besides phenotypic characteristics such as breeder's preference, maturity group, tuber defects, skin roughness, skin and tuber flesh color, characteristics such as the number of tubers per hill, tuber yield per hill, average tuber weight, depth of lateral (eye) and apical buds were examined and data on clones belonging to each hybrid family were obtained. Thus, it was decided to proceed to the next selection stage with 918 clones selected due to their compliance with the criteria determined in the first clonal generation stage.

Keywords: First Clonal Generation, Potato, *Solanum tuberosum* L., Selection

1. INTRODUCTION

The aim of potato breeding is to develop varieties that are high yielding, early-maturing, suitable for the intended use, high quality, high adaptable, suitable for storage, resistant to diseases-pests and tolerant to stress factors [1], [2]. In order to achieve this goal, the phenotypic selection is made in each generation.

New cultivar development stages in potato breeding; are parental selection, hybridization between parents, starting F1 seedling generation by producing seedlings from the seeds obtained, selection of clones with the desired characters as a result of selection studies, and reaching a sufficient amount of selected clones. After that, clones are tested in some locations and superior varieties are registered and produced [3].

Potato clones are selected from F1 progeny by vegetative propagation without genetic modifications. Breeding experiments are largely based on phenotypic selection for yield and other related characteristics. On the other hand, due to the limited resources, it is not possible to examine all characteristics that can contribute to breeding goals [4].

In potato breeding, the selection made in the early generation period is mostly based on the experience of the breeder by examining at the external appearance of the plant and tuber. It is very important to use the phenotypic selection parameters optimally to achieve a maximum gain in variety development. For instance, about 18 phenotypic selection parameters are used in Agriculture and Agri-Food's breeding program. Phenotypic selection in the early period comprises characteristics such as tuber size, eye depth, number of eyes, early maturity, maturity group, etc. [5]. on the other hand, made evaluations on eye depth, apical bud depth, tuber shape, tuber size and general appearance and total yield in clones belonging to 12 hybrid families in their selection in terms of tuber yield and appearance [6].

Yılmaz et al. (2017a) stated that in order to develop new varieties in potatoes, it is necessary to make hybridization with suitable parents, to develop seed tubers by using hybrid seeds, seedling generation, and to proceed to the first clonal selection stage with these tubers. In their research, it was aimed to develop seed tubers required for the first clonal selection after seedling generation by using hybrid seeds from different potato combinations. The first field generation selection was made with approximately 8800 clones in their study, and as a result of the selection, 1186 clones suitable for marketable tuber characteristics were determined [7].

Yakar-Tan and Bilge (1979) stated that the variations to be observed when plants with the same genotype are grown in different places are caused by the environment. Furthermore, they reported that the issue of whether the genotype or environmental conditions have a greater effect on the phenotype can be determined by growing plants with different genotypes

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in the same environmental conditions or growing individuals with the same genotype under different environmental conditions [8] Each new variety must be sustainable against changes in agricultural and climatic conditions [9]. Therefore, it is important to try these varieties in suitable environments for several years. Many characteristics of potatoes such as tuber yield, tuber number and size, dry matter content and quality are greatly affected by the environmental conditions in which the plant is grown [10]. In the present study, it was aimed to select clones that show superior characteristics in terms of tuber shape, earliness, cooking and industrial use in different locations in the first clonal generation stage from the segregated population created by hybridization between some commercial registered potato varieties, local potato varieties and some clones with superior characteristics.

2. MATERIAL AND METHOD

In the study, the variation was created by hybridization with some commercially registered potato varieties, some local potato varieties currently being produced in the high altitudes of Tokat province, and clones with some superior characteristics developed by the TÜBİTAK-TOVAG project numbered 106 O 626. The study was carried out in Tokat / Kazova (600-650 m) and Tokat / Artova (1100 m) locations in 2017.

The planting density of 3316 hybrid clones belonging to six combinations was 70x40 cm, and if the number was sufficient for each of the clones, two tubers each, if not enough, one tuber was planted (Table 1). The clones were planted in Tokat / Kazova on 30-31 March 2017 and in Artova on 15 May 2017. All treatments required for cultivation were carried out at this stage, and irrigation was carried out with the drip irrigation method in Artova location and with the sprinkler irrigation method in Kazova location. According to the results of soil analysis, fertilization was carried out as 20 kg Nitrogen, 10 kg Phosphorus and Potassium per decare. In the Tokat / Kazova location, the early-maturing clones were harvested on 16-17 August 2017, while the other clones were harvested on 6-13 September 2017. Moreover, the harvest in Tokat / Artova location was made on 17-18 October 2017. Tubers belonging to the plants in both locations were labeled separately, bagged and stored, then necessary observations and measurements were performed. In the first clonal generation, the clones belonging to each hybrid family were grown in two locations and started to be monitored. Clones with disease and clones with abnormal growth and habitus structure were removed before harvesting. The selection study was mostly carried out after the harvest. Moreover, the clones that were rough, cracked, cleft, shapeless, rotten, and clones that had the high depth of eye and apical bud, could not grow their tubers sufficiently and had an insufficient number of tubers were eliminated by the negative selection.

Table 1 Combinations and number of clones examined in the experiment

Combination	Parent-1		Parent-2	Number of hybrid clon
1	Slaney	x	T5/4	384
2	Başçiftlik Beyazı	x	Lady Olympia	526
3	A3/15	x	Bafana	690
4	Başçiftlik Beyazı	x	Slaney	769
5	T5/4	x	Marfona	613
6	T5/4	x	Bafana	334
Total				3 316

3. RESULTS AND DISCUSSION

In the present study, in the first clonal selection stage, besides phenotypic characteristics such as breeder's preference, plant growth form, tuber defects, skin roughness, skin and tuber flesh color, characteristics such as the number of tubers per hill, tuber yield per hill, average tuber weight, depth of eye and apical bud were considered.

3.1. Breeder's Preference Scale

Unlenen (2010) stated that different plant characteristics were taken into consideration before and after the harvest. Criteria such as plant height, plant growth type, stolon length, stem thickness, and maturity can be considered before the harvest while criteria such as stolon length, tuber shape, tuber defect, eye depth, skin smoothness, number of tubers per plant and yield can be considered during and after the harvest [11] According to the general appearance of the plants under field conditions and the tubers after the harvest, they were scored as 1- Very Bad, 2-Bad, 3- Medium, 4- Good, 5- Very Good and determined by taking their means. The clones belonging to the hybrid families were evaluated by the scoring parameters such as the affection level of the plants by diseases, growth form, stolon length and branching status, tuber shape, tuber color, tuber form, general appearance

and bulk homogeneity of the tubers. Among the combinations in Kazova location, A3 / 15 x Bafana (11.3%) and Başçiftlik Beyazı x Lady Olympia (8.3%) had the highest number of clones in the very good category in terms of overall appearance (Table 2). Moreover, the clones evaluated at the Artova location belonging to the combinations of Slaney x T5 / 4 (7.6%) and Başçiftlik Beyazı x Lady Olympia (7.7%) were found to be very good in terms of general appearance before and after the harvest (Table 2).

Table 2 Evaluation of clones belonging to hybrids from Kazova and Artova locations according to the breeder's preference

Combination	Number of plants	Very bad	%	Bad	%	Medium	%	Good	%	Very good	%
Kazova											
1	274	16	5.8	71	25.9	84	30.7	93	33.9	10	3.6
2	349	27	7.7	57	16.3	121	34.7	115	33.0	29	8.3
3	506	9	1.8	50	9.9	190	37.5	200	39.5	57	11.3
4	615	21	3.4	150	24.4	257	41.8	162	26.3	25	4.1
5	468	43	9.2	205	43.8	151	32.3	60	12.8	9	1.9
6	265	15	5.7	82	30.9	101	38.1	53	20.0	14	5.3
Total	2 477	131	-	615	-	904	-	683	-	144	-
Average	-	22	5.6	102	25.2	151	35.8	114	27.6	24	5.7
Artova											
1	172	5	2.9	44	25.6	60	34.9	50	29.1	13	7.6
2	313	14	4.5	87	27.8	67	21.4	121	38.7	24	7.7
3	316	7	2.2	84	26.6	82	25.9	129	40.8	14	4.4
4	489	11	2.2	128	26.2	198	40.5	135	27.6	17	3.5
5	332	21	6.3	58	17.5	88	26.5	142	42.8	23	6.9
6	96	5	5.2	34	35.4	16	16.7	37	38.5	4	4.2
Total	1 718	63	-	435	-	511	-	614	-	95	-
Average	-	10	3.9	72	26.5	85	27.7	102	36.2	16	5.7
1=Slaney x T5/4, 2= Başçiflik Beyazı x Lady Olympia, 3=A3/15 x Bafana, 4=Başçiflik Beyazı x Slaney, 5=T5/4 x Marfona, 6= T5/4 x Bafana											

3.2. Plant Maturing Group

After sprouting, and before the five leaves at the top dried, observations were made and very early-maturing, early-maturing, medium early-maturing, late-maturing, and very late-maturing clones were determined. Of the 2476 clones examined in the Kazova location, 2.5% were found to be very early-maturing, 15.5% were early-maturing, 28.3% were medium early-maturing, 31.0% were late-maturing and 21.1% were very late-maturing (Table 3). When the plant maturing groups of the clones were examined in the Artova location, it was determined that 2.9% were very early-maturing, 7.9% were early-maturing, 31.1% were medium early-maturing, 38.3% were late-maturing and 19.9% were very late-maturing (Table 3). It is seen that the number of clones found to be late-maturing in both locations was high. It is thought that this situation was due to the fact that the maturity status of the parents used in crossbreeding was mostly late.

In a study conducted, it was investigated what percentage of clones could be lost when late-maturing clones were discarded, and the clones were examined under five groups as very early-maturing, early-maturing, mid-early-maturing, late-maturing and very late-maturing. Moreover, plant vitality (very weak, weak, medium, high, very high) was also scored. While 20% of the genotypes were found to be in the late-maturing group, 9.2% were in the very early-maturing group. Besides, it was concluded

that 6.2% of late-maturing genotypes could be lost [12]. There is no problem with the loss of early-maturing plants, however, late-maturing plants can be eliminated due to this feature. However, if the plants are grown in short-day conditions, this risk can be eliminated since early tuber formation and early ripening will be encouraged [13].

Table 3 Plant maturing group of clones belonging to hybrids from Kazova and Artova locations (number)

Combination	Number of plant	Very early-maturing	%	Early-maturing	%	Medium early-maturing	%	Late-maturing	%	Very late-maturing	%
Kazova											
1	273	5	1.8	25	9.2	79	28.9	105	38.5	59	21.6
2	349	8	2.3	32	9.2	65	18.6	125	35.8	119	34.1
3	506	18	3.6	178	35.2	146	28.9	100	19.8	64	12.6
4	615	19	3.1	46	7.5	156	25.4	187	30.4	207	33.7
5	468	12	2.6	68	14.5	143	30.6	175	37.4	70	15.0
6	265	4	1.5	47	17.7	100	37.7	64	24.2	25	9.4
Total	2 476	66	-	396	-	689	-	756	-	544	-
Average	-	11	2.5	66	15.5	115	28.3	126	31.0	91	21.1
Artova											
1	172	3	1.7	12	7.0	43	25.0	67	39.0	47	27.3
2	313	13	4.2	16	5.1	78	24.9	106	33.9	100	31.9
3	316	8	2.5	21	6.6	200	63.3	52	16.5	35	11.1
4	489	9	1.8	37	7.6	91	18.6	236	48.3	116	23.7
5	332	16	4.8	56	16.9	164	49.4	64	19.3	32	9.6
6	96	2	2.1	4	4.2	5	5.2	70	72.9	15	15.6
Total	1 718	51	-	146	-	581	-	595	-	345	-
Average	-	8	2.9	24	7.9	97	31.1	99	38.3	57	19.9
1=Slaney x T5/4, 2= Başçiflik Beyazı x Lady Olympia, 3=A3/15 x Bafana, 4=Başçiflik Beyazı x Slaney, 5=T5/4 x Marfona, 6= T5/4 x Bafana											

3.3. Tuber Defects

Defects such as cracks, clefts, formlessness and secondary tuber formation, deformity and swollen eyes seen in the skin of the tubers were macroscopically observed and it was determined that if they were present or not. When the tuber defects belonging to the hybrid families in the Kazova location were examined, it was observed that 48% of the total 2477 clones did not have tuber defects, however, 51.7% of them had problems such as wrinkling, rotting, softening, secondary tuber formation, cracking, splitting, and deformity (Table 4). While 43.6% of tubers harvested from Artova location did not have any negative characteristics, 56.4% of tubers in Kazova location had defects (Table 4). In a study conducted by Ünlenen (2010), the values obtained from the scoring based on the observations at the first clonal generation stage were examined. In the research, it was determined that the rate of genotype with any tuber defect was 18.0%, and no tuber defect was observed in 82.0% of the genotypes [11]

Table 4 Tuber defect values of clones belonging to hybrids in Kazova and Artova locations

Combination	Number of plant	Any tuber defect	%	No tuber defect	%
Kazova					
1	273	142	52.0	131	47.9
2	349	203	58.2	146	41.8
3	506	240	47.4	266	52.6
4	615	235	38.2	380	61.8
5	468	244	52.1	224	47.9
6	265	132	49.9	133	50.2
Total	2 476	1 197	-	1 280	-
Average	-	199.3	49.6	213.3	50.3
Artova					
1	172	59	34.3	113	65.7
2	313	146	46.6	167	53.4
3	316	180	57.0	136	43.0
4	489	156	31.9	333	68.0
5	332	142	42.8	190	57.2
6	96	66	68.8	30	31.3
Total	1 718	750	-	969	-
Average	-	124.8	46.9	161.5	53.1
1=Slaney x T5/4, 2= Başçiflik Beyazı x Lady Olympia, 3=A3/15 x Bafana, 4=Başçiflik Beyazı x Slaney, 5=T5/4 x Marfona, 6= T5/4 x Bafana					

3.4. The Number of Tubers per Hill

The number of tubers per hill was determined by counting the tubers in each hill. As seen in Table 5, the average number of tubers per hill of 2476 clones examined in the Kazova location was 10.59. When the number of tubers was examined on a combination basis, the highest tuber number per hill was obtained from T5 / 4 x Marfona combination with 11.90 while the lowest tuber number per hill was obtained from the Başçiftlik Beyazı x Lady Olympia combination with 8.50. There were 1132 clones above the average. When the mean number of tubers per hill in Artova location was evaluated, the mean of 1718 clones was 4.54 and 676 clones were above the average.

When the combinations are considered, it is observed that, Başçiftlik Beyazı x Slaney had the highest value with 6.02 while the Başçiftlik Beyazı x Lady Olympia had the lowest value with 3.25 (Table 5). Although the number of tubers is an important feature that affects the yield, the seed value effects are not the same due to the structural heterogeneity, size and other characteristics of the tubers taken from the first generation seeds. Therefore, the deviations in the number of tubers in the first field generation were at the expected level. Although the number of tubers is not an absolute feature during selection, it is also thought that it is not a feature away from attention. Therefore, clones with a low number of tubers were not eliminated much, other characteristics were also examined, however, clones with a high number of tubers were followed closely [14].

Table 5 The average number of tubers (number) per hill of clones belonging to the hybrids in Kazova and Artova locations

Combination	Number of plant	The number of tubers per hill (average)	Above average number of clones
Kazova			
1	273	10.87	118
2	349	8.50	147
3	506	11.70	225
4	615	9.97	280
5	468	11.90	246
6	265	10.61	116
Total	2 476	-	1 132
Average	-	10.59	-
Artova			
1	172	5.59	73
2	313	3.25	109
3	316	3.42	106
4	489	6.02	217
5	332	4.84	130
6	96	4.14	41
Total	1 718	-	676
Average	-	4.54	-
1=Slaney x T5/4, 2= Başçiflik Beyazı x Lady Olympia, 3=A3/15 x Bafana, 4=Başçiflik Beyazı x Slaney, 5=T5/4 x Marfona, 6= T5/4 x Bafana			

3.5. Average Tuber Weight

The weight of tubers obtained from each hill was determined by dividing by their number. The mean of tuber weight of the clones examined at the Kazova location was 71.2 g. The Başçiftlik Beyazı x Lady Olympia combination had the highest average tuber weight (92.9 g) while the lowest one was determined in Başçiftlik Beyazı x Slaney combination as 55.7 g (Table 6). There were 1071 clones above the average. The tuber weight mean of the clones of six combinations in Artova location was 41.8 g. The combination with the highest mean tuber weight was A3 / 15 x Bafana with 46.0 g. Moreover, the lowest tuber weight was obtained from the combination of Başçiftlik Beyazı x Slaney (39.6 g). Furthermore, the number of clones above the average in all combinations was 599 (Table 6). The clones, which were decided to be selected in the study, were not chosen according to their unidirectional characteristics, but according to their status of having several properties together. However, in terms of giving an idea and revealing the condition of the first generation, the examination of tuber sizes made the selection easier.

Table 6 Evaluation of average tuber weight (g) of clones belonging to hybrids at Kazova and Artova locations

Combination	Number of plant	Average tuber weight (g)	Above average number of clones
Kazova			
1	273	63.1	120
2	349	92.9	149
3	506	74.0	220
4	615	55.7	264
5	468	74.4	201
6	265	67.4	117
Total	2 476	-	1 071
Average	-	71.2	-
Artova			
1	172	44.2	55
2	313	40.4	110
3	316	46.0	105
4	489	39.6	183
5	332	44.6	121
6	96	36.1	25
Total	1 718	-	599
Average	-	41.8	-
1=Slaney x T5/4, 2= Başçiflik Beyazı x Lady Olympia, 3=A3/15 x Bafana, 4=Başçiflik Beyazı x Slaney, 5=T5/4 x Marfona, 6= T5/4 x Bafana			

3.6. Tuber Yield per Hill

Tubers taken from each hill were weighed and determined in grams. The highest mean tuber yield per hill was obtained from T5 / 4 x Marfona (858.2 g) combination, followed by A3 / 15 x Bafana (819.0 g) (Table 7). The combination with the lowest average was Başçiftlik Beyazı x Slaney (543.2 g). The average tuber yield per hill of 2476 clones examined in the Kazova location was 710.5 g, and the number of clones above the average was 1103. In Artova location, the highest average tuber yield per hill (231.7 g) was obtained from the number 1 combination while the lowest (124.9 g) was obtained from Başçiftlik Beyazı x Lady Olympia. Moreover, the mean of 1718 clones was 177.2 g. (Table 7). Only negative selection is recommended for tuber yield and components in early generations in potato breeding programs. Simultaneous selection should be made for plant vigour, average tuber weight and tuber yield in increasing total yield in potatoes, furthermore, yield and components should be a good guide to improve the value of clones [15].

Table 7 Evaluation of average tuber yield per hill (g) of clones belonging to hybrids in Kazova and Artova locations

Combination	Number of plant	Tuber yield per hill (g)	Above average number of clones
Kazova			
1	273	641.5	120
2	349	736.6	152
3	506	819.0	231
4	615	543.2	263
5	468	858.2	220
6	265	664.5	117
Total	2 476	-	1 103
Average	-	710.5	-
Artova			
1	172	231.7	58
2	313	124.9	104
3	316	142.5	99
4	489	228.6	177
5	332	208.4	118
6	96	127.3	30
Total	1 718	-	586
Average	-	177.2	-
1=Slaney x T5/4, 2= Başçiflik Beyazı x Lady Olympia, 3=A3/15 x Bafana, 4=Başçiflik Beyazı x Slaney, 5=T5/4 x Marfona, 6= T5/4 x Bafana			

3.7. Lateral (eye) and Apical Buds Depth in Tubers

Another characteristic taken into consideration in selection in this study is the distribution of tubers with a high depth of apical bud. Measurements were made with a digital caliper, the means were expressed in mm and classification was made into 5 groups according to the 1-9 scale in the EAPR standards. When the average eye depth of the clones belonging to the combinations numbered 1, 2, 5 and 6 in Table 8 was observed, they were found to have shallow eye depth. Moreover, combinations 3 and 4 had very shallow eye depth. Besides, combinations 1, 2, 4, 5 and 6 were found to have a shallow apical bud. In the clones examined in Artova location, the average eye depth of clones belonging to all combinations was defined as the superficial eye. Moreover, apical bud depth means the protruding bud. In potato tubers, it is not desirable that the apical bud part protrudes excessively. Similarly, it is not preferred that the apical bud part is deep inward. In this case, it can be said that the superficial apical bud depth is appropriate, as in the eyes [14]. Those with very abnormal characteristics were eliminated in later generations, considering other characteristics.

Table 8 Eye and apical bud evaluation of clones belonging to hybrids in Kazova and Artova locations

Combination	Number of plant	Average eye depth	Meaning	Average apical buds depth	Meaning
Kazova					
1	273	1.02	shallow eye	1.10	shallow apical bud
2	349	1.20	shallow eye	1.10	shallow apical bud
3	506	0.90	very shallow eye	0.90	protruding bud
4	615	0.98	very shallow eye	1.03	shallow apical bud
5	468	1.01	shallow eye	1.11	shallow apical bud
6	265	1.05	shallow eye	1.04	shallow apical bud
Total	2 476	1.02	shallow eye	1.04	shallow apical bud
Artova					
1	172	0.66	shallow eye	0.60	protruding bud
2	313	0.65	shallow eye	0.67	protruding bud
3	316	0.73	shallow eye	0.64	protruding bud
4	489	0.86	shallow eye	0.84	protruding bud
5	332	0.76	shallow eye	0.68	protruding bud
6	96	0.71	shallow eye	0.68	protruding bud
Total	1 718	0.72	shallow eye	0.68	protruding bud
1=Slaney x T5/4, 2= Başçiflik Beyazı x Lady Olympia, 3=A3/15 x Bafana, 4=Başçiflik Beyazı x Slaney, 5=T5/4 x Marfona, 6= T5/4 x Bafana					

3.8. Skin Smoothness

Skin smoothness in tubers of each clone selected after the harvest was determined according to a scale of 3-7 (3 = Smooth, 5 = Medium, 7 = Rough). Tubers belonging to all clones in Kazova location were examined in terms of skin roughness and 43.7% were found to be smooth, 52.2% medium, and 4.1% rough. In Artova location, 43.3% of the examined clones showed smooth, 52.6% medium and 4.1% rough skin characteristics (Table 9). Skin smoothness is a very important feature in terms of marketability. Although it is determined by the senses of sight and touch, it gives an important idea and is evaluated together with other characteristics. Moreover, it is considered in selection as a characteristic that directly affects the tuber mass quality.

Table 9 Skin roughness values of tubers of hybrids in Kazova and Artova locations (number)

Combination	Number of plant	Smooth (1-2)	%	Medium (3-4)	%	Rough (5)	%
Kazova							
1	273	120	43.8	137	50.4	16	5.8
2	349	164	47.0	158	45.3	27	7.7
3	506	274	54.2	222	43.9	10	2.0
4	615	182	29.6	413	67.2	20	3.3
5	468	245	52.4	211	45.1	12	2.6
6	265	98	37.0	150	56.6	17	6.4
Total	2 477	1 083	-	1 292	-	102	-
Average	-	-	43.7	-	52.2	-	4.1
Artova							
1	172	65	37.8	107	62.2	0	0
2	313	164	52.4	123	39.3	26	8.3
3	316	147	46.5	161	50.9	8	2.5
4	490	163	33.3	318	64.9	9	1.8
5	332	163	49.1	150	45.2	19	5.7
6	96	43	44.8	45	46.9	8	8.3
Total	1 719	745	-	904	-	70	
Average	-	-	43.3	-	52.6	-	4.1

1=Slaney x T5/4, 2= Başçiflik Beyazı x Lady Olympia, 3=A3/15 x Bafana, 4=Başçiflik Beyazı x Slaney, 5=T5/4 x Marfona, 6= T5/4 x Bafana

3.9. Skin and Tuber Flesh Color

After the harvest, the skin and tuber flesh colors of each clone were macroscopically determined. Skin and tuber flesh color is a very important feature in terms of marketability. When the skin colors of tubers belonging to 2477 clones in Kazova location were examined, it was observed that 855 of them (34.5%) were found to be light yellow, 738 (29.8%) were yellow, 869 (35.1%) were dark yellow, and 15 (0.6%) were red spotted (Table 10). Besides, it was determined that 34.6% of the 1719 clones examined in the Artova location had light yellow, 34.1% yellow, 30.2% dark yellow and 1.2% of the clones had red-spotted skin color (Table 10).

As a result of the observations made on the tubers of 2477 clones in Kazova, it was determined that 988 of the clones had light yellow flesh color, while 677 yellow, 279 dark yellow, 341 cream and 192 of them had white flesh color (Table 11). Of the 1719 clones observed in Artova location, 39.2% were found to have light yellow, 28.5% yellow, 10.8% dark yellow, 13.5% cream and 8.1% of them had white flesh color (Table 11). Although tuber flesh color formation is affected by environmental

factors related to pigment formation and density, it attracts attention as a feature with high heritability. When examined from this aspect, no elimination process was done among the clones in terms of flesh color. This characteristic should be examined together with other quality characteristics in future generations in selection. Flesh color preference varies according to the intended use. In some cases, varieties with tubers that have quite white flesh color, and in some cases quite yellow, are preferred. Therefore, while classifying the tubers belonging to clones in terms of flesh color in the present study, it was aimed to produce information about the current variation in terms of the flesh color of the tuber.

Table 10 Tuber skin color of hybrids belonging to clones in Kazova and Artova locations (number)

Combination	Number of plant	Light yellow	%	Yellow	%	Dark Yellow	%	Red spotted	%
Kazova									
1	274	120	43.8	50	18.2	101	36.9	3	1.1
2	349	120	34.4	65	18.6	157	45.0	7	2.0
3	506	205	40.5	176	34.8	124	24.5	1	0.2
4	615	171	27.8	203	33.0	238	38.7	3	0.5
5	468	144	30.8	198	42.3	126	26.9	0	0
6	265	95	35.8	46	17.4	123	46.4	1	0.4
Total	2 477	855	-	738	-	869	-	15	-
Average	-	-	34.5	-	29.8	-	35.1	-	0.6
Artova									
1	172	83	48.3	38	22.1	50	29.1	1	0.6
2	313	117	37.4	73	23.3	109	34.8	14	4.5
3	316	135	42.7	125	39.6	56	17.7	0	0
4	490	127	25.9	180	36.7	179	36.5	4	0.8
5	332	99	29.8	144	43.4	89	26.8	0	0
6	96	33	34.4	26	27.1	36	37.5	1	1.0
Total	1 719	594	-	586	-	519	-	20	-
Average	-	-	34.6	-	34.1	-	30.2	-	1.2
1=Slaney x T5/4, 2= Başçiflik Beyazı x Lady Olympia, 3=A3/15 x Bafana, 4=Başçiflik Beyazı x Slaney, 5=T5/4 x Marfona, 6= T5/4 x Bafana									

Table 11 Tuber flesh color of hybrids belonging to clones in Kazova and Artova locations (number)

Combination	Number of plant	Light yellow	%	Yellow	%	Dark yellow	%	Cream	%	White	%
Kazova											
1	274	150	55	49	18	24	9	39	14	12	4
2	349	172	49	87	25	45	13	17	5	28	8
3	506	166	33	235	46	78	15	27	5	0	0
4	615	164	27	40	7	60	10	214	35	137	22
5	468	251	54	161	34	3	1	39	8	14	3
6	265	85	32	105	40	69	26	5	2	1	0.4
Total	2 477	988	-	677	-	279	-	341	-	192	-
Average	-	-	40	-	27	-	11	-	14	-	8
Artova											
1	172	88	51	46	27	8	5	25	15	5	3
2	313	133	43	108	35	46	15	9	3	17	5
3	316	125	40	129	41	45	14	16	5	1	0.3
4	490	139	28	32	7	54	11	159	32	106	21
5	332	165	50	124	37	11	3	22	7	10	3
6	96	23	24	51	53	21	22	1	1	0	0
Total	1 719	673	-	490	-	185	-	232	-	139	-
Average	-	-	39	-	29	-	11	-	14	-	8

1=Slaney x T5/4, 2= Başçiflik Beyazı x Lady Olympia, 3=A3/15 x Bafana, 4=Başçiflik Beyazı x Slaney, 5=T5/4 x Marfona, 6= T5/4 x Bafana

4. CONCLUSION

It was determined that the clones selected from the six combinations had 40% light yellow, 30.3% yellow, 10.3% dark yellow, 12% cream and 7.4% white tuber flesh color. According to the maturity groups, 2.3% were very early-maturing, 15.9% were early-maturing, 32% were mid-early-maturing, 29.7% were late-maturing, and 20.1% were very late-maturing. While the mean of tuber weight was 11-307 g, tuber yield per hill was 17-2879 g, a number of tubers per hill was 1-38, eye depth was 0.14-3.76 mm (very superficial-very deep), apical bud depth was 0.11-5.33 mm (protruding to very deep). In order to be evaluated in the second clonal generation stage, 103 clones from Slaney x T5 / 4 combination, 147 clones from Başçiftlik Beyazı x Lady Olympia, 200 clones from A3 / 15 x Bafana, 157 clones from Başçiftlik Beyazı x Slaney, 231 clones from T5 / 4 x Marfona, and 80 clones from T5 / 4 x Bafana were selected. As a result of selection in the first clonal generation stage, 918 clones were transferred to the second clonal generation stage. As a matter of fact, this number corresponds to 27.7% of the total material. Therefore, a selection intensity was 72.3%. Of the clones selected locations with different ecological conditions, 772 of them were selected from the Kazova location, while 146 were selected from the Artova location, besides, there were 45 clones selected from both locations.

SIMILARTY RATE: %2

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