Breeding and seed production of protected soil vegetable crops in the Middle Urals

Karpukhin Mikhail Yuryevich, Vice-Rector for Research and Innovation, Ural State Agrarian University (city of Yekaterinburg), Candidate of Agricultural Sciences, Associate Professor

Abstract. The article examines the scientific achievements of Ural scientists in the field of breeding and seed production of protected soil vegetable crops. Department of Vegetable and Fruit Growing named after Prof. N.F. Konyaeva has been breeding vegetable crops since 2004. Since 2015, joint breeding work has been underway with RPC Agrosemtoms LLC, Breeding and Seed Growing Company Ilyinichna LLC. The business partners are Teplichnoye JSC, Agroactive LLC of the UMMC-Agro holding, the NPO Union of Peasant (Farmer) Farms of the Sverdlovsk Region, and the Union of Horticulturists of the MD of the city of Yekaterinburg and Sverdlovsk Region.

During the breeding period, 3 cucumber hybrids ("Legkoatlet", "Kolyan", "Uralochka") and 3 tomato hybrids (F1 "Naslazhdeniye", F1 "Zateynik", F1 "Nastavnik") were created.

In recent years, scientific research laboratories for molecular and biological research, modern breeding and genetic research in vegetable growing, microclonal reproduction and DNA technologies have been opened and provided with all necessary equipment. This allows the use of modern breeding methods (marker-oriented breeding, "speed breeding" technology, etc.), which almost doubles the process of obtaining new competitive hybrids.

In 2025 (the Year of Defender of the Fatherland and 80 years of the Great Victory), a hybrid F1 Snaryad was created dedicated to this event. Unique cucumber hybrids have been created in terms of taste, biochemical composition, and universal use - F1 Olympiyets and F1 Nezhny.

Breeding work is carried out on the basis of the greenhouse complex in Sadovy village and the university greenhouse complex of Studenchesky village in the greenhouses of various types, which makes it possible to create hybrids for both winter greenhouses with low-volume crops and ground polycarbonate greenhouses in the region to meet the demand for protected ground vegetable seeds (cucumber, tomato) to ensure import substitution in the seed market and food security for these crops in the region.

Introduction. The Russian greenhouse industry is developing not only towards an extensive increase in production volumes, but also due to the large-scale introduction of modern agricultural technologies, equipment, structures, breeding achievements, optimization of business processes, improvement of pre-sale preparation of products, expansion of geography and sales channels.

A significant role is assigned to the variety in solving the problem of further development of the vegetable industry. According to A.A. Zhuchenko, the share of the variety in crop formation is about 70%. At the same time, it is possible to increase resistance to environmental stressors, including pests and diseases, minimizing the use of pesticides, avoiding contamination of food and environment. The basis of modern technologies of cultivation (production) of vegetable crops is also a variety. Therefore, the demand for new varieties and hybrids is constantly growing.

The limiting factors for the development of the protected soil vegetable growing industry are: insufficient number of domestic competitive hybrids and varieties of staple crops (tomato, cucumber), quantity and quality of seed material. Depending on the crop, the dependence on seed imports is from 65 to 90%. In the face of unprecedented pressure and international sanctions on our country, it is necessary to overcome dependence on imported seeds as soon as possible. Therefore, the creation of domestic competitive varieties and hybrids of cucumber and tomato and their seed production for greenhouse plants, complexes and polycarbonate greenhouses of farms and households are extremely relevant at the present stage.

Materials and Methods. All breeding experiments were conducted according to the guidelines for protected soil (Dospekhov, Vashchenko, Nabatova, 1974; Vashchenko, Nabatova, 1976). The area of plots in the experiments is 5-6 m^2, the repeatability is 3-4-fold. The arrangement of plots is systematic, considering the microclimatic zones in the greenhouse. The variety study was carried out according to the method of variety testing in protected soil.

The following calculations and observations were carried out in the experiments.

Phenological observations of the appearance of seedlings, the unfolding of the first and fifth leaves, the onset of the flowering phase of staminate and pistillate flowers, the dates of the first and last harvest.

Biometric readings were taken for 4-5 typical plants in all replicates, reflecting the condition of the variant, the height of the plants, the number of lateral shoots, the length of the internodes, the width and length of the leaf blade, and the mass of the roots were determined. The leaf surface was calculated according to the method of V.Ya. Volkov and V.F. Selevtsev (1959). The observations were carried out in seedlings, at the beginning, middle, and end of the growing season.

Pest and disease damage was recorded according to a generally accepted methodology (Berim, Sokolovskaya, 1969).

The yield of hybrids was recorded by weighing fruits from plots on electric scales and recalculated by kg/m^2. Early and total yields were determined.

The results of the experiments were processed by the method of variance analysis according to B.A. Dospekhov (1985).

Discussion. Scientists of the Ural State Agrarian University have been breeding protected soil vegetable crops since 2004. Breeding in the FSBEI HE Ural SAU is aimed at obtaining heterotic F1 hybrids. Since 2015, breeding work has been carried out jointly with leading breeders of the Russian Federation and business partners of RPC Agrosemtoms, breeding and seed agricultural company Ilyinichna, and since 2025 with the Federal Scientific Center for Vegetable Growing and GC Gavrish. Every year, on the basis of the modern greenhouse complex of Teplichnoye JSC and the greenhouse complex in the university's experimental farm, a collection, hybrid nursery of the source material, breeding and control nurseries of preliminary testing are organized.

The main areas of training for protected soil vegetable growing at the FSBEI HE Ural SAU: 35.03.05 Horticulture (bachelor's degree), 35.04.05 Horticulture (Master's degree), profile "Modern technologies in protected soil".

To conduct practical training in protected soil vegetable growing, breeding and seed production of vegetable crops, the basic department "Modern Technologies in protected soil" was established on the basis of Teplichnoye JSC, Agroactive LLC of the UMMC-Agro holding.

Breeding at the FSBEI HE Ural SAU is aimed at obtaining heterotic F1 hybrids, which differ from varieties in that their seeds are obtained by crossing two or more parental forms with strong genetic properties.

The main requirements for the resulting tomato hybrids are the following:

high productivity, resistance to diseases, large fruit, high tastiness, absence of a hard fibrous core, high content of lycopene, anthocyanin, nutrients, and vitamins, shelf life, creation of a new type of hybrids.

The main requirements for the resulting cucumber hybrids are the following:

High productivity, resistance to diseases, versatility of use, parthenocarpic type, high species qualities, absence of bitterness, high content of nutrients and vitamins, shelf life.

During the entire period of breeding work, 3 cucumber hybrids ("Legkoatlet", "Kolyan", "Uralochka") and 3 tomato hybrids (F1 "Naslazhdeniye", F1 "Zateynik", F1 "Nastavnik") were created and entered into the State Register under the scientific supervision and with the direct participation of university scientists. Every year, the FSBEI HE Ural SAU receives from 0.5 to 1.5 kilograms of tomato and cucumber seeds for protected soil.

As a result of the research work, the university's scientists have obtained the following patents:

- No. 2299539 "Method of growing plants in greenhouses";
- No. 2391813 "Method of growing cucumbers in spring greenhouses";
- No. 2541307 "Method of intensive tomato cultivation in the Ural region";
- No. 2740106 "Method of selection of tomato hybrids for industrial greenhouses in the Urals";
- No. 2825155 "Method of obtaining seeds of heterotic cucumber hybrids".

Hybrids of cucumber F1 Olympiyets and F1 Nezhny have been created.

Scientific school "Breeding and seed production of vegetable crops and potato".

In 2025, a new tomato hybrid with a unique shape and excellent taste was created in honor of the Defender of the Fatherland year and the celebration of the 80th anniversary of the Great Victory F1 Snaryad.

Breeding achievements

Tomatoes

Nastavnik F1

The plant is tall, of an indeterminate type of growth, but it can also be grown in the open ground with mandatory pinching of the tip, because the Nastavnik is an early-ripening tomato and the first fruits ripen on the 100th-110th day from germination. The fruits are bright red, about 200 g, with dense, delicious flesh, high in sugars and healthy lycopene.

The peculiarity of the Nastavnik variety is not only that it is adapted to adverse weather factors, but that this salad-type tomato has an enviable shelf life and transportability!

It is resistant to tobacco mosaic virus, fusarium, and brown patch (cladosporiosis).

Zateynik F1

The Zateynik is a tall, early-ripening tomato. It takes 105-110 days from germination to fruit ripening. The plant grows intensively, the first inflorescence is laid over the 9th leaf, the rest through three leaves. There are 6 to 8 beautiful fruits on each brush. The fruits are of medium size 90-110 g, which is very convenient, because the pickling qualities of the Zateynik are beyond praise. Another distinctive feature of the fruits of the Zateynik is that they are well transported and perfectly preserved for a whole month without losing their qualities. This is despite the fact that there are no hard vegetable fibers in them! Delicious, versatile, and reliable tomato.

The Zateynik sets the fruit well, even in adverse weather conditions. It has group resistance to major tomato diseases.

Naslazhdeniye F1

Naslazhdeniye is the tomato that will always be missed on the table. It's so delicious.

Tall, early-ripening tomato (100-110 days from germination to ripening) of the salad type. It is suitable for growing in greenhouses, but it also bears fruit well in the open ground, with a mandatory tying. After all, the Naslazhdeniye tomato is able to set fruits and ripen even in adverse weather conditions.

There are five to seven fruits in the Naslazhdeniye bunch, each weighing 120-140 g. The fruits are rich orange, multi-chambered, dense. The taste is amazing. Sweet and bright. After all, fruits contain a huge amount of sugars and other compounds useful for the body.

It perfectly tolerates temperature and humidity fluctuations. The fruits at the same time do not crack! It is resistant to brown patch and tobacco mosaic virus.

Cucumber

Kolyan F1

Parthenocarpic, salad, cannery. It enters fruiting on the 45-50 day after full shoots. The plant is indeterminate, medium-branched, predominantly female flowering type, the number of female flowers in the node is 1-3. The leaf is medium-sized, green. The young fruit is short with a neck, spindle-shaped, light green with short stripes, bumpy, white pubescence, medium density. The young fruit weight is 126-138 g. The taste is good. Commercial yield is 6.6-8.2 kg/sq.m. The yield of marketable products is 94%. Resistant to mildew, tolerant to downy mildew.

Uralochka F1

Parthenocarpic, salad, cannery.

It enters fruiting on 46-50 days after full shoots.

The plant is indeterminate, strongly branched, predominantly of the female type of flowering, the number of female flowers in the node is 1-3. The leaf is medium-sized, green. The young fruit is short with a neck, spindle-shaped, light green with stripes of medium length, large-bumpy, with white pubescence, medium density. The weight of the young fruit is 95-111 g. The taste is good.

Commercial yield is 7.0-8.2 kg/sq.m. The yield of marketable products is 89%.

Resistant to mildew, tolerant to downy mildew.

Conclusion.

The results of research work in the field of breeding, seed production, and cultivation of the main types of vegetable crops have been successfully implemented in Agroactive LLC (Teplichnoye JSC, UMMC-Agro), RPC Agrosemtoms LLC, the University's educational and experimental farm, the NPO Union of Peasant (Farmer) Farms of the Sverdlovsk region, the Union of Horticulturalists of the MD if the city of Yekaterinburg and the Sverdlovsk region".

The use of highly productive hybrids of cucumber and tomato from the Ural SAU in protected soil under conditions of import substitution on low-volume crops and ground polycarbonate greenhouses, the production and use of high-quality seed material of domestic vegetable hybrids can reduce the cost of domestic vegetable crops cultivated in protected soil due to high productivity and resistance to major diseases by 15-20%.

Creation of new competitive tomato and cucumber hybrids with high adaptability, productivity, and resistance to major diseases. Original seed production and the introduction of new hybrids into production. Obtaining tomato hybrids of a "new type" will significantly reduce production costs and increase the profitability of protected soil. The uniqueness of the "new type" hybrids lies in the closer location of generative organs on the plant stem, which significantly reduces the cost of caring for plants during the growing season in protected soil. In recent years, marker-based breeding has been used to carry out breeding work, which makes it possible to evaluate genes in a plant organism using molecular methods for disease resistance and choose the best combination for crossing. It is expected to create a technology for accelerated breeding of new tomato and cucumber hybrids based on modern genetic methods.

To carry out successful breeding work, the FSBEI HE Ural SAU has established and equipped with all the necessary equipment a research laboratory for molecular and biological research, a research laboratory for "Modern breeding and genetic research in vegetable growing", and the greenhouses of the university's experimental farm have been renovated. The modern material and technical base allows the use of innovative breeding and genetic methods and technologies (marker-oriented breeding and "speed breeding" technologies), which double the speed of the breeding process.

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