



Breeding value of collection varieties of potato in the forest-steppe zone of the tyumen region

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Abstract

In the conditions of the Tyumen region, sources of valuable economic traits that may later be used for creating intensive and semi-intensive varieties of potato have been isolated. Since potato is grown in 70-80% of farms with the average level of farming culture, breeding is performed in two areas – creating varieties of intensive and semi-intensive types that are adapted to the local conditions. Special attention is paid to studying collection varieties of domestic and foreign breeding. Varieties that combine late blight resistance and other characteristics are of particular value. These include: Udacha, Lina, Sentyabr, Bryanskaya Novinka, Zarevo, Lorkh, Asterix, Golubizna, Lybid, Ogonyok, Post 86, etc., which gave rise to new varieties in other regions of the country. The collection varieties obtained by the method of interspecies hybridization, Pushkinets, Zarevo, Charoite, Gusar, Ocharovaniye are simultaneously resistant to several diseases.

These sources are a valuable source material for creating potato in the Tyumen region.

Keywords: source material, maturing rate, yield, starch content, adaptability.

INTRODUCTION

In the Tyumen region and in Siberia in general, potato is grown mostly at farms with the medium level of soil cultivation, although the state grade testing is performed with high level of farming. Varieties of the intensive type with the yield of 50-60 t/ha and more implement the potential in the production conditions by 30-40%, therefore, along with intensive varieties, semi-intensive potato varieties are to be picked, which are capable of implementing the potential by 50-70% in the production conditions. Therefore, potato breeding should pursue the goal of creating intensive and semi-intensive potato varieties, and the state grade testing should be conducted at high and medium nutrition levels [1, 2].

The success of creating potato varieties with the desired characteristics depends on the availability and knowledge of the source material [3, 4, 5, 6, 7, 8]. In this context, the research is aimed at studying source potato material, and detecting valuable sources for further use in breeding.

PLACE AND METHODS OF RESEARCH

The research was performed in 2011-2015 in the experimental field of the Northern Trans-Urals State Agrarian University. The soil was leached heavy-loamy black soil, with soil density 1.1-1.2 g/cm³, average availability of nutrition elements, pH 6.7. Predecessor: potato and annual herbs.

Tillage included plowing to the depth of arable layer, harrowing in the spring, cultivation to the depth of 13-15 cm, and ridge-forming tillage. Planting was made in the optimum period with the soil temperature of +10+12°C, the planting pattern was 70 x 30 cm, plots area was 30 m², reference plot area was 25 m², and the standard was the best registered variety Sarma.

The potato plantings were taken care of in the form of two row cultivations, hilling and two chemical treatments with preparations Aktara and Decis against the Colorado beetles.

The observations and counts were made according to the methods of the All-Russian Relay Research, Design & Technology Institute n.a. N.I. Vavilov, the All-Russian Research Institute of Potato Breeding n.a. A. G. Lorkh [9], and the State Grade Testing for Agricultural Crops [10]. Adaptability was studied by the method of S. A. Eberhart and W.A. Russell as presented by Zykin V. A. [11]. The quantitative traits were

processed statistically according to the method of B. A. Dospekhov [12].

RESULTS AND DISCUSSION

During the years of study, the weather conditions were contrasting. 2012 was characterized by drought and high air temperature, 2013 and 2014 were characterized by the weather close to the long-term data, and 2015 was characterized by high moisture and low temperature. Thus, the prevailing weather conditions in the years of research allowed to fully assess the collection potato varieties.

In the conditions of the Tyumen region, and Siberia in the whole, ripening rate of a variety is of paramount importance [2, 13, 14]. Early and medium ripening potato varieties take about 60% of the area intended for cultivating the crop in the region. In terms of the ripening rate, the following varieties were outstanding: Vesna white and pink, Zhukovsky Early, Skoroplodny, Khibinsky Early, Beloyarsky Early, Borodyansky pink, Ermak improved, Impala, Karatop, Meteor, Una, Udacha, Arosa, Red, Scarlet, Adretta, Lina, Valentina, Svitanok Kievsky, Nevsky, etc. On the 60th day after planting, they formed 400 to 500 g. the tubers per bush, and 700 to 1,200 g. on the day of final harvesting.

In the Tyumen region, diseases destroy 20 to 30% of the yield, and more [15]. The most common are late blight and virus diseases. Producers at large specialized farms have to perform several chemical treatments per summer. Among collection varieties, the following varieties are outstanding in terms of resistance to late blight: Udacha, Lina, Sentyabr, Bryanskaya Novinka, Lugovskoy, Belousovsky, Hybrid BK1, Zarevo, Asterix, Loshitsky, Nikulinsky, Filatovsky, Lorkh, Golubizna, Lybid, Ogonyok, Lazar, Post 86, Reserve, Zekura, Rosara, Skoroplodny, Vyatka.

In the last decade, nematode has become widely spread in Siberia [7, 16], therefore, valuable sources should be outlined in studying the source material. Among domestic varieties, the following varieties are resistant to nematode: Zhukovsky Early, Almaz, Prigozhy 2, Prolisok, Pushkinets, Bezhitsky, Desnitsa, Rozhdestvensky, Shurminsky, Granat, Zavorowski; among foreign varieties, Anosta, Impala, Karatop, Latona, Rosara, Ukama, Fresco, Valiza, Red Scarlet, Zekura, Sante, Diamant, Asterix, etc.

Good taste qualities were characteristic of varieties Svitanok Kievsky, Alena, Lazar, Lina, Tuleevski, Sarma, Solnetchny, Borodyansky pink, Adretta, Zekura, and Skarb.

The previously obtained collection varieties are included into the adaptability study experiment. Along with that, attention is focused on the main agronomic characteristics – the yield, the number of tubers per bush, and the starch content in them. Our many years of observations show that yields are closely related to the number of tubers per bush, and are much less related to the size of the tubers. In this context, the model variety for the Tyumen region should have the average particle size of 90 to 100 g; the tubers should be round or oval. Stability of the number of tubers per bush can be judged upon by the data in Table 1 and Figure 1.

Table 1. The number of tubers per bush for collection potato varieties

Variety	Tubers per bush, pcs.				Average	To the standard ±
	2012	2013	2014	2015		
Predecessor potato						
Zhukovsky Early, standard	13	16	15	17	15	-
Charoite	9	12	11	13	11	-4
Meteor	11	12	10	14	12	-3
Una	8	10	12	11	10	-5
Udacha	10	12	15	13	12	-3
Red Scarlett	9	13	11	15	12	-3
Aroza	11	14	12	13	12	-3
Karatop	14	18	17	21	17	+2
Impala	15	18	16	20	17	+2
Peas-oats mixture						
Zhukovsky Early, standard	13	18	16	17	16	-
Charoite	11	12	13	15	13	-3
Meteor	10	14	11	13	12	-4
Una	10	11	12	10	11	-5
Udacha	12	11	13	14	12	-4
Red Scarlett	8	15	12	13	12	-4
Aroza	13	16	11	15	14	-2
Karatop	14	20	19	23	19	+3
Impala	17	18	17	22	18	+2

Standard variety Zhukovsky Early by predecessor potato had 13-17 tubers per bush, and by the peas-oats mixture, 13-18 tubers. The collection varieties included into the Table were inferior to the standard by 2-5 tubers, although on the average during the research years they yielded 10 to 14 tubers per bush. With both predecessors, two varieties were distinguished - Karatop and Impala - with 14-19 tubers per bush, which was 2-3 tuber above the yield of standard varieties. Both varieties are of interest for breeding.

By the regression coefficient (bi), the most valuable are varieties Zhukovsky Early, Charoite, Meteor, Red Scarlett, Impala, with both predecessors form the same number of tubers on a stable basis.

In the post-perestroika period, potato yield in the Tyumen region increased from 14 to 24 t/ha, and remained the same in the last five years. The best farms, like agricultural company KriMM in the Uporovsky region, the Druzhba farm in the Zavodoukovsk region, and the Ptchela farm in the Tyumen region get yields of 30-50 t/ha [17]. These farms have high level of the farming culture, and intensive varieties here reach adequate productivity. However, it should be noted that the major part of potato is produced at farms with medium and low level of the farming culture [2, 7]. At these farms, it is advisable to grow semi-intensive varieties that are well adapted to the local

conditions. Surely, work should be performed to improve soil fertility, seed production, and the cultivation technology, etc.

Yield of the varieties outstanding by the complex of economically valuable characteristics is shown in Table 2.

Table 2. The yield of early maturing collection potato varieties

Variety	Yield, t/ha				Average	To the standard ±
	2012	2013	2014	2015		
Predecessor potato						
Zhukovsky Early, standard	14.9	22.1	20.8	19.4	19.3	-
Charoite	17.3	20.9	23.2	21.7	20.7	+1.4
Meteor	16.5	21.3	20.1	22.9	20.2	+0.9
Una	18.1	19.6	22.0	20.7	20.1	+0.8
Udacha	16.8	21.8	18.6	20.1	19.3	-
Red Scarlett	15.6	19.2	21.9	23.5	20.1	+0.8
Aroza	16.7	19.0	21.7	20.9	20.3	+1.0
Karatop	10.4	21.3	15.1	22.6	17.3	-2.0
Impala	16.0	19.8	20.0	20.7	19.1	-0.2
LSD ₀₅	1.8	1.2	1.5	2.1		
Peas-oats mixture						
Zhukovsky Early, standard	19.3	26.0	28.7	24.2	24.5	-
Charoite	22.5	24.9	25.3	27.1	24.9	+0.4
Meteor	16.1	27.4	26.8	30.6	25.2	+0.7
Una	20.8	25.2	29.0	26.4	25.3	+0.8
Udacha	19.6	28.1	27.5	28.9	26.0	+1.5
Red Scarlett	14.3	24.0	30.2	25.7	23.5	-1.0
Aroza	21.8	25.4	27.0	29.1	25.8	+1.3
Karatop	12.5	27.2	22.6	32.4	23.6	-0.9
Impala	22.0	26.9	31.3	28.5	27.1	+2.6
LSD ₀₅	2.0	1.6	1.9	2.4		

Table 3. Starch content in tubers of early-ripening potato varieties

Variety	Starch, %				average	To the standard ±
	2012	2013	2014	2015		
Predecessor potato						
Zhukovsky Early, standard	13.1	11.4	10.8	9.5	11.2	-
Charoite	17.3	16.5	15.7	16.1	16.4	+5.2
Meteor	14.6	13.9	12.4	13.0	13.5	+2.2
Una	15.8	15.0	14.1	15.3	15.0	+3.8
Udacha	14.1	13.7	14.5	15.0	14.3	+3.1
Red Scarlett	13.4	12.9	12.3	11.6	12.5	+1.3
Aroza	14.7	13.0	14.1	13.8	13.9	+2.7
Karatop	16.3	14.9	15.7	14.2	15.2	+4.0
Impala	15.0	14.1	15.3	14.9	14.8	+3.6
LSD ₀₅	1.1	1.5	0.9	1.3		
Peas-oats mixture						
Zhukovsky Early, standard	14.3	12.3	11.9	12.1	12.6	-
Charoite	18.2	17.1	16.4	17.0	17.1	+4.5
Meteor	15.4	14.0	14.2	15.3	14.7	+2.1
Una	16.1	15.6	15.0	16.7	15.8	+3.2
Udacha	15.0	14.9	15.7	15.4	15.2	+2.6
Red Scarlett	13.9	13.4	12.9	13.1	13.3	+0.7
Aroza	15.4	14.2	14.7	14.9	14.8	+2.2
Karatop	16.8	15.6	16.3	15.8	16.1	+3.5
Impala	14.7	15.3	16.1	16.4	15.6	+3.0
LSD ₀₅	1.6	2.1	1.8	1.3		

Analysis of the data in Table 2 shows that standard variety Zhukovsky Early by predecessor potato is not inferior to the studied collection varieties. It may be used in breeding for obtaining a higher yield rate along with them.

By the peas-and-oats mixture, the maximum yield of 27.1 t/ha was obtained for variety Impala, which was 2.6 t/ha higher than the standard. This variety may be used as a source in breeding intensive varieties.

It is important to identify varieties that consistently provide stable yield over years Figure 2.

Varieties Meteor, Red Scarlett and Karatop are characterized by high yields and high response rate to the growing conditions with potato and peas-and-oats mixture predecessors ($b \geq 1$). This reaction is characteristic of intensive varieties.

Starch content in tubers is one of the main indicators of a variety. Processing requires varieties with high content of dry matter and starch, and low content of reducing sugar. It should be

noted that for the table purposes, especially for mashing, Siberians prefer potato varieties with high starch content.

In the conditions of the Tyumen region, collection potato varieties accumulate high enough starch percentage (Table 3).

With the starch content in the standard variety Zhukovsky Early of 11.2% with predecessor potato, and 12.6% with predecessor peas-oats mixture for green mass, collection grades exceeded it only by 0.7 to 5.2%. The maximum excess of 3.0 to 5.2% was observed in varieties Una, Karatop, Impala, and Charoite. Stability of starch formation depends on the variety (Figure 3).

Plastic and stably forming starch content in the tubers were early ripening potato varieties Zhukovsky Early, Charoite, Meteor, Red Scarlett, Karatop, bi was close to or exceeded 1, sd2 was close to 0, meaning that starch content in the tubers corresponded to changes in the environmental conditions.

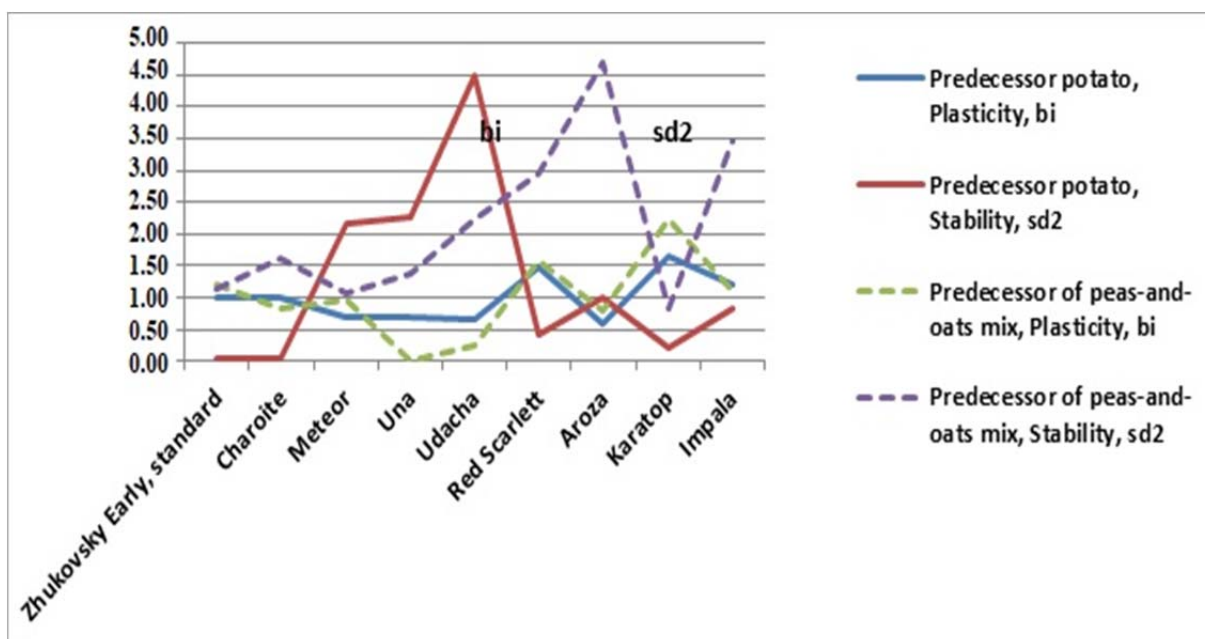


Figure 1. Plasticity and stability of the number of potato tubers per bush with various predecessors, 2011-2015

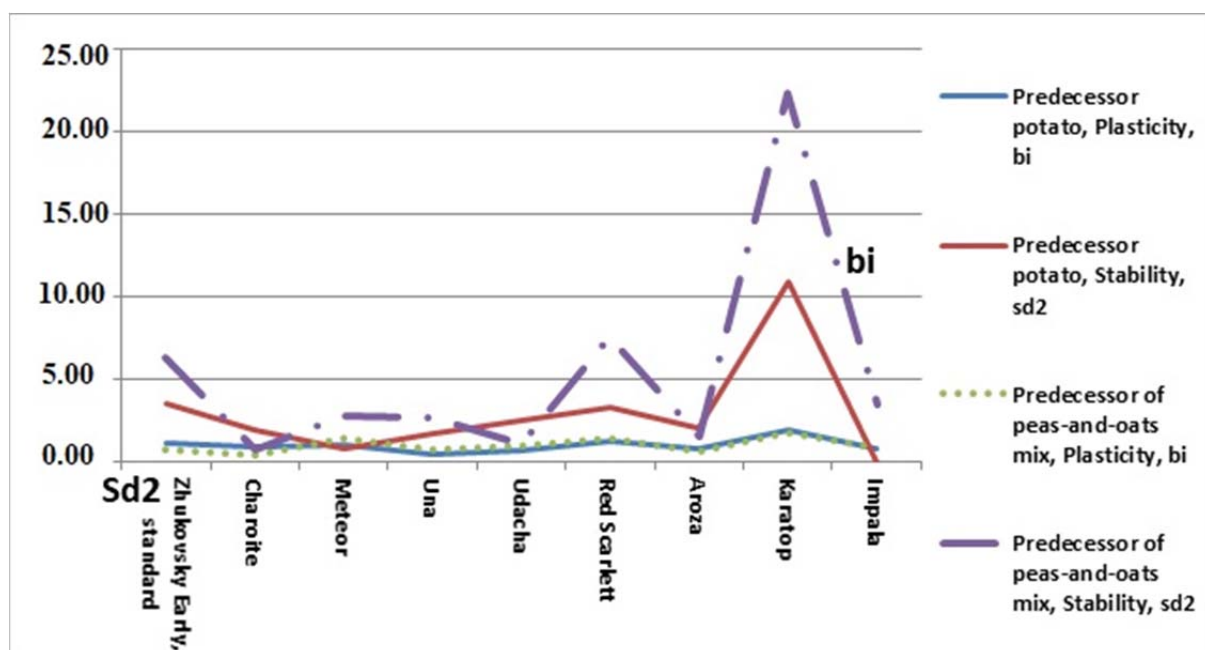


Figure 2. Plasticity and stability of potato yield with various predecessors, 2011-2015

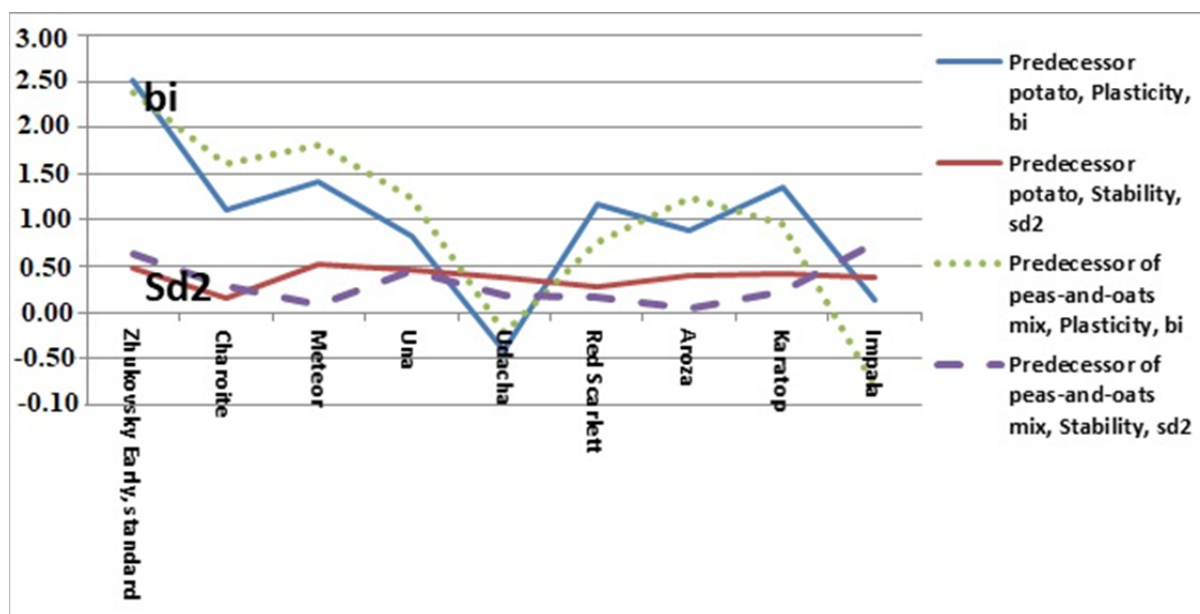


Figure 3. Plasticity and stability of starch content in the tubers of early potato varieties with various predecessors, 2011-2015

CONCLUSION

As a result of studying the source material, sources of valuable economic characteristics have been identified, which may then be used in breeding programs for creating intensive and semi-intensive potato varieties adapted to the conditions of the Tyumen region. Especially valuable for breeding potato are varieties resistant to late blight: Udacha, Lina, Sentyabr, Bryanskaya Novinka, Zarevo, Lorkh, Asterix, Golubizna, Lybid, Ogonyok, Post 86, etc., which have given rise to new varieties in other regions of the country.

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