

Study of growth, development and yield dynamics of eggplant varieties samples

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Abstract: This article presents the results of the scientific-research work carried out on the study of morphobiologically valuable farm signs and productivity of eggplant varieties and hybrids in the Southern region of Uzbekistan. In the experiments, 55 varieties of eggplant samples from the World Collection served as research objects. Among the studied variety samples, 9 samples originated from Japan, 8 from Russia, 4 from the Netherlands and 4 from India, 3 from the USA, France and Nepal, 2 from Armenia, Afghanistan, North Korea and one sample from Uzbekistan, Italy, Bulgaria, Azerbaijan, Spain, Georgia, Germany, Iran, Moldova, Australia and Hungary. In the conditions of the market economy, the earlier the vegetable crop is harvested, the more expensive it is sold. Taking into account this situation, information is given about the study of the dynamics of yielding of eggplant varieties and the results.

1 Introduction

Eggplant (*Solanum melongena* L.) exhibits significant morphological diversity, offering potential for crop improvement through hybridization and selection. Studies have examined various traits including plant growth habits, stem pigmentation, leaf characteristics, flowering patterns, and fruit attributes [1]. Eggplant exhibits significant morphological and genetic diversity, particularly in regions like Turkey and Spain, which are considered secondary centers of diversity [2]. Hybrids between local varieties have shown promising yields, often comparable to commercial hybrids, with heterosis for yield averaging 86.2% [3]. The wide regional variations observed in plant, flower, and fruit descriptors indicate ample scope for yield improvement through selective breeding [4].

Recent studies have explored the phenotypic characterization of eggplant (*Solanum melongena*), its wild relatives, and interspecific hybrids to identify potential traits for breeding programs. Researchers have utilized both conventional morphological descriptors and advanced phenomics tools to assess various traits [5]. Wild species exhibited greater variability than cultivated accessions, while interspecific hybrids showed intermediate characteristics [6]. Principal component analysis revealed distinct groupings among cultivated eggplants, wild relatives, and hybrids [7]. These studies identified promising

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wild species and hybrids for introgression breeding, potentially enhancing eggplant's genetic diversity and climate change adaptation [8]. Additionally, research on Sicilian eggplant ecotypes demonstrated variability in morphological, phenological, and production traits, with some ecotypes outperforming commercial varieties in yield and fruit quality [9]. These findings highlight the importance of characterizing genetic resources for eggplant improvement.

Studies have revealed considerable variation in fruit traits, plant characteristics, and yield components among different eggplant populations and varieties [10]. Commercial F1 hybrids, while productive, show reduced morphological and molecular diversity compared to landraces and old varieties. This limited genetic base in commercial varieties highlights the importance of conserving and utilizing diverse germplasm for breeding programs. Incorporating landraces and traditional cultivars into breeding efforts could broaden the gene pool, potentially increasing heterosis in F1 hybrids. Morphological and molecular characterization of eggplant populations provides valuable information for conservation strategies and the development of new varieties with improved traits.

In the cultivation of vegetable crops, the choice of high-yielding varieties suitable for soil and climate conditions, the timely and consistent implementation of all necessary technological measures, proper feeding, taking into account the biological characteristics of the plant, and the selection of predecessor crops that are convenient for them are the guarantee of a high yield.

Soil-climatic conditions of the research area. Field experiments in the fields of Kashkadarya Scientific Experimental Station of the Research Institute of Vegetable, Melon crops and Potato, Kitob District, Kashkadarya Region, production trials and implementation. A scientifically based experiment was carried out on the development of some elements of the technology of selection of varieties and hybrids of eggplant.

The field of experiments and the introduced land area consists of grassy gray soils, and seepage water is located at a depth of 4.5 m. The soil is not saline. Meadow gray soils differ from automorphic gray soils by some of their properties, including stronger biological circulation of substances, the thickness of the humus layer, and a greater amount of humus.

Since the eggplant plant is a heat-loving crop, its seedlings were planted in the open field from the second half of April in Kitab district of Kashkadarya region.

2 Methods of conducting experiments

Phenological observations: time of seed sowing, initial (10%) and final (75%) grass emergence, flowering, time of planting in the open field, initial (10%) and final (75%) flowering, initial (10%) and final (75%) the emergence of buds, initial and final fruit technicalization, first and last fruit picking days were recorded.

From sowing to the appearance of sprouts, from sprouting to flowering, from sprouting to technical maturity, from sprouting to technical maturity, from sprouting to biological maturity, the yielding period is the period between the phases.

The rate of ripening of fruits was compared with the standard. The speed of ripening of the samples was recorded in the field notebook as follows: germination - first harvest: up to 120 days - early, 120 - 140 days medium, more than 140 days late.

Number of seedlings: counted twice 10 days after planting and before harvesting the first crop. The number of planted seedlings was compared with the number of seedlings caught.

Determining the yield and its marketability: the amount of the harvested fruit from 10 plants in the technical phase of each sample was weighed and then counted.

The weight (kg) of one fruit is divided by the number of fruits. Then, the yield from the whole plant was weighed. The total yield was determined to 0.01 kg, the commodity (kg

and pieces), unproductive harvest (kg), diseased and injured ones (kg) were weighed separately.

Then the amount of the commodity crop was determined as a percentage. The yield from one plant in 15 days and the yield obtained during the entire growing season were compared with the standard variety in percentage.

Research results. As a result of our initial study of 55 varieties and hybrids of eggplant from the world collection in 2022-2023, the most promising varieties were selected. They were studied for their suitability for rapid yielding and given a comprehensive assessment.

Seedlings of Standard Aurora and Erevansky - 3 varieties, sorghum germinated 16 days after sowing. The total germination time of all the variety samples was 14.7 days on average. Seedling germination of most cultivars studied was close to that of the standard cultivars.

It took 98 days for the standard Aurora variety from germination to flowering, while 92 days were enough for the Yerevansky-3 variety. In the samples of the following varieties, this stage passed 13–16 days earlier than the Aurora variety, and 6–9 days earlier than the Erevansky 3 variety: Glassie Fj (Netherlands, K–991), Nameless (Russia, K–472), Violette longue (France, K–310), Crimson (USA, K–420) Angliysky (Russia, K–51), Tburulas sennarib (Japan, K–283), Negro Prince (Germany, K–343), Adonis (Moldova, K–946) , Belomyasy–155 (Russia, K–635), Mestnyy skorospelyy (North Korea, K–3015), Solara Ft (Netherlands, K–2926), Dusky Hubz (USA K–1031), Kabusyu (Japan, K–3025) , Ofose (Japan, K–814), Mestnyy (Afghanistan, K–1022), Keskenut 198 (Hungary, K–2835), Hobak (Japan, K–3024).

Standard Aurora and Erevansky-3 varieties needed 16 days for lateral germination of seedlings after sowing, while the average indicator of all varieties for this characteristic was 14.7–15 days.

The average index of all variety samples was equal in the samples of Japan, Russia, Holland, USA, France, Nepal, Uzbekistan, Bulgaria, Spain, while the sprouts of the samples brought from other countries germinated one day later.

When the sprouts germinated until the flowering period of the plant, it was 98 days in the standard Aurora variety, 92 days in the Erevansky - 3 variety, and the average indicator of all samples was 89 days.

Technicalization of the fruit is an important stage, the earlier the harvest is harvested, the higher its price. It took 124 days for the standard Aurora variety from the time the sprouts germinated until the fruit was ready, and 117 days were enough for the second standard Yerevanskiy - 3 variety. The average of this number for all samples was 115 days.

25 days were enough for the standard Aurora and Erevansky-3 varieties to start the flowering phase of the eggplant plant - the technical ripening phase of the fruit. The relatively short duration of this stage indicates that the specimen is rapidly maturing and yielding.

From the time of sprouting to fruit technicalization, it took an average of 115 days for all samples, while this phase was 103–112 days for 38 samples. Among them, this stage is the shortest (103-108 days) Eggplant S - 64 (Ukraine, K - 627), Crimson (USA, K - 420), Angliysky (Russia, K - 51), Gordabansky (Georgia, K - 659) , Dasky Hubz (USA, K - 1034) and Otose (Japan, K - 814) samples stood out.

Technical-biological fruit ripening stage is short - 27-32 days in variety samples, emergence of sprouts - fruit biological ripening period was also short in most cases, it was 140-144 days.

Among the samples of the tested variety, the following samples with small fruit size (less than 14 x 6 cm) were identified: Bolgarsky (Armenia, K-479), Dlinnoplodnyy (Japan, K-221), Bolgarsky ch/14 (Ukraine, K-556), Nameless (India, K–110), Chus en Vitta (Japan, K–849), Glassie F1 (Netherlands, K–991), Adonis (Moldova, K–946), Kruglyy (India),

Nurki (Nepal). There are also specimens of this group whose fruit length is less than 14 cm, but their fruit width is more than 6 cm.

Samples with medium fruit size (14–16x6–12 cm): Kanadaskaya (Japan, K–538), Marada Zarga (Spain, K–2629), Grozdevyy (India). Some specimens were 14–16 cm tall, but were not included in this group because they were less than 6 cm in diameter.

Samples with large fruit size (more than 16x6–12 cm): Chernaya krasavitsa (Netherlands, K–3604), Bakota F1 (Netherlands, K–138) and standard Aurora variety.

The length of the fruit was 17.5 - 20.2 cm: the diameter of the fruit of the standard variety Erevansky-3, Mestnyy (Armenia, K-480) was 5.8 and 4.8 cm, respectively.

112-120% compared to the average value of standard Aurora and Bataysky (Russia, K-913), Kanadaskaya (Japan, K-538), Nurki (Nepal), Kabusyu (Japan, K-3025) variety samples, 124-128% established the standard Erevansky-3 variety and Mestnyy skorspelyy (North Korea, K-3015), Mestnyy (Afghanistan, K-1022), Dreen jong Brinjae (Nepal, K-956) samples. In this regard, the highest indicator - 148% Mestnyy (Armenia, K-480) and 168% M.M.212.38/73 (France, K-89) was observed.

It is known that the smallest (40-60%) numbers compared to the average are in the following varieties: Bolgarsky (Armenia, K-479), Eggplant S-64 (Ukraine, K-627), Keskenut-198 (Hungary, K-2855) it happened. The fruit index of these samples was 1.0-1.5.

Among the samples of the studied variety, the color of the fruits is as follows: black purple - standard Aurora and Erevansky - 3, Chernaya Kravitsa (Netherlands, K - 3604), Chus en Vita (Japan, K -849), Bakota F1 (Netherlands, K -138), Keskenut-198 (Hungary, K-2855) and Kabusyu (Japan, K-3025) variety samples; light purple–Bolgarsky (Armenia, K–479), Dlinnoplodnyy (Japan, K–221), Belomyasyy–155 (Russia, K–635); dark purple – No. 1297 (Afghanistan, K–879), Nameless (India, K–110), Violet (Russia, K–308), Marada Zarga (Spain, K–2629), Violet (Iran, K–1031) was in the samples.

In addition to the listed colors, there were samples of the variety - siren color, road - road siren color, white color, road - light siren color, purple, dark purple and light green flowing samples.

In terms of the shape of the eggplant fruit, the standard Aurora and Erevansky-3 varieties are cylindrical, and this shape was repeated in the samples of the following varieties: Niki (Nepal, K-1093), Fioletovyy (Iran, K-547), Belomyasyy-155 (Russia, K-635), Nurki (Nepal).

Short pear shape - Bolgarsky (Armenia, K–479), Bolgarsky ch/14 (Ukraine, K–556), Glassie F1 (Netherlands, K–991), Peont Takus Song Black (Japan, K–799), Kochang Jaeial (North Korea, K-1090) was in the variety samples, elongated pear-shaped - Eggplant S - 64 (Ukraine, K-627), Blackhite (Australia), Keskenut-198 (Hungary, K-2855), Kabusyu (Japan, K-3025), Ofose (Japan, K–814) samples, pear-shaped - Dlinnoplodnyy (Japan, K–221), Nameless (India, K–110), Chus en Vitta (Japan, K–849), Violette Longue (France, K–310), Nameless (Russia, K–472), English (Russia, K–51), Bakota F1 (Netherlands, K–138), Nameless (Azerbaijan, K–199) samples; oval - Bataysky (Russia, K-913), Crimson (USA, K-480), Nameless (Russia, K-575), Umid (Uzbekistan), Solara G'1 (Netherlands, K-2926), Hobak (Japan, K-3024) was in the variety samples.

Eggplant fruits were divided into the following groups by weight (g): very small - 40-100 g, small - 101-150 g, medium - 151-200 g, large - 201-250 g, and very large - 251 g. entered above.

Among the studied samples, very small (40–100 g.) group: Nikki (Nepal, K–1093), 12 (Bulgaria, K–737), Kochang Jaeial (North Korea, K–1090), Belomyasyy–155 (Russia, K-635), Kruglyy (India), Nurki (Nepal) samples were included. The fruit weight of 32 variety samples belonged to the small (101-150 g) group, while the fruit weight of 16 samples belonged to the medium (151-200 g) group, Bakota (Netherlands, K-138) and Grozdevyy

(India) samples were large (201–250 g.) was included in the fruit group, and the fruit of the Chernaya krasavitsa (Holland, K-3604) sample was included in the very large (277 g) group. The fruit of Standard Aurora and Erevansky - 3 varieties also belonged to the middle group in terms of weight.

The average fruit weight of all variety samples was 135.6 g. Compared to it, the higher 110-119% indicator is Mand (France, K-2747), Nameless (India, K-725), Fioletovyy (Iran, K-547), Adonis (Moldova, K-946), Solara G'1 (Netherlands, K –2926), Hobak (Japan, K–3024), Ofose (Japan, K–814) samples, 120–132% standard Aurora and Erevansky – 3 varieties and Melangenium jakobana Japan (Japan, K–464), M.M. 212.38/73 (France, K–89), Kanadaskaya (Japan, K–538), Marada Zarga (Spain, K–2629), Gordabansky (Georgia, K–659), Umid (Uzbekistan), 139–204% Chernaya krasavitsa (Netherlands, K – 3604), Bakota F1 (Netherlands, K–138), Grozdevy (India) and Keskenut – 198 (Hungary, K – 2855) were samples and hybrids. As the fruit weight of standard Aurora and Erevansky-3 varieties participated in the research was 174-175 g, according to the methodological instructions, their fruit belonged to the medium (151-200 g) group.

Among the samples tested, samples from Nepal and Bulgaria were included in the group with very small fruits (40-100 g). The group with small fruit (101–150 g) was made up of varieties from Japan, Russia, India, USA, Armenia, Afghanistan, North Korea, Ukraine, Italy, Azerbaijan, Germany, and Australia. Samples from the Netherlands, France, Spain, Georgia, Iran, Moldova and Hungary were included in the medium-sized (151–200 g) fruit group, like standard varieties (Table 1).

Table 1. Fruit weight and yield of eggplant varieties depending on the origin (2022-2023 year)

№	Origin	Weight of one commodity fruit, g	% vs. St. Aurora	Productivity		
				га/т	St	
					% vs. St. Aurora	Regarding Yerevansky 3, %
1.	Aurora st	174	100	70,7	100	98
2.	Yerevan-3 st	175	101	72,5	103	100
3.	Japan	144	83	76,1	108	105
4.	Russia	124	71	79,9	113	110
5.	Netherlands	195	112	92,5	131	128
6.	India	136	78	77,3	109	107
7.	USA	127	73	83,4	118	115
8.	France	157	90	68,8	97	95
9.	Nepal	80	46	69,9	99	96
10.	Armenia	120	69	61,5	87	85
11.	Afghanistan	138	79	79,3	112	109
12.	North Korea	103	59	62,9	89	87
13.	Ukraine	119	68	69,0	98	95
14.	Uzbekistan	170	98	66,8	94	92
15.	Uzbekistan	122	70	89,0	126	123
16.	Uzbekistan	96	55	66,4	94	92
17.	Azerbaijan	115	66	63,4	90	87
18.	Spain	163	94	71,3	101	98
19.	Georgia	166	95	73,3	104	101
20.	Germany	105	60	60,5	86	83
21.	Iran	153	88	79,4	112	110
22.	Moldova	152	87	76,0	107	105

23.	Australia	119	68	90,7	128	125
24.	Hungary	188	108	79,1	112	109

Among the studied variety samples, there were no samples belonging to the group of large (201–250 g) and very large (over 251 g) fruits.

The productivity level of aubergine is divided into the following groups in relation to standard varieties and average productivity of all varieties: 65-75% - very low productivity, 76-95% - low, 96-115% - medium, 116-135% - high and more than 135% - very high.

Among the samples of the studied variety, there was no very low yield (65-75%) sample compared to the standard Aurora variety. The productivity of 15 samples belonged to the low (76–95%) group, 24 samples to the medium (96–115%) group, 13 samples to the high (116–135%) group of productivity, Chernaya krasavitsa (Netherlands, K-3604) yield was 145%, that of Bataysky (Russia, K-913) was 146%, and that of Bakota F1 (Netherlands, K-138) was 156%.

Since the productivity of the standard Erevansky-3 variety is 3-5% higher than that of the Aurora variety, the difference between the yield of the studied variety samples was also 3-5% for the Erevansky-3 variety.

The average yield of all variety samples was 75.9 t per hectare and was 4-8% higher than both standard varieties. High (111 – 119 %) productivity compared to the average of variety samples Eggplant S-64 (Ukraine, K-627), Black Uyant (Italy, K-414), Belomyasy-155 (Russia, K-635), Blackhite (Australia , Hobak (Japan, K-3024), Dasky Hubz (USA, K-1031) samples, while the highest (121-142%) productivity was found in Chernaya krasavitsa (Netherlands, K-3604), Bataysky (Russia, K-913, observed in Bakota Fj (Netherlands, K-138), Grozdevyy (India) samples.

The yield of 17 samples was 10–29% lower than the average. The productivity of the remaining variety samples was close to and equal to the average.

The yield of standard varieties was close to each other, the difference between them was 1.8 tons per hectare. Very low (65-75%) and very high (more than 135%) yield samples were not found among the variety samples brought from different countries.

High (116–135%) productivity was shown in samples of the Netherlands, USA, Italy and Australia.

The coefficient of variation of the yield between the variety samples was average ($V=11.3\%$), and the average yield was equal to $X=73.4 \pm 8.3$ t.

Compared to the average yield of the samples of the studied variety, a convincing addition (+ 8.3 ha/t) high yield was obtained from samples of the Netherlands, USA, Italy, Australia, while a low yield (- 8.3 ha/t) was obtained from Armenia, North Korea, Azerbaijan, Germany variety taken from the samples. The productivity of the samples brought from the rest of the countries was equal to the average productivity.

Among the samples studied, the following varieties are relatively early: Eggplant S - 64 (Ukraine), Violette Longue (France), Crimson (USA), Angliysky (Russia) the most 9.9%, Gordabansky (Georgia) the least 3.7% . (USA), Keskenut - 198 (Hungary), Kabusyu (Japan) and Ofose (Japan) samples were separated and yielded 3.7-9.9 percent of the total yield in the first deka of July.

In addition, 22 more samples were harvested in the second decade of July. In the first harvest, 7.5–8.6 percent yield was given by Bolgarsky ch/14 (Ukraine), Nomsiz (Russia), Peont Takus Song Black (Japan), Nomsiz (India), Dreen jong Brinjae (Nepal).

In addition to the above-mentioned variety samples, the following ones were included: Chernaya krasavitsa sample and standard Aurora, Erevansky - 3 varieties with relatively late ripening and harvest in the third decade of July.

In July, the fairy tale and the highest yield per hectare is 30.9 - 44.5 t or 50.8 - 57.2% Violette Longue (France), Crimson (USA), Angliysky (Russia), Tburulas sennarib (Japan),

Negro Prince (Germany), Mestnyy skorospelyy (North Korea), Solara Ft (Netherlands), Mestnyy (Afghanistan) were obtained from variety samples.

In July, the lowest yield (8.1%) was obtained from the sample of Chernaya krasavitsa (Holland) and the standard variety, while the yield of the remaining variety samples was around 20.4 - 38.7%.

In August, the highest yield in relation to the total yield (50.6 - 60.4 %) was in the standard Aurora and Erevansky - 3 varieties and #1297 (Afghanistan, K-879), Ddinnoplodnyy (Japan, K-221), Chernaya krasavitsa (Netherlands, K-3604), Chus en Vitta (Japan, K-849), Nikki (Nepal, K-1093), Mestnyy (Armenia, K-480), Nameless (Russia, K-575), Kanadaskaya (Japan, K-538), Kochang Jaeial (North Korea, K-1090), Kruglyy (India), Grozdevyy (India) samples were obtained. Bolgarsky (Armenia, K-479), Bolgarsky ch/14 (Ukraine, Km556), Nameless (India, K-110), Glassie (Netherlands, K-991), Marada Zarga (Spain, K-2629), Blackhite (Australia), Chumak (Russia, K-898), Umid (Uzbekistan), Nurki (Nepal) samples yielded 40.6-49.9%.

The productivity of most of the remaining samples was 31.2 - 38.4 percent of the total yield.

In September, 20.0 - 26.2% of the total harvest was obtained from Avrora and Erevansky-3 varieties, as well as Chernaya krasavitsa (Netherlands, K - 3604), Fioletovy (Russia, K-308), M.M 212. 38/73 (France, K-89), Nameless (Russia, K-575), Kochang Jaeial (North Korea, K-1090), Kruglyy (India), Grozdevyy (India), Blackhite (Australia) were obtained from variety samples.

In September, 15.2-19.3% of the total harvest #1297 (Afghanistan, K-879), Dlinnoplodnyy (Japan, K-221), Chus en Vita (Japan, K —849), Glassie Fj (Netherlands, K- 991), Black Uyant (Italy, K-414), Nikki (Nepal, K-1093), Bataysky (Russia, K-913), Skorospely (Russia, K-650), #12 (Bulgaria, K-737), Nameless (Russia, K-472), Melangenium jakobana Japan (Japan, K-464) and 12 other similar varieties were sampled.

In October, the drop in air temperature stopped the growth of the plant. But the fruits that appeared earlier grew in size, albeit slowly. In the last harvest, the productivity of all studied variety samples decreased sharply and made 1.6-8.1% of the total yield.

At the beginning of July, the first two harvests yielded a lot (13.7-17.3% of the total harvest): Eggplant S-64 (Ukraine, K - 627), Crimson (USA, K -420), English (Russia, K- 51), Tburulas sennarib (Japan, K-283), Mestnyy skorospelyy (North Korea, K-3015), Solara F1 (Netherlands, K-2926), Hobak (Japan, K-3024), Mestnyy (Afghanistan, K-1022), Dasky Hubz (USA, K-1031) samples can be used in the selection of early eggplant varieties. By starting the seed production of these hybrids and samples, planting them in large areas across the republic, it will be possible to increase the yield of eggplant by 2.5-3.0 times.

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