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MORPHOLOGICAL, PHYSIOLOGICAL RESPONSES OF TOMATO VARIETIES CULTIVATED IN SOILS OF THE BUKHARA

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Abstract
The article presents the results of a study of a collection of local and introduced early, mid-early and mid-ripening tomato hybrid varieties in terms of growth rate, development, formation of leaf surface area, tops, root system, photosynthetic potential, fruit formation, productivity indicators, total and marketable yield by harvest, coefficient adaptability. On their basis, tomato hybrid varieties were isolated from the early-ripening group; from other studied groups, they were tall, branched, with a high leaf surface area, powerful tops, root system and productivity. The hybrid varieties Tomsk F1, Bobcat F1, Lojain F1, Seraj F1 were especially distinguished by these indicators, leaf surface area 0.57-0.95 m2, root weight 124-144 g, tops 473-574 g, fruit yield per bush 1525.5-2470.5 g.
The highest adaptability coefficient was in the hybrid varieties Tomsk F1 (1.49), Bobcat F1 (1.28), Seraj F1 (1.22), Red stone (1.40), Pink trind F1 (1.16), in which the yield was 44.0-109.8 t/ha.

Keywords: Tomato hybrid varieties, growth, leaf surface, photosynthetic potential in crops, productivity, adaptability coefficient, soil salinity, irrigation, cash crop.

Introduction

Tomato (Solanum lycopersicum L.) is one of the most important fruit vegetables and cash crops in the world. Tomato is used either directly as fresh vegetable or in the form of various processed products including paste, whole peeled, diced, juices and soups (Grandillo et al., 1999). According to the Food and Agriculture Organization (FAO), more than 189,1 million metric tons of tomatoes were produced globally in 2021(FAO, 2021). The average yield of tomato ranges from about 10

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t0 more than 200 ton per hectare across the world. In Uzbekistan, tomatoes are cultivated on 43-45% of the total area of vegetable crops the average yield is about 36 ton per hectare (FAO, 2021). The Bukhara region in the republic is characterized by peculiar soil and climatic conditions, a low level of provision of the population with tomato production, and the yield does not exceed 21-22 tons per hectare. The Selection of the environment depends on the specifics of the cultivated object and the goals of growingultivation. Media can be liquid and solid (agarized). Liquid media are used to produce algae biomass necessary for their use; solid media are used to store collectible (museum) crops. Most algae grow well on mineral media. At the same time, many of them require the presence of organic substances for normal growth. In this case, algae are grown on specialized media, where various organic compounds are added, for example, extracts from peat, soil, silt deposits, etc.

The following methods are most often used. One part of the soil and one part of the water are boiled for 1 hour, infused for 1 Glue Day and boiled again for 1 hour. The mixture is then cooled, filtered and sterilized in an autoclave. Plant growth is adversely affected by soil salinity stress causing 7% decrease in crop yield all over the world (Latef and Chaoxing, 2011; Maggio et al., 2004). Due to the arid climate with annual evaporation rates of approximately 2000 mm, large areas of the Bukhara region are covered by the Kyzyl Kum desert, and only 4.7% of the lands are used for agriculture (Alihanov, 2008; Kulmatove et al., 2015). While the percentage of agricultural land is low, it is of great importance for the regional economy. A total of 274,900 ha of agricultural lands in Bukhara region are intensively irrigated to allow the production of cotton and wheat. The combination of the high salinity of the irrigation water and the generous application of fertilizers leads to a widespread soil salinization in this region (Kulmatove et al., 2015). The agrochemical parameters of meadow alluvial soils of Bukhara region are representing in the following table (Table 1). It is relevant that although tomato is the leading vegetable crop in the republic, the need has not yet been satisfied. The main reasons for this, taking into account each soil-climatic region, are that the collection of different tomato hybrid varieties has not been assessed for growth, formation of leaf surface area, photosynthetic potential, yield and adaptability coefficient, that is, adaptive, highly productive hybrid varieties have not been identified, the lack of high-quality varietal seeds [1,2,3,4].

The purpose of the study is to conduct a comprehensive study of a collection of local and introduced early, mid-early and mid-ripening tomato hybrid varieties in terms of early maturity, growth, development, formation of leaf surface area, tops, root system, photosynthetic potential, fruit formation, productivity indicators, general and commercial yields based on harvests and, on their basis, the selection of promising, high-yielding, adaptive hybrid varieties for slightly saline meadow alluvial soils.

2. Materials and Methods

2.1 The study area and soil characteristics. Field experiments were carried out in the conditions of irrigated meadow alluvial soils of the Khamroev Khalil Bozorovich farm in the Zhandar district of the Bukhara region (39°45'11"N 64°10'36"E) . The Bukhara region, located on the southwest of the Republic of Uzbekistan, covers 40,320 km^2 and has a population of 1.7 milion people. The

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climate is continental, with cold winters (monthly average: 1.6˚C in January) and hot summers (monthly average: 29.4˚C in July). The mean annual air temperature and precipitation are 15.6˚C and 142 mm, respectively. Most of the rainfall occurs during the winter months and in early spring (20.7 mm in December, 19.5 mm in January, 18.3 mm in February 28.8 mm in March) while the summer months are very dry (Kulmatove et al., 2015).

2.2 The experimental design and plantation. We studied 18 varieties and heterotic hybrids of tomato which were three groups of early (6 varieties), mid-early (8 varieties) and mid-season (4 varieties) hybrid varieties. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The experimental plots were laid out in one contour of the field, and the area of each plot was 36 m^2 (10 × 3.6 m) (Figure 1).

Figure 1. Bush of varieties that are ripe before harvesting, from which they are separated from tomatoes

2.3 Measurements and data analysis. All records, observations, calculations and analyzes on the experimental plot were carried out according to generally accepted methods and agricultural recommendations [5,6,7,8,9,10,13,14]. Adaptability coefficient of tomato varieties (hybrids) in the conditions of the Bukhara region was calculated by the method of L. A. Zhivotkov (Zhivotkov et al., 1994), Photosynthetic potential of the tomato varieties (hybrids) was calculated by the method Semykin V.A and Pigorov (2007). Water use efficiency (WUE) was calculated according to the following formula:

WUE (kg m^{-3}) = Total fruit yield (kg ha^{-1}) / applied water (m^3 ha^{-1}). A one-way ANOVA analysis was performed using the general linear model univariate procedure with SPSS 13.0 software (SPSS, Chicago, IL). The mean values of the measured physiological and morphological

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characteristics of the tomato varieties were compared using Duncan's multiple range test when significant differences were detected. The significant level was $P < 0.05$.

3. Results and Discussion

The studied tomato hybrid varieties differed significantly ($P<0.05$) in germination, growth, development, formation of leaf surface area, tops, roots and productivity indicators (Table 2).

Table 2. Growth, development and productivity of tomato varieties and hybrids in slightly saline soils of the Bukhara region (2022-2023).

	Name and origin of the variety (hybrids)	Length of periods in days			Growing season, in days	Leaf surface area (m^2)			Weight from 1 bush, g		
		planting seedlings-flowering	flowering-fruiting	fruiting-ripening		flowering	fruiting	ripening	roots in layer 0-20 cm	tops	fruit harvest
In early hybrid varieties											
1.	Мустакиллик-28(UZ)-**st.**	15	12	26	53	0,41	0,68	0,73	105	460	859,5
2.	Ogastin (DE)	13	14	30	57	0,42	0,71	0,74	116	479	949,5
3.	Lojain F1 (NL)	12	10	28	50	0,57	0,85	0,88	124	473	1525,5
4.	Tomck F1 (NL)	14	12	28	54	0,65	0,92	0,95	144	574	2470,5
5.	Bobcat F1 (NL)	14	12	28	54	0,62	0,90	0,92	130	510	2119,5
6.	Seraj F1 (NL)	12	12	30	54	0,63	0,90	0,92	135	546	2025,0
In mid-early hybrid varieties											
7.	Rio-grande (NL)-**st.**	19	15	28	62	0,40	0,70	0,73	104	466	929,3
8.	Volgogradsky 5/95(RU)	15	15	30	60	0,38	0,66	0,70	112	450	573,8
9.	Red stone (USA)	21	17	26	64	0,51	0,83	0,88	126	490	1035,0
10.	Yusupov (UZ)	20	15	26	61	0,42	0,70	0,74	130	516	753,8
11.	Vostok (UZ)	21	12	31	64	0,40	0,68	0,70	103	464	623,3
12.	BT 1019 F1 (TR)	16	11	32	59	0,35	0,60	0,69	102	475	299,3
13.	Terra cotta F1 (NL)	16	11	32	59	0,45	0,76	0,81	127	502	785,3
14.	Wolverine F1 (NL)	16	11	34	61	0,47	0,79	0,84	129	510	918,0
In mid-season hybrid varieties											
15.	Floradade (US)-**st.**	19	14	39	69	0,48	0,74	0,48	114	486	877,5
16.	Campbell (DE)	19	14	36	69	0,46	0,70	0,46	117	485	821,3
17.	H2274 F1 (TR,)	20	14	37	71	0,44	0,65	0,44	120	490	720,0
18.	Pink trind F1 (NL)	21	14	36	71	0,52	0,75	0,52	134	545	990,0

The data showed that the duration of interphase periods for hybrid varieties changed significantly and in the group of early varieties the period of "planting seedlings-flowering" was 12-15 days, the period of "flowering-fruiting" was 10-14 days, the period of "fruiting-ripening" was 28-30 days. The group of mid-early varieties has, respectively, 15-21; 11-17; 26-34 days, and for the group of mid-season varieties - 19-21; 14; 36-39 days. The growing season, that is, the period from planting seedlings to the first harvest, for the group of early hybrid varieties was 50-57 days, for

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the group of mid-early hybrid varieties it was 59-64 days, and for mid-season hybrids it was 69-71 days. In the group of early ripening hybrid varieties, all hybrid varieties differed from the standard Mustakillik-28 variety by ripening fruits 1-7 days earlier; in the group of mid-early hybrid varieties, only the hybrid Terra Cotta F1, Yusupov had a growing season of 61 days, and in the other studied varieties - For hybrids, the growing season was 1-4 days longer. In the group of mid-season varieties, the duration of the growing season was 69-71 days, only the Campbell and the H2274 F1 hybrid was 2 days longer. In compare with other groups of hybrid varieties, the group of early ripening hybrid varieties were relatively tall, branched, with a high leaf surface area, powerful tops, root system and fruit yield [12].

According to the results of a number of studies (L.A. Zhivotkov et al., 1994, V.A. Semikin et al., 2007, T.E. Ostonakulov, V.I. Zuev, O.K. Kodyrkhodzhaev, 2019) it was established that the average yield in advanced farming conditions is 35-40 t/ha, and in many cases 18-25 t/ha. The big difference between the actual and potential yield is due to the fact that farms cultivated “popular” varieties, that is, the adaptability to the specific soil and climatic conditions of a given variety is not taken into account. Therefore, we studied collections of tomato hybrid varieties on slightly saline soils of the Bukhara region in terms of potential yield and adaptability coefficient (Figure 3).

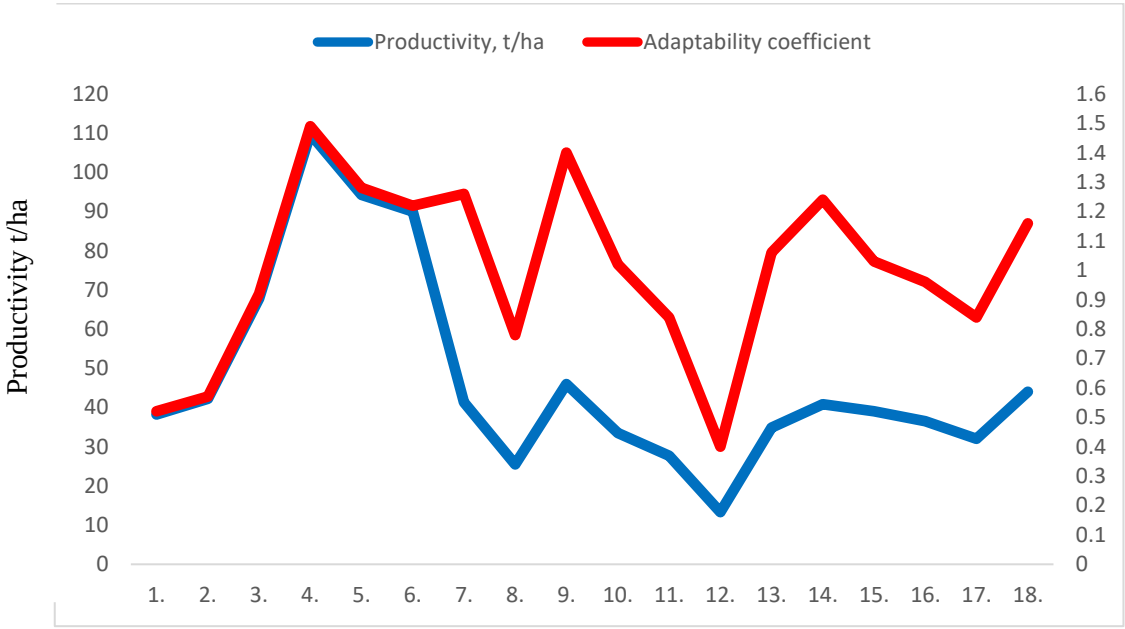

Figure 3. Productivity and adaptability coefficient of tomato varieties (hybrids) in conditions of the Bukhara region

It was established that the yield of early hybrid varieties was 38.2-109.8 per hectare, for mi y varieties - 13.3-46.0, for mid-season - 32.0-44.0 tons, and the adaptability coefficient, respe ', 0.52-1.49, 0.78-1.40 and 0.84-1.16. The highest adaptability coefficient was observed in the d varieties Tomsk F1 (1.49), Bobcat F1 (1.28), Seraj F1 (1.22), Red stone (1.40), Pink t 1 (1.16), the yield of these hybrid varieties was 44.0-109.8 t/ha. The lowest adaptability coe t was observed in the hybrid varieties BT-1019 F1 (0.40), Mustakillik-28 (0.52), Augustin), H2274 F1 (0.84). In general, the adaptability coefficient of the studied varieties from th y

tomato varieties (hybrids)

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group was 3, from the mid-early groups - 5, and from mid-ripening varieties (hybrids) - 2; a total of 10 varieties were 1.0 or high. Based on the results, the overall yield and economic efficiency indicators were determined, i.e. costs per hectare, cost price of 1 centner of crop, cost of crop obtained from 1 hectare, net income from 1 hectare and the level of profitability for the studied tomato hybrid varieties and technologies. The results of the production test showed that in the conditions of the farms "Khamraev Khalil Bozorovich" and "Obod Zhuizar" (on an area of 4.6 hectares) when cultivating according to the existing technology (irrigation regime for pre-irrigation soil moisture of 65-75-75% of the maximum permissible water content, planting pattern 90x30 cm with a density of 36.6 thousand hectares, application of fertilizers at the rate of N150P120K75 kg/ha) the yield of the standard variety Volgogradsky 5/95 was 25.0 t / ha, and for the selected adaptive varieties 30.1-76.8 t/ha, with the recommended technology (irrigation regime - 75-85/85% of the maximum permissible water content, planting pattern 90x20 cm with a density of 44.4 thousand hectares, organomineral fertilizers were applied jointly at the rate of 20 t/ha of manure + N200P160K100 kg/ha) the yield of the standard variety Volgogradsky 5/95 was 28.5 t/ha, and of the selected adaptive varieties 35.2-85.0 t/ha or the yield increase was 3.5 and 5.2-8.2 t/ha. The cost price of 1 centner of the harvest depending on the hybrid varieties with the existing technology is 58.0-153.6 thousand soums, and with the recommended technology 56.6-146.7 thousand soums. The amount of costs per 1 hectare with the existing technology is 38.4-44.5 million soums, and with the recommended technology 42.1-48.1 million soums, the cost of the harvest obtained from 1 hectare according to the technologies, respectively, 37.5-115.2 and 42.8-127.2 million soums. As a result, the net income from 1 hectare according to the existing technology is 5.5-70.7, and with the recommended technology 8.1-79.4 million soums, the profitability level is, respectively, 13.9-158.9 and 18.1-165.1%. The recommended cultivation technologies of the selected adaptive hybrid tomato varieties contributed to obtaining 4.8-8.7 million sums of additional net income and profitability of 4.2-7.2% compared to the existing technology. Similar data were obtained in the farm "Obod Zhuizar" on an area of 4.0 hectares. Thus, the results of field experiments confirmed the results of production tests and were implemented on an area of 8.6 hectares.er.

4. Acknowledgments

We express our sincere gratitude to the Khamroev Khalil Bazorovich farm in the Jandar district of the Bukhara region for the opportunity to scientifically study its territory.

5. Conclusions

1. The group of early-ripening hybrid varieties from other studied groups were relatively tall, branched, with a high leaf surface area, powerful tops, root system and fruit yield. The tomato hybrid varieties Tomsk F1, Bobcat F1, Lojain F1, Seraj F1 were especially distinguished by these indicators, the leaf surface area was 0.57-0.95 m^2, and the root weight was 124 -144 g, tops - 473-574 g, fruit yield per bush 1525.5-2470.5 g, where the ratio of fruits and tops differed 1: 3.6-4.1. Relatively high growth and productivity indicators were observed in the mid-early variety Red stone, mid-season variety Floradade, hybrid Pink teind F1, where the fruit yield per bush was 877.5-1035.0 g, the ratio of fruits and tops was 1: 1.8-2, 1. The average fruit weight of the hybrids

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Seraj F1, Tomsk F1, Bobcat F1, Pink trink F1 was the largest (106.1-329.6 g), the Floradade variety was 56 g, and the Red stone variety was 103 g.

2. It was established that the yield of early hybrid varieties was 38.2-109.8 per hectare, for mid-early varieties - 13.3-46.0, for mid-ripening - 32.0-44.0 tons, and the adaptability coefficient, respectively, 0.52-1.49, 0.78-1.40 and 0.84-1.16. The highest adaptability coefficient was observed in varieties (hybrids) Tomsk F1 (1.49), Bobcat F1 (1.28), Seraj F1 (1.22), Red stone (1.40), Pink trind F1 (1.16) , the yield of these hybrid varieties was 44.0-109.8 t/ha. The lowest adaptability coefficient was observed in the hybrid varieties BT-1019 F1 (0.40), Mustakillik-28 (0.52), Augustin (0.57), H2274 F1 (0.84).

4. Cultivation of selected adaptive varieties and hybrids of tomato using the recommended technology helps to obtain additional net income from 1 hectare of 4.8-8.7 million soums and profitability of 4.2-7.2%.

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