

Possible ways to save seeds of tomato varieties in Kyrgyzstan

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Abstract. This research summarizes practical experience on possible ways of restoring and developing seed production of heritage selection tomato varieties in the conditions of southern Kyrgyzstan. At the moment, providing farmers, especially in remote areas, with high-quality and selected seeds of local tomato varieties is difficult. In order to meet the needs of farmers in seeds, measures were taken to organize a seed plot, undergo special training on the technology of tomato production for seeds and create a "community seed bank". The research material was the local selection variety Bishkek and the heritage released tomato variety Volgogradsky 5/95. The research results have shown that the most acceptable way for farmers to preserve, restore and distribute the heritage selection tomato varieties of Bishkek and Volgogradsky 5/95 was to create a seed exchange network in local communities. During the implementation of the project, joint research work was performed with farmers to assess the yield, seed productivity, selection of fruits for seeds of the studied tomato varieties. Due to the efforts of farmers, endangered tomato seeds have become available through the "community seed bank" for rural residents in remote areas of Batken region.

Keywords: Tomato, selected seeds, jaamat, seed production, seeds, community seed bank

1. Introduction

As the National Development Strategy of the Kyrgyz Republic for 2018-2040 notes, the priority for the agriculture development is to provide the population with quality food and turn the industry into a supplier of high quality, environmentally friendly, organic products in the global and regional markets [1]. These tasks also apply to the vegetable industry, including tomatoes.

Tomatoes are a highly profitable crop in vegetable growing. The natural and climatic conditions of the republic are exceptionally favorable for tomato cultivation, it ranks first in terms of sown area and, therefore, it is widely cultivated in all state, farming and household plots. Tomato fruits are an important food product with high taste and nutritional qualities that has a beneficial effect on metabolism and maintains vitamin balance in the human body. For the canning industry, tomato is also a valuable raw material for the production of tomato products.

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In addition, fresh and processed tomato products are the main export-oriented goods for the republic.

In recent years, a special development trend has been observed in the gross tomato harvest. Despite the positive trends in production, there is a serious threat to the provision of selected seeds of valuable released varieties for sowing.

The results of studies have shown that selected seeds only can increase yields by 15-20%. And the further development of the vegetable growing industry, including of tomatoes, largely depends on well-organized seed production of varieties, taking into account the specific needs of farmers, the population and the processing industry [2]. Seeds as the main means of plant propagation are a strategic commodity. Therefore, a well-established network of seed production of agricultural crops can be considered as the main factor in the food independence of the country [3]. It is also known that in agriculture, varieties and seeds are the main means of production, which determine not only the volume of production, but also its quality. And the quality of tomato products depends on the genetically embedded economically valuable properties of the variety in the seed material.

According to the State Register of plant varieties and hybrids approved for use on the territory of the republic [4], there are more than 155 names, of which 95% include F1 single-use hybrids from leading foreign companies, and there are only 8 varieties. In fact, farmers know only the names of hybrids from the register; and for seeding, only 5-6 varieties are used. Hybrids are only externally attractive by shape and color, resistant to field cracking, but have tasteless pulp, dominated by fiber with a weakly pronounced sugar-acid ratio. Therefore, they are not suitable for fresh consumption and processing and used mainly for the production of tomato products with flavor enhancers.

In addition to hybrids, private entrepreneurs also import seeds of nonreleased and unknown tomato varieties, having sometimes a late ripening period and leading to infestation and contamination of crops with pathogens, which causes dissatisfaction among farmers. Therefore, the share of valuable tomato varieties in seeds sowing is gradually decreasing.

The agrarian reform performed in the republic led to the destruction of the unified centralized system of industrial production of tomatoes and the loss of specialization. It contributed to the emergence of cooperatives and small-scale farms, independently deciding how to use their land plots, as well as to the disruption of the sowing structure, cultivation technology and seed production system. Due to the collapse of seed farms, centralized reproduction of varietal seeds is not performed. In this regard, the provision of high-quality selected seeds for sowing is becoming more and more difficult every year. Farmers are aware of the danger of F1 hybrids as a source of genetically modified organisms (GMOs), and the use of nonreleased varieties as a source of sowing contamination. Therefore, they demand that specific actions are to be taken to restore the seed production system of vegetable crops, including tomatoes, by combining the efforts of scientists, farmers, owners of private seed vaults, young people working and studying in this industry [5].

Considering the current situation, farmers of the Samarkandek village area of Batken district, Batken region appealed to the Bio-Muras Public Fund (translated as "Living Heritage") to find possible ways for restoring well-liked released tomato varieties of local selection Bishkek and the heritage varieties of Volgogradsky 5/95 and Viktorina with unique taste and the best nutritional value.

In this regard, in order to meet the requirements of the farmers, the employees of the Bio-Muras Foundation and the Samarkandek ayil okmotu (village council) performed certain work to provide initial seed material for sowing and asked for help from the Kyrgyz Research Institute of Farming, the Kyrgyz National Agrarian University named after K.I. Skryabin (KNAU), Sughd branch of the Tajik Research Institute of Horticulture and Vegetable Growing and Public Foundation "Agency for Development Initiatives" (PF ADI).

Due to the support of KNAU and PF ADI, seeds of the desired varieties Bishkek and Volgogradsky 5/95 were found but in very small quantities, the latter had low sowing qualities. Unfortunately, the elite seeds of the Viktorina variety could not be purchased. For the restoration, further reproduction and distribution of the Bishkek and Volgogradsky 5/95 varieties, a plan for an experiment entitled "*Preservation and dissemination of the diversity of local varieties of agricultural crops by creating a seed exchange network in local communities*" was developed. *The experiment was implemented* with the support of KNAU scientists as well as with the financial support of the Christensen Fund.

It should be noted that in recent years, scientists in neighboring Uzbekistan have also actively begun to preserve and reproduce the seeds of the heritage variety Volgogradsky 5/95 and the local variety Yusupovsky [6].

2. Materials and Methods

The purpose and objectives of the experiment were to find possible ways to restore, propagate, spread and maintain the identity of the following varieties: locally selected Bishkek and heritage Volgogradsky 5/95, adapted to all soil and climatic conditions of Kyrgyzstan and being under the threat of disappearance.

In this regard, the tasks of the experiment were as follows:

1. organizing a network for the exchange of seed material by creating a jaamat (community, group) of local farmers and other interested persons, with the participation of representatives of the aiyl okmotu,
2. training on the technology of tomato seed production,
3. conducting observations, accounting for tomato yield and seed yield,
4. creating of a "community seed bank" for the storage and further distribution of seed material.

Location of the experiment. Geographically, the Batken district is located in the southernmost point, in the southwestern part of the Kyrgyz Republic, remoteness from the capital city of Bishkek is 969 km. The remoteness of the Samarkandek aiyl aimag (rural area), where the experiment was performed, from the city of Batken is 42 km. The aiyl aimag includes four villages Samarkandek, Zhany-Bak, Pasky-Aryk, Orto-Sai. Climatic conditions are continental, hot, dry and shallow [7].

The experiment was performed in 2016-2018. The experiment included the following material: the released tomato varieties of local selection Bishkek (the originator was KNAU) and Volgogradsky 5/95 (the originator was the Volgograd Experimental Station of the N.I. Vavilov All-Union Research Institute of Plant Industry) differing in certain varietal signs and properties. Bishkek variety has a standard and determinate plant type, and Volgogradsky 5/95 variety has an indeterminate type. The control variety was Fabel.

In the first year of the experiment, due to the fact that the seed material of the studied varieties was old and the quantity was limited, each seed had to be sown in Petri dishes and germinated in a university laboratory thermostat. Before sowing, the seeds were disinfected with a 1-2% solution of potassium permanganate for disinfection from pathogens. In order to increase viability and accelerate germination, the plant growth regulator Mycophyte was used at the rate of 0.01 g per kg of seeds. The seeds were sown in containers, then after the appearance of the first true leaves, the seedlings were transplanted into paper cups. Seedling care was performed in accordance with the recommendations [8].

After the appearance of 5-6 true leaves, the seedlings in paper cups were put in boxes, transported by road to the farmer Nurlan Atabekov's pre-prepared personal plots in the village Pasky - Aryk. The predecessors in the plots were cucumbers and onions. Seedlings were planted according to the scheme of 35-40 x 70 cm in 2-row plots with observance of lateral and transverse protective zones and 2-fold replication. The area of one registration plot of 12 m² was

laid according to the scheme of randomized blocks, the total area was 138.6 m². The plots of each variety were marked with a label with deciphered numbers, and for the entire experiment one label reflecting its name was used. For the experimental plot scheme, OST 4671-78 [9] was followed. Further agrotechnics included more than 10 irrigations, cultivation, two manual loosening, fertilization with local fertilizers, etc. Measures for the seedling growth care were taken in accordance with the generally accepted methods for tomato culture in the conditions of the south of the republic [10]; monitoring of plant growth and development, assessment of resistance to diseases and accounting for yield were performed in accordance with the methods of the State variety testing of potatoes, vegetables and melons [11].

During the season, roguing, controlling plant pathogens as well as testing of the seed plot were performed three times. When at least 20% of ripe fruits appeared, harvesting was performed. The collected fruits were sorted into commercial and noncommercial products. From commercial products, typical, healthy and well-ripened fruits were selected for seeds. Acts of roguing, approbation chart and an act of selecting fruits for seeds were drawn up with the participation of members of the jaamat, university scientists and a representative of the aйл okmotu (village council). Roguing and approbation of sowings were performed according to the instructions for approbation of sowings of vegetables, melons, fodder root crops [12]. Data on tomato yield and seed yield were processed statistically according to B.A. Dospekhov [13].

3. Discussion

During the first year of experiment, through the efforts of farmers and other interested parties, a jaamat (community) consisting of six people and a “community seed bank” were organized. Farmer Nurlan Atabekov was appointed as the responsible person. A jaamat was created to unite farmers and conduct training on the proper management of tomato seed production on farm plots in order to provide them with seeds of the endangered released varieties Bishkek and Volgogradsky 5/95 in the future.

While this project was implemented, training seminars were constantly held on the technology of growing tomatoes for seeds and the rules for identifying varieties [14]. Recommendations were given on how to use local fertilizers and biological plant protection products for the production of safe, high-quality products and seeds. Training was conducted on the approbation of sowings, the rules of roguing, the features of the selection of fruits, isolation, drying and storage of seeds, as well as on the rules for reporting on the work done [15]. Theoretical training was carried out at a local school, and practical training was performed at the experimental plots.

During the growing season, all agrotechnical measures for the seedling care, observations, records, seed selection with subsequent fermentation were performed in a timely manner and with high quality. Farmers were taught the correct selection of tomatoes for seeds, directional selection and seed harvesting. After completion of the work, the harvested tomato seeds were equally divided among the members of the jaamat. Each member of the jaamat received a share of the seeds, so that in the next season these seeds could be used for sowing on each member's plot, and took on the obligation to attract new members to the community.

In the second year of experiment, members of the jaamat performed sowing at their plots and observed the entire technology of production and harvesting of seeds. At the end of the season, some of the harvested seeds were kept, some were transferred to the seed bank and shared with the next new members of the jaamat.

In subsequent years of research, seed propagation continued in the same way. As a result, the number of members of the jaamat increased, the seed fund was replenished and, in parallel, the seeds and seedlings were distributed among the farmers, the access to seed material was created for farmers in the south of the republic. Over the years of the experiment, special attention was paid to the adaptation of the studied varieties to harsh climatic factors: high

temperature and low air humidity. The terms of maturation of tomato varieties, susceptibility to tobacco mosaic virus (TMV) and bacterial black spot were studied. The total commercial yield per hectare was determined, and the fruit quality was assessed. The research results are summarized in Table 1.

Table 1. The results of phenological observations, gross and commercial yields, average fruit weight and contamination with TMV of various tomato varieties on the plots of farmer N. Atabekov, average for 2016-2018

Years	Vegetation period, days	Gross yield, t/ha	Commercial yield			Average fruit weight, g	Affected by diseases, score
			dt/ha	% to gross	% to control		
Fakel - control							
2016	104	40.9	33.5	82.0	100	75	0
2017	103	42.5	33.7	79.3	100	69	0
2018	106	40.2	34.1	84.1	100	73	0
Average	101	41.2	33.8	81.8	100	72	0
Bishkek							
2016	112	55.1	50.7	92.2	112.4	115	0
2017	109	58.0	54.5	93.9	118.4	111	0
2018	107	56.8	53.7	94.6	112.5	109	0
Average	109	56.6	53.0	93.6	114.4	112	0
Volgogradsky 5/95							
2016	116	54.6	41.2	75.5	92.1	147	0
2017	114	57.1	44.5	77.8	98.1	139	0
2018	115	51.0	40.8	80.0	95.2	121	0
Average	115	54.3	42.3	78.4	95.8	136	0

The results of the research of the growing season showed that the Bishkek variety belonged to the mid-ripening group, Volgogradsky 5/95 – to the medium-late ripening group compared to the control variety. In terms of gross and commercial yields, among the studied varieties, Bishkek variety produced the highest gross and commercial yields which amounted to 56.6 t/ha and 53.0 t/ha, respectively, on average for three years with the marketability being equal to 93.6%. For the Volgogradsky variety, the highest gross and commercial yields and the marketability were 54.3 t/ha, 42.3 t/ha and 78.4%, respectively; for standard variety – 41.2 t/ha, 33.8 t/ha and 81.8%, respectively (Table 1).

The commercial yield parameter of the Volgogradsky 5/95 variety being equal to 95.8% was especially low compared to the control variety. This was due to the fact that this variety with large, flat, rounded multichamber fruits weighing 136 g was less resistant to rare harvests. The Bishkek variety had beautiful fleshy, small-chambered and few-seeded fruits, round and round-oval in shape, weighing 112g. And in the control variety, the fruits were of rounded shape, weighing 72 g. In all varieties, the fruits were of red color, had a beautiful attractive shape, and were characterized by high taste qualities suitable for fresh consumption and various types of food processing.

Assessing of varieties for resistance to TMV and bacterial black spot, which often infected tomatoes in the south of the republic, was performed visually by means of counting the number of affected plants and was defined on a 5-point scale, then the average score and the degree of damage were established [State testing of varieties]. Viral disease pathogens were not identified in the experiment.

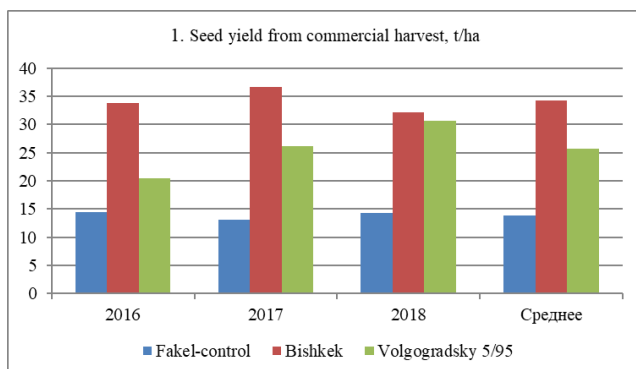


Diagram 1. Seed yield from commercial harvest, t/ha

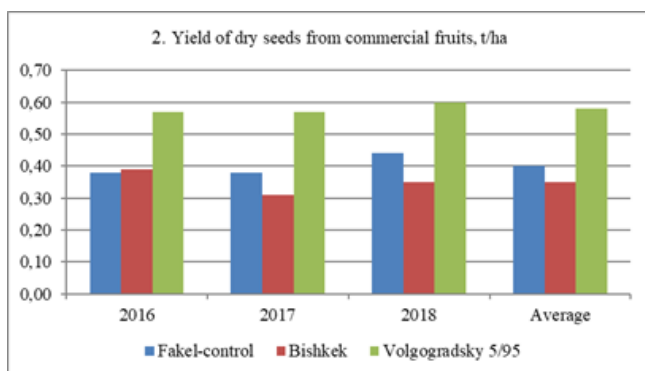


Diagram 2. Yield of dry seeds from commercial fruits, t/ha

The results of the selection of fruits for seeds from a commercial yield showed that the Bishkek variety gave the highest yield of fruits for seeds which amounted to 34.2 t/ha on average for three years; for Volgogradsky 5/95 variety, this parameter was 25.7 t/ha, and for the control variety - 13.9 t/ha; in percentage correlation, this parameter amounted to 64.6%, 50.5% and 40.1%, respectively (Diagram 1).

The highest yield of seeds from commercial fruits was obtained from the Volgogradsky 5/95 variety and amounted to 0.47 t/ha on average over three years, and it was by 118.3% more than in the control variety. The seed yield of the Bishkek variety was 0.32 t/ha or 85%. Such results are due to the few-seeded fruits of the Bishkek variety compared to other varieties. The seed yield of the control variety Fakel was 0.39 t/ha (Diagram 2).

In order to determine the yield of seeds of the studied varieties, the fruits were separately selected from the commercial yield of each variety. At the same time, special attention was paid to the shape, color of fruits and the absence of bark-like spots on their base. Then the seed pulp was isolated from these fruits and placed for 24-36 hours for fermentation. After fermentation, the pulps were washed with clean water, the seeds were separated and placed under a shed for drying. The results of determining the seed yield of various varieties of tomatoes on the plot of the farmer N. Atabekov are shown in Figures 1- 6.

4. Conclusion

Based on the results of the experiment, the most acceptable way for farmers to preserve, restore and distribute the heritage selection tomato varieties Bishkek and Volgogradsky 5/95 was to create a seed exchange network in local communities.

Conducted training activities on the technology of tomato cultivation for seeds had a positive impact on the further practical work of farmers on the reproduction and distribution of seeds.

During the implementation of the project, joint research work was carried out with farmers to assess the yield, seed productivity, selection of fruits for seeds of the studied tomato varieties.

Due to the efforts of farmers, endangered tomato seeds have become available through the “community seed bank” for rural residents in remote areas of Batken region.

Working moments during the experiment



Fig 1. Selection of fruits for seeds on the plot of the farmer N. Atabekov



Fig 2. On the plot of farmer Mariam Asanova in Zhany-Bak



Fig 3. On the plot of Ikram Umarov in Pasky-Aryk



Fig 4. Meeting of active community members



Figs 5 and 6. Farmer N. Atabekov on the seed plot of Bishkek and Volgogradsky 5/95 elite tomato varieties

References

1. National Development Strategy of the Kyrgyz Republic for 2018-2040 (Bishkek,2018) [Online]. Available:https://zinref.ru/000_uchebniki/04600_raznie_14/532_Strategiya_razvitiya_us_toichivogo_Kirgizii_do_2040/001.htm
2. R.A. Khakimov, E.V. Ermolova. Uzbek varieties of vegetable and melon crops and their seed production. //Scientific support of the vegetable growing industry in Russia in modern conditions. Collection of scientific papers based on the materials of the International Scientific and Practical Conference dedicated to the 85th anniversary of the All-Russian Research Institute of Vegetable Growing (M., FGBNU VNIIO, 2015, p. 406). [Online]. Available: http://lib.vniioh.ru/wp-content/uploads/2016/06/sb2015_full.pdf
3. V.F Pivovarov, F.B Musaev, S.L Beletsky, Seed production of vegetable crops in modern conditions.//Vegetable growing and greenhouse economy. 2021;3. [Online]. Available: <https://panor.ru/articles/semenovodstvo-ovoshchnykh-kultur-v-sovremennykh-usloviyakh/60444.html>
4. State Register of varieties and hybrids approved for use on the territory of the Kyrgyz Republic (Bishkek, 2020, p. 25-26). [Online]. Available: <https://agro.gov.kg/wpcontent/uploads/%D0%A0%D0%B5%D0%B5%D1%81%D1%82%D1%802020.pdf>
5. K.N.Osmonalieva K.N., E.B.Kaparova, A.Kh.Kasymov. Guide to the technology of cultivation of tomato and pepper for seeds (Bishkek, "DEMI", 2017, 63s)
6. G.A. Saidova, S.A. Yunusova. Restoration of seed production of tomatoes varieties Volgogradsky 5/95 and Yusupovsky. // Universum: chemistry and biology: electron. scientific magazine Biological Sciences. - General biology, 27. Botany (M., 2021, p.5) [Online]. Available: <https://7universum.com/ru/nature/archive/item/11980>
7. Batken weather for 2016-2018. [Online]. Available: <https://world-weather.ru/pogoda/kyrgyzstan/batken/2018/>.
8. Recommendation on agricultural technology for growing seedlings of vegetable crops (Frunze, "Kyrgyzstan",1986, 26p)
9. OST 4671-78: Parameters [Plots and sowing schemes in breeding, variety testing and primary seed production of vegetable crops] (M., 1979,p.11-12)
10. Recommendation on the cultivation of vegetable crops in the south of the Kyrgyz Republic (Frunze - "Kyrgyzstan" 1987 - 32p)
11. Methodology of the State variety testing of potatoes, vegetables and gourds. (Issue four)-M., "Spike", 2015, p.29-35, 50-59)
12. Instructions for approbation of seed crops of vegetables, melons, fodder root crops. - M., 2001.- S. 12-15, 40-45. [Online]. Available: <https://files.stroyinf.ru/Data2/1/4293735/4293735206.pdf>.
13. B.A.Dospekhov. Methods of field experience (M., «Agropromizdat», 1968. - S. 256-261) [Online]. Available: http://www.biometrika.tomsk.ru/contents/dospehov_0.pdf
14. International CMEA classifier of the genus Lecopersicon tourn. - Leningrad, VIR. - 1986. - 37p.
15. A.F.Gizatova, N.N.Zhuravleva, A.P.Legeyda, K.N.Osmonalieva and others.// Reference book on approbation and basics of seed production of vegetable and melon crops. - Frunze, "Kyrgyzstan" - 1986. - p. 5-22.