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TESTING OF POTATO CULTIVARS IN THE TIRANA REGION CONDITIONS

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The potato is a very important crop in Albania and the cultivation of new cultivars with high productivity and better quality is very significant. This study was conducted to test some imported cultivars of potato and explore some features in their characterization and evaluation, with the aim of increasing interest in those that are the best for Albanian farmers, as well as for other studies. Thirteen potato cultivars of foreign origin were tested in a field trial for their morphological and agronomical characteristics under the climatic conditions of the Tirana region. It was found that among the potato cultivars studied there is a significant variation, both in the characterization traits (qualitative traits) and in the evaluation traits (quantitative traits). Drawing on the conclusions reached, we recommend the most suitable cultivars for cultivation in this region.

Keywords: cultivars, quality, potato, testing, variation

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Krumpir je u Albaniji vrlo važan usjev te je kultiviranje novih kultivara s visokom produktivnošću i boljom kvalitetom vrlo značajno. Ovo istraživanje je provedeno da bi se testiralo uvezene kultivare krumpira te da bi se istražila njihova svojstva za daljnju evaluaciju, s ciljem promoviranja onih kultivara koji bi bili najbolji za albanske seljake, i za druga istraživanja. Na pokusnoj plohi u klimatskim uvjetima Tiranske regije testitane su morfološke i agronomske osobine 13 kultivara krumpira uvoznog porijekla. Utvrđeno je da među testiranim kultivarima postoje značajne varijacije, kako u kvalitativnim, tako i u kvantitativnim osobinama. Slijedom dobivenih zaključaka, donosimo preporuke za kultivara najpogodnijih za uzgoj u ovoj regiji.

Ključne riječi: kultivari, kvaliteta, krumpir, testiranje, varijacije

INTRODUCTION

The potato (*Solanum tuberosum* L.) is an important crop and it has good nutritional value. It is ranked the 3rd crop in terms of total production, with over 365 million tons per year (FAO, 2013), after rice and wheat (Virupaksh *et al*., 2016).

It remains an essential crop in Europe, especially in Northern and Eastern Europe, where per capita production is still the highest in the world, while the most rapid expansion in production over the past few decades has occurred in southern and eastern Asia, with China and India leading the world in overall production as of 2018 (Anon., 2023).

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Apart from the 5,000 cultivated varieties, there are about 200 wild species and subspecies, many of which can be cross-bred with cultivated varieties. The major species grown worldwide is *Solanum tuberosum* (a tetraploid with 48 chromosomes), and modern varieties of this species are the most widely cultivated (Anon., 2023).

Cultivar selection is very important for growers trying to market quality products. Estévez *et al*. (1982) studied the factors affecting tuber yield in potato cultivars. They observed that the number of tubers per plant, average tuber weight and plant height were most closely related to tuber yield (Mohammadi *et al*., 2010).

Individuals of a population, even though they have the same genetic factors, when cultivated in different environmental conditions, give different phenotypes (Xhuveli & Salillari, 1984).

The environmental conditions of the cultivated potato are various and for this reason it is necessary for different varieties to be cultivated sustainably in different agroclimate conditions. Use of the new varieties has a special role in that task. Since 1992 imported potato seeds have been introduced in Albania (Mecollari *et al*., 2002).

The production of the potato is increased using new varieties more suitable in the different regions (Elezi, 2013).

During the field testing we identified the planting period for each new variety (Salceni *et al*., 2000). The observations carried out indicated that the same cultivars have a 3-4 days longer vegetative period in the Korca than in the Tirana region (Elezi & Mecollari, 2001). The goal of the study is to test and investigate the productivity potential of different varieties and to identify which variety to choose for best adaptation to the climatic and soil conditions of the farms where it will be cultivated (Rusinovci *et al*., 2001). One of the main reasons for low potato yields is the planting of unsuitable varieties (Kaciu & Salceni, 2001). The improvement of the varietal structure with new varieties necessarily requires their preliminary study in field, which includes testing trials in different areas (Bardhi *et al*., 2007). The potato cultivars planted in Albania are valued for early ripening with the aim of ensuring production for export as well as for the purpose of use, for fresh consumption or for industry (Mecollari *et al*., 2002).

Materials and methods

The study was conducted during 2019 at the experimental base of the Plant Genetic Resources Institute, near the Agricultural University of Tirana, in Valias (19°43'59.90"E; 41°24'04.30"N; altitude 39 m). We studied 13 imported potato cultivars with the following numbers: Gala (CV1), Maima (CV2), Blondine (CV3), Fokus (CV4), Universa (CV5), Alaska (CV6), Groky (CV7), Grescenda (CV8), Estrella (CV9), Spectra (CV10), Fanisango (CV11), Daunia (CV12), Kenzia (CV13).

The field trial was set up according to randomized block designs, with three replications. Each variant was raised in an area of 6.3 m^2 for each replication, being represented by 3 rows of 10 plants each. Planting was done in furrows at 70 cm between rows and 30 cm between plants, providing 47,600 plants/ha. Planting was done in March. Potato agrotechnical services were performed, depending on the concrete conditions. Field observations were made, and plant growth and development stages were recorded, as well as data on plant height, number of stems per plant, number of tubers per plant, size and quality of tubers, shape and color were recorded of the tuber.

Study data (mean values) were subjected to analysis of variance using ANOVA. Correlation coefficients were grouped according to the classes: r = ± 0.3 weak correlation; r = ± 0.3 to ± 0.5 medium correlation relation; r = ± 0.5 to ± 0.7 good correlation and r = ± 0.7 to ± 0.9 strong correlation (Xhuveli & Salillari, 1984).

Results and discussion

Germination of the cultivars in the study occurred 13–17 days after sowing (Tab. 1). Differences among the cultivars in the study were observed for the germination–flowering period. Thus, for example, the average period for all 13 cultivars was 61.3 days , while the minimum and maximum periods were 51 days (Grescenda) and 72 days (Gala); two cultivars (Blondine and Spectra) had a period of 55 days, etc. Cultivars also differed in the germination–maturity period. Thus, for example, cultivars Blondine and Grescenda had the shortest period (75 days), while cultivar Gala had the longest period 1 (92 days), two cultivars (Estrella and Fanisango) had a germination–maturity period of 88 days, etc., from 81.8 days, which was the average period for all genotypes under study (Tab. 1).

The fact that, at a quick glance, the potato accessions in the study varied in those morphological characteristics that were examined, shows that we are dealing with different potato cultivars. For flower color, potato cultivars are divided into two groups, 9 cultivars (69.2%) formed white flowers (code 1) and 4 cultivars (30.8%) had light purple flowers (code 6). Similarly, for the color of the tuber skin, the accessions were divided into two groups; from 13 cultivars 10 (76.9%) had white–creamy tuber skin (code 1) and only 3 cultivars (23.1%) had yellow skin (code 2) (Tab. 2). Although for the color of the tuber flesh the cultivars were divided into two groups, the variation for this trait was weak; 12 cultivars (92.3%) had yellow flesh (code 4), one cultivar had yellow–creamy flesh (code 3).

Tab. 1. Planting, germination and periods of growth and development of cultivars.

Cultivars	Planting–germination	Germination–flowering	Germination–maturity	Planting–maturity
Gala	14	72	92	106
Maima	17	68	86	103
Blondine	16	55	75	92
Fokus	14	66	78	93
Universa	16	67	86	102
Alaska	14	69	83	97
Groky	17	66	85	102
Grescenda	13	51	75	88
Estrella	15	58	88	103
Spectra	13	55	78	91
Fanisango	15	58	88	103
Daunia	13	56	81	94
Kenzia	13	56	81	94
Average	13.7	61.3	81.8	95.5

For tuber shape, potato cultivars were divided into three groups: 3 cultivars (23.1%) had round tubers (code 2), 2 cultivars (15.4%) had ovate tubers (code 3) and 8 cultivars (61.5%) had reverse obovate tubers, code 4 (Tab. 2).

The use value of potato tubers was also evaluated. Although the use value is subjective, the study showed that there is variation among the 13 potato cultivars. According to this assessment, potato cultivars are divided into three groups; for example, "Very good for baking and boiling" was one cultivar (Gala); 9 cultivars (Maima, Blondine, Fokus, Groky, Grescenda, Estrella, Fanisango, Daunia and Kenzia) were rated as "Good for baking and boiling" and three cultivars (Universa, Alaska and Spectra) were rated as "Very good for baking, frying and boiling".

The identification and recognition of the morphological characteristics of various genotypes are important mainly for the identification and recognition of genotypes in order to distinguish them from one another.

We examined and analyzed the quantitative traits to find the possibility of choosing the most suitable genotype (cultivar) for cultivation, with the highest production and the best quality indicators, which is in the interest of not only the grower (or the farmer) but also of the consumer.

Initially, the study data were subjected to analysis of variance through the ANOVA. From the variance analysis for genotypic differences, it was found that among the potato cultivars the differences for all quantitative traits among them were statistically significant at the $P<0.01$ level, while for the replications there were differences only in tuber weight, at the $P<0.05$ level (Tab. 3).

Tab. 2. Some morphological characteristics and value of potato cultivars.

Cultivars	Flower and tuber color			Tuber shape	Use value
	Flower	Tuber			
		Skin	Flesh		
Gala	White	White–creamy	Yellow	2	Very good for baking and boiling
Maima	White	Yellow	Yellow	4	Good for baking and boiling
Blondine	White	Yellow	Yellow	2	Good for baking and boiling
Fokus	White	White–creamy	Yellow	4	Good for baking and boiling
Universa	White	White–creamy	Yellow	4	Very good for baking, frying and boiling
Alaska	White	White–creamy	Yellow	4	Very good for baking, frying and boiling
Groky	White	White–creamy	Yellow-cream	4	Good for baking and boiling
Grescenda	Light purple	White–creamy	Yellow	4	Good for baking and boiling
Estrella	Light purple	White–creamy	Yellow	4	Good for baking and boiling
Spectra	Light purple	Yellow	Yellow	4	Very good for baking, frying and boiling
Fanisango	White	White–creamy	Yellow	3	Good for baking and boiling
Daunia	White	White–creamy	Yellow	3	Good for baking and boiling
Kenzia	Light purple	White–creamy	Yellow	2	Good for baking and boiling

Tab. 3. Analysis of variance data for potato traits.

Source of variation	df	F factual					
		Plant height (cm)	Primary Stem/plant	Tuber Set/ Hill	Tubers/ stem	Tuber weight	Productivity (kv/ha)
Cultivars	12	212,380858**	98,996904**	26,595636**	174,500264**	3279,575052**	12,498258**
Replication	2	2,952756	0,2	1,0	0,17	5,333897*	0,3

** - P≤0.01; * - P≤0.05

Based on the analysis of variance, we continue with the examination of the data according to the cultivars for the six quantitative traits.

For the height of the plant, the study showed that there were significant differences between the potato cultivars (Tab. 4, Fig. 1). Thus, for example, out of 69.4 cm which was the average plant height for all 13 potato cultivars, the shortest plant was 45.3 cm in cultivar Maima, followed by cultivar Fokus by 48.0 cm, etc. Cultivars with the tallest plants were Fanisango and Estrella at 102.7 and 88.3 cm, respectively.

Potato cultivars also differed in the number of primary stems per plant. For example, of the 4.1 stems per plant that was the average of all cultivars, the lowest number was in cultivars Blondine, Fokus, etc., with 2.9 and 3.2 stems per plant respectively, while the largest number was in Grescenda with 5.5 stems, Kenzia with 5.2 stems and Spectra with 5.0 stems, etc. (Tab. 4, Fig. 2). Even for the number of tubers per plant there was significant variation among cultivars. From 17.7 which was the average number of tubers per plant, the smallest number was 11.0 in cultivar Gala, 12.3 to Universa, while the largest number was 25.2 tubers per plant in Spectra, followed by Estrella with 20.3 tubers and Kenzia with 19.7 tubers per plant (Tab. 4, Fig. 3). The number of tubers that the plant gives also depends on the number of stems that it forms and develops. Even for this trait, the potato cultivars had a significant variation. For example, from 4.2 tubers which was the average number, their smallest number was 2.9 tubers in cultivar Gala, while the largest number was 5.0 in cultivars Blondine and Spectra, followed by cultivar Estrella with 4.9 tubers per plant stem (Tab. 4, Fig. 4).

The power of the tuber developing plant is expressed in the number of tubers that it sets and in the size of the tubers. The study data show that the average tuber weight was very different in different cultivars. Thus, out of 155.2 g which was the average tuber weight for all cultivars, 3 cultivars (Spectra, Kenzia and Estrella) had tubers weighing less, 123.2, 124.2 and 124.8 g. Cultivar Alaska had the tuber with the largest weight, with the average weight of 201.8 g, i.e. 1.6 times greater than the minimum weight (123.2 g), followed by cultivar Gala with the average weight of the tuber 192.2 g (Tab. 4, Fig. 5).

The study also evaluated the distribution of production (in %) according to the size of the tuber; this indicator helps to evaluate the production rate for the market, removing the small tubers that are part of the production but have no commercial value, even though they can be used for other purposes. In general, among the potato cultivars under study, the small tubers are in a small percentage; however, even for this indicator there are differences between them (Tab. 5). For example, in 4 cultivars (Gala, Maima, Fokus and Alaska) small tubers account for less than 2 percent of the harvested production. But there are also cultivars that have more small tubers in their producti-

on, such as cultivars Groky and Fanisango in which small tubers make up 6.0 percent of production, while the largest percentage of these tubers was 21.0 percent in cultivar Grescenda, followed by cultivars Estrella and Kenzia in which these tubers constitute respectively 11.1 and 10.4 percent of the total production.

The position occupied by medium-sized tubers, which may be most desired by the consumer, varied widely among the potato cultivars studied. Thus, in cultivar Kenzia these tubers make up 83.1 percent of production, followed by cultivars Estrella with 63.2 percent and cultivar Daunia with 61.5 percent, etc. Cultivar Alaska has the lowest percentage of these tubers with 14.74 percent and Gala with 15.53 percent. According to large tubers cultivars Alaska and Gala have the highest percentage of these tubers, respectively with 83.13 and 83.00 percent.

Tab. 4. Quantitative trait data of potato cultivars.

Cultivars	Quantitative trait values				
	Plant Height (cm)	Primary Stem per plant	Tuber Set per hill	Tubers per Stem	Tuber weight (g)
Gala	65,4im	3,7fh	11,0eg	2,9lp	192,2fh
Maima	45,3ns	4,7cd	17,1de	3,6il	134,7
Blondine	54,9lp	2,9hk	15,4df	5,0de	161,1v~
Fokus	48,0nr	3,2gj	13,3ef	4,0gj	185,6il
Universa	73,5gj	3,4gi	12,3eg	3,5jm	173,5pu
Alaska	66,4il	4,6cd	14,7df	3,2kn	201,8a
Groky	74,7gj	3,4gi	14,1ef	4,0gj	162,3 v}
Grescenda	77,0gi	5,5a	32,4a	5,8a	150,5 ł†
Estrella	88,3de	4,1ef	20,3cd	4,9de	124,8
Spectra	69,1ik	5,0bc	25,2bc	5,0de	123,2
Fanisango	102,7a	3,6fh	16,1de	4,5fh	144,5
Daunia	70,6hk	4,3de	18,6de	4,3fh	138,7
Kenzia	66,7il	5,2ab	19,7cd	3,4jm	124,2
Average	69,4	4,1	17,7	4,2	155,2
D_{01}	4,2 cm	0,3	4,5	0,26	1,9 g
D_{05}	3,1 cm	0,2	3,3	0,19	1,4 g

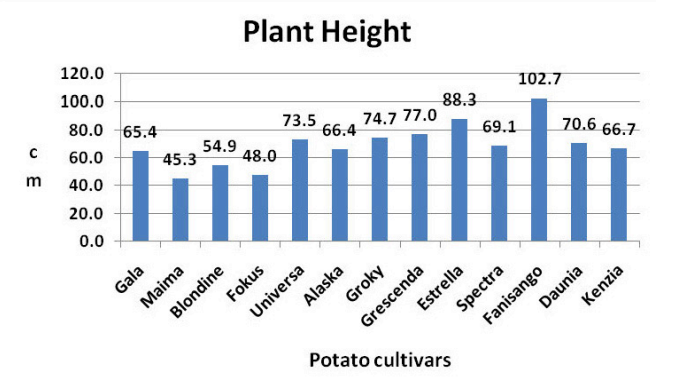

Fig. 1. Plant height of potato cultivars

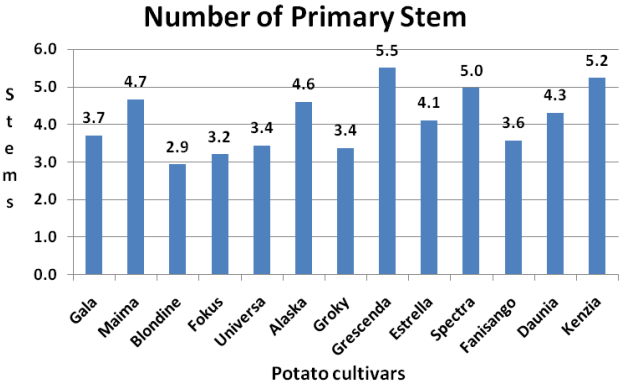

Fig. 2. Number of stems per plant of potato cultivars

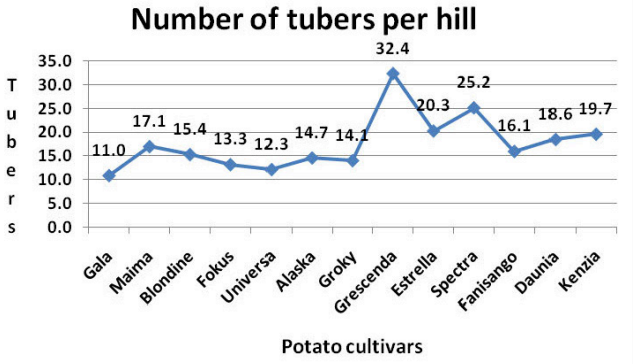

Fig. 3. Number tubers per hill of potato cultivars

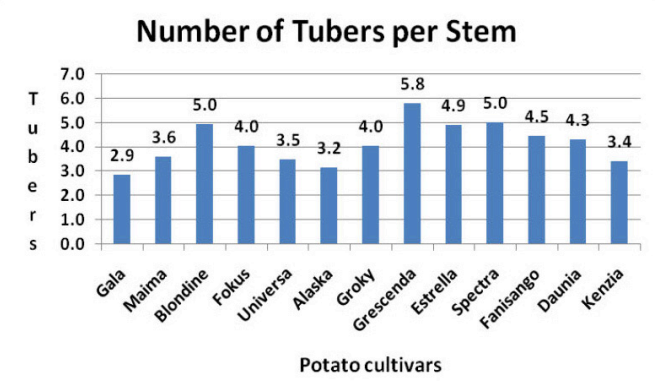

Fig. 4. Number of tubers per primary stem of potato cultivars

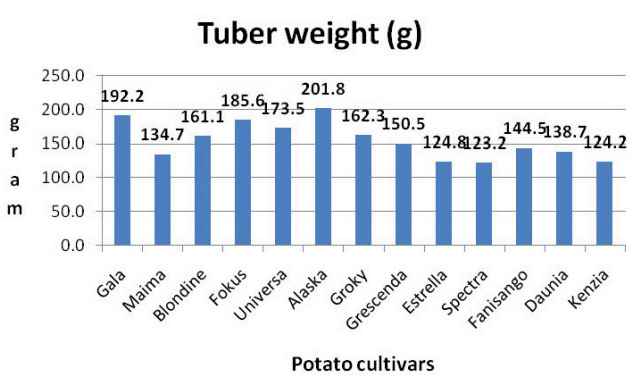

Fig. 5. Tuber weight of potato cultivars

Tab. 5. Production frequency by tuber size, in percent

Accessions	Production by tuber size groups, in %		
	Small	Medium	Large
Gala	1,47	15,53	83,00
Maima	1,54	41,31	57,15
Blondine	2,28	33,89	63,83
Fokus	1,96	27,62	70,42
Universa	1,63	31,59	66,76
Alaska	2,13	14,74	83,13
Groky	6,00	21,07	72,93
Grescenda	21,0	40,10	38,90
Estrella	11,1	63,20	25,70
Spectra	3,60	54,60	41,80
Fanisango	6,00	51,30	42,70
Daunia	3,50	61,50	35,00
Kenzia	10,4	83,10	6,50

Of course, the final goal of cultivating agricultural crops, including potatoes, is the yield of the cultivar. Every potato grower would prefer to choose for cultivation the cultivar that gives the highest yield and the best quality of production. It is in this perspective that we should examine the data of the study of 13 potato cultivars. Based on these data (Tab. 6; Fig. 6) we can see that all cultivars have generally given high yields. However, although cultivars generally show higher production capacities in experimental trials than in large–scale production conditions, there are notable differences in actual production. Thus, for example, the first group for the highest yield, based on D_{01}, includes the two cultivars Alaska and Fokus with respectively 1,045.5 kv/ha and 890.4 sq/ha. Six cultivars (Blondine, Spectra, Kenzia, Groky, Universa and Maima) belong to the second group for yield level, respectively with yields of 757.9 kv/ha, 749.3 kv/ha, 708.5 kv/ha, 695.2 kv/ha, 667.7 kv/ha and 667.2 kv/ha; cultivar Estrella gave the lowest yield which was 344.7 kv/ha.

Tab. 6. Productivity of potato cultivars, kv/ha.

Accessions	Productivity			
	Productivity by repetition			Average Productivity
	I	II	III	
Gala	592,7	639,7	595,2	609,2cd
Maima	654,0	673,0	674,6	667,2bc
Blondine	708,0	830,1	735,6	757,9bc
Fokus	895,2	854,0	922,0	890,4ab
Universa	671,4	646,0	685,7	667,7bc
Alaska	1036,5	977,8	1122,2	1045,5a
Groky	709,5	685,7	690,5	695,2bc
Grescenda	658,7	695,2	638,0	664,0c
Estrella	507,9	482,5	43,8	344,7df
Spectra	747,6	733,3	767,0	749,3bc
Fanisango	458,7	479,4	533,3	490,5cd
Daunia	669,8	641,3	611,1	640,7c
Kenzia	711,1	676,2	738,1	708,5bc
Average productivity of all cultivars				687,0
D_{01}				189,6
D_{05}				139,9

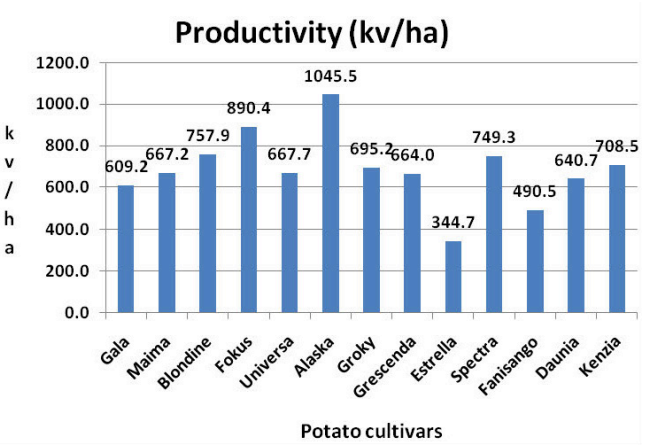

Fig. 5. Tuber weight of potato cultivars

From the data of correlation coefficients there are 3 positive correlations. Two correlations: the number of primary stems per plant with the number of tubers per plant (r_{23}=0.76**) and the number of tubers per plant with the number of tubers per primary stem (r_{34}=0.76**) were strong and validated at the P< 0.01, while the relationship between productivity and tuber weight (r_{56}=0.57*) is a good correlation and confirmed at the P< 0.05 level. It seems that the correlations found in this study are reliable because cultivars Alaska (1,045.5 kv/ha) and Fokus (890.4 kv/ha) had good and very good values for the number of primary stems per plant, the number of tubers per primary stem and per plant. Therefore, rapid field evaluation of potato cultivars for production even relying on the number of primary stems per plant can be effective.

CONCLUSIONS

We can conclude that the 13 potato cultivars included in the study showed distinct variations in all morphological characteristics and quantitative traits.

For plant height the 13 potato cultivars showed good variation: 69.4 cm was the average height, while the extreme values were 45.3 cm and 102.7 cm;

For the number of primary stems per plant, 4.1 was the general average, and the smallest and largest numbers were, respectively, 2.9 and 5.5 primary stems per plant;

For the number of tubers per plant, 17.7 was the overall average, while the lowest number was 11.0 tubers and the highest number was 25.2 tubers;

The average number of tubers per primary stems was 4.2, while the smallest and largest numbers were 2.9 and 5.0 tubers per stem, respectively.

The weights of the tubers varied widely:155.2 g/tuber was the average weight, while largest tuber was 201.8 g and the smallest 123.2 g;

Even for the ratio of tuber sizes to total production there was wide variation. Medium tubers accounted for 83.1 percent of production to 14.74 percent of total production;

Although productivity data were generally high, the best cultivars in productivity were Alaska (1,045.5 kv/ha) and Fokus (890.4 kv/ha). The lowest productivity was 344.7 kv/ha (Estrella);

The variation among cultivars may be important for potato genetic improvement.

According to the study data, the highest yield for the conditions of Tirana was given by cultivar Alaska followed by cultivar Fokus.

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REFERENCES

Anon, 2023: Wikipedia History of the potato (https://tinyurl.com/58dyuajj) (Accessed in 2023).

Bardhi, N., Salceni, A., Subashi, Y. & Borici, Xh., 2007. Studimi krahasues i disa varieteteve te patates ne Bazen Eksperimentale te IPP Tirane. Agricultural University of Tirana. Revista Shqiptare e Shkencave Bujqesore 6 (9), 10-14.

FAO, 2013. Food and Agriculture Organization of the United Nations.

Elezi, F. & Meçollari, E., 2001: Testing some potato cultivars. Bulletin of Agricultural Sciences 1, 49-56.

Elezi F., 2013: The productivity analysis of some potato varieties in the agro ecological conditions in Albania. IXth International Symposium, Biodiversity Conservation and Sustainable use for Rural Development. Tirana, November 27, 2013. BLEKALB Foundation, ISBN: 9789928407092, 180-183.

Estévez, M.P., Orús, M.I. & Vicente, C., 1982: Desfoliación de *Quercus rotundifolia* inducida por *Evernia prunastri* en condiciones naturales y simuladas. In: Estudios sobre Biologia. Libro homenaje al Profesor D. Florencio Bustinza Lachiondo, pp. 117–131, Vicente. C., Municio, A.M., coord Editorial de la Universidad Complutense, Madrid

Kaciu, S. & Salceni, A., 2001: Krahasimi zonal i kultivareve te patates ne disa rajone te Kosoves. 13. Buletini i Shkencave Bujqesore, 2/2001, p.63- 68. Tirane.

Mecollari, E., Salceni A. & Selaci, F., 2002: Patatja. IFDC.

Mecollari, E. & Selaci, F., 2003: Prodhimi i fares se patates.

Mohammadi, J., Khasmakhi-Sabet, S.A., Olfati, J.A., Dadashpour, A., Lamei, J. & Salehi, B., 2010: Comparative Studies of Some New Potato Cultivars and Their Morphological Characteristics. https://www.biotech-asia.org/?p=8935

Rusinovci, I., Salillari, A., Pudja, A. & Gjet, Z., 2001: Pataja dhe kultivimi i saj. Prishtine, Kosove.

Salceni, A., Teneqexhi, K. & Binishi, P., 2000: Studimi krahasues i kultivareve te patates ne kushtet e rrethit te Pogrdecit. Buletini i Shkencave Bujqesore 3/2000 p. 51-56.

Virupaksh P., Sundaresha, S., Prashant, G. K. & Vinay B., 2016: Biology of *Solanum tuberosum*. (Potato). Ministry of Environment, Forest and Climate Change (MoEF&CC) and Central Potato Research Instutute, Shimla and UNEP/GEF Supported Phase II Capacity Building Project on Biosafety.

Xhuveli, L. & Salillari, A., 1984: Basics of scientific experimentation in agriculture, f.68; 75. Tiranë.