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CONSERVATION, EVALUATION AND USE IN BREEDING OF POTATO GENETIC DIVERSITY AT THE N.I. VAVILOV INSTITUTE OF PLANT INDUSTRY (VIR).

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Abstract

The Potato Collection of the N.I.Vavilov Institute of Plant Industry is one of the biggest in the world. It totals about 9000 accessions including 3000 accessions of wild and 3500 of cultivated species, 2100 of bred varieties, 400 of interspecific hybrids and dihaploids. Accessions of cultivated species, hybrid clones and bred varieties are preserved *in vitro*. One hundred potato cultivars stored under in vitro conditions have been genotyped with 10 SSR primers. The initial material with a complex of valuable traits including resistance to fungal, viral, bacterial diseases and pests has a special importance for modern breeding programs. The main source of genes that control resistance to diseases and pests are the wild and cultivated species. Complex evaluation of hundreds of samples is carried out annually at VIR and its experimental stations. As a result, valuable material for breeding has been selected. Crossability of wild potato species belonging to the series *Acaulia* Juz., *Glabrescentia* Buk., *Commersoniana* Buk., *Demissa* Buk., *Longipedicellata* Buk., *Simpliciora* Buk., *Megistacroloba* Card. et Hawk., *Transaequatorialia* Buk. (=*Tuberosa* wild Hawkes, =*Bukasoviana* Gorbat.) with species of other series and bred cultivars has been investigated recently. The first generation of hybrids and their subsequent backcrosses and synthetic crossings have been obtained. Germplasm from the VIR collection is permanently requested and widely used by breeders as initial material for creating new varieties.

Key words: collection, accession, trait, resistance, breeding

Introduction

The collection of the N.I.Vavilov Institute is widely represented by diversity of *Solanum* genus, section *Petota*: about 170 wild and cultivated potato species, both Russian and foreign breeding cultivars. The field potato collections maintained using traditional methods suffer significant losses, caused by the influence of extreme environmental factors and accumulation of viral and bacterial diseases in plants. Therefore, *in vitro* collection of the plants cleaned and identified by modern methods is an obligatory and integral part of modern banks of genetic resources.

One doubtless advantage of *in vitro* collections is that many hundreds of collection samples can be stored in controllable conditions and exchanged between various genebanks and breeding companies.

One of the major directions of VIR activity – researches in prebreeding area, searching and creation of sources and donors of various valuable traits, including resistance to most dangerous pathogens. Our institute is focusing on research in pre-breeding area, as well as selection and creation of sources and donors of various valuable traits, including resistance to most dangerous pathogens.

Now, in Russia about 90 % of potato is grown in little farms and kitchen gardens, where the improvement of agricultural technology with elements of plants protection appears very difficult. In this situation, now the most important question is the creation of universal cultivars that would combine high efficiency, earliness, high table and processing qualities, with high and stable resistance to the most harmful diseases and pests. The most harmful pathogens for potato grown in Russia are late blight (*Phytophthora infestans* (Mont) de Bary), rhizoctonia *Rizoctonia solanii* Kuhn., common scab *Streptomycies scabies*, potato viruses X, Y, S, M, golden potato cyst nematode *Globodera rostochiensis* Woll and Colorado beetle. Breeders require new genetic sources of resistance to these pathogens, and also sources of high yield, earliness and tuber quality. Therefore, the primary goal of the researches which have been carried out over the last 6 years (2001-2006) was to comprehensively study the VIR potato collection, and to determine which genotypes have valuable agronomic features (characteristics, properties, traits) and are resistant to the above-mentioned pathogens.

Material and methods

The comprehensive evaluation of the samples from the potato collection was carried out in collaboration with researchers from the All-Russian Plant Protection Institute (RPPI) and was aimed at finding new genetic sources for breeding on resistance to the main potato pathogens. The samples for screening were selected after a preliminary three-year visual evaluation. Laboratory and field screening on resistance to fungal, viral diseases and golden potato cyst nematode was carried out using methods developed by the VIR (Guidelines on methodics, 1986), RPPI and All-Russian Potato Research Institute. In total, more than 1900 accessions of the potato collection were screened. The evaluation of commercial traits of breeding cultivars and cultivated species was carried out simultaneously in five VIR's experimental stations in various geographical regions: St.-Petersburg, Murmansk, Moscow, Tambov Region, Krasnodar. The breeding varieties selected after the preliminary studying evaluation were studied using a relatively new method, based on evaluation of the progenies derived from the self-pollination. According to this method of pre-breeding is recommended to use an initial material with the donor properties, selected on the basis of multistage screening (four stages). The methods of *in vitro* collection maintenance are described by E.V.Truskinov [1987]. PCR method, microsatellite (SSR), RAPD and organelle-specific primers were described earlier (Antonova et al., 2004; Gavrilenko et al., 2007).

Results and discussion

Maintaining, conservation and evaluation of genetic diversity of the VIR potato collection

The world potato collection of the VIR today account totals about 9000 accessions, including 3000 samples of wild species, 3500 accessions of cultivated species, 2100 – breeding varieties, 400 – dihaploids and interspecific hybrids. About 300 old varieties created 60 and more years ago are unique, because they are maintained only in the VIR Potato Genebank. Currently, studies are being carried out to investigate taxonomically important morphological characteristics of the samples and establish the number of chromosomes in them. In 2006, such studies were carried out for 250 accessions of cultivated species and 90 samples of closely related wild species. We have almost finished working on passport and evaluation databases that include information on geographical, taxonomic and biological characteristics of the samples. The collection grows each year through the exchange with other genebanks, breeding companies and research institutes.

The VIR *in vitro* potato collection is not large (compared to field collections), consisting of about 350 stocks, and has been created as a doublet collection of the virus-free plants representing unique and most valuable material, and also samples which cannot be reproduced by seeds. The majority of samples maintained in *in vitro* conditions are represented by breeding varieties (Russian and foreign). The *in vitro* collection also includes thri- and pentaploid cultivated species (*S.juzepczukii*, *S.chaucha*, *S. curtilobum*) which can not be reproduced by seeds and samples that are of particular interest for geneticists and breeders, including samples of wild species and hybrid clones. The *in vitro* collection is constantly growing as new material cleaned using standard methods of meristem culture and chemotherapy comes in each year. Every 2-3 years, indexation of the *in vitro* collection on presence of the main viral diseases (Y, X, M, S, L and Andean viruses) is performed using ELISA method. The *in vitro* collection is stored as microtubers under minimal growth conditions at +2^{o}C in darkness. The samples of plants are stored for 1–3 years (depending on the genotype) without carrying on fresh nutrient media.

Maintenance of large collections requires control and identification of the material maintained. Therefore, since 2000 the VIR has increasingly applied molecular methods based on the use of DNA markers that make it possible to genotype the samples and evaluate their genetic diversity. The genotyping of breeding varieties and South American aborigine potato cultivars on basis SSR of the analysis is carrying out. Ten nuclear microsatellite markers were successfully used for genotyping 100 breeding and 20 Chilean aborigine cultivars from the VIR collection (Antonova et al., 2004).

The genetic diversity of 100 Russian and foreign breeding varieties was analyzed by PCR with organelle-specific primers. 8 various haplotypes were identified in the analyzed subset. Low level of genetic diversity was shown both for foreign and for Russian varieties based on analysis of polymorphism of organelle DNAs – the majority of cultivars (92,9 %) related only to two haplotypes, 62 of them had the same "cultivated" type of cytoplasm (Gavrilenko et al., 2007).

The genetic stability of 20 *in vitro* samples was confirmed by comparing SSR-and RAPD-spectra of plants maintained *in vitro* for long periods of time (6 – 20 years) and their field analogues. The results of this research confirm the reliability of an *in vitro* sample maintenance method, which does not include cell culture and consists of consecutive stages of propagation by axilliary buds, maintenance of microshoots and storage of microtubers.

In vitro collections make it possible to maintain the improved field samples in controllable conditions and can be a source of material for future cryocollections.

Evaluation of the VIR collection for valuable breeding traits

The comprehensive evaluation of the collection for such commercial traits as yield, earliness, starch content, made it possible to identify valuable initial material for breeding.

Yield. The yield evaluation of breeding cultivars identified both Russian and foreign varieties which within 3-5 years exceeded the standard varieties by 60-80 %. The following varieties showed the highest yield (compared to standard, Nevsky and Petersburgsky, Aurora, Akrosia, Bouquet, Elizaveta, Elyseyevsky, Lazar', Malinovka, Russkii souvenir, Sparta, Kholmogorsky, Effect, Youbiley Zhukova (Russia); Blakit, Zhouravinka, Zarnitsa, Zdabytak, Lazourit, Odissey, Talisman, Yavor (Byelorussia); Baszta, Bzura, Koga, Triada, Tristar, PS-17036 (Poland); Alwara, Ivetta, Velox (Germany); Koreta, Korneta (Czech Republic). Varieties Udacha and, Lazurite were equally high and stable in terms of years in different geographical conditions and were considered plastic on yield, earliness and table qualities.

Number of tubers - is one of the components of potato yield. The richest sources of this trait are South American cultivated species *S. andigenum, S. rybinii, S. goniocalyx* and *S.*

stenotomum. The wide polymorphism characteristic of these species has made it possible to identify the new sources of high number of tubers, namely *S. andigenum* k-3141, k-8194, k-4629, S. *rybinii* k-1713, k-6406, k-7160, k-8592, k-5935, k-5974, k-8596, *S. goniocalyx* k-6507, k-7048, k-8069, k-3154, k-8162, k-4620, k-17961, *S. stenotomum* k-12782, k-10915, k-13257, k-13250, k-10433. The average number of tuber per one plant in these samples is between 25 and 40.

Earliness. Creation of early varieties is an important breeding objective, especially for North and Northwest regions of Russia. Over the last years, the potato collection has been augmented with new early varieties, many of which combine earliness with other valuable traits. After three years of studying the new varieties, the following have been considered to be the best early varieties: Alyona, Bezhitskii, Bryanskii delicatess, Daryonka, Debryansk, Zhavoronok, Zhukovskii rannii, Lakomka, Lina, Ljubava, Pamyaty Osipovoy, Pogarsky, Russkii souvenir, Snegir', Udacha, Kholmogorsky, Effect (Russia), Yavor (Byelorussia), Aster, Bekas, Irga, Harpun, Lena (Poland), Andra, Bonus, Velox (Germany); Kobra, Korela, Korneta, Krasa, Tegal (Czech Republic) etc. Most of them exceeded the standard for this parameter by 20–40 %.

High starch content. Byelorussian varieties are a valuable source for breeding on high starch content. It was confirmed by the results of an evaluation on progeny from self-pollination of the varieties that had shown a high degree of inheritance of this trait (60-80 % of seedlings). The following cultivars can also be recommended as high-starch varieties: Bryanskii nadjozhnyi, Bryanskaya novinka, Golubizna, Nakra (Russia), Alpinist, Atlant, Garant, Zdabytak, Zoubryonok, Lazurit, Miolavitsa, Synthez (Byelorussia), Zarevo (Ukraine), Asaja, Assia (Germany), Agria, Kardal, Karida, Karnico, Vebeca (Netherlands), Ceza (Poland).

Resistance to late blight. This disease is still one of the most harmful and common disease for potato grown in Russia. Therefore, the problem of creating varieties resistant to late blight is one of the most important tasks on potato breeding. Wild species of the *Solanum* L. genus are the main source for breeding late blight-resistant cultivars. The studies of their wide diversity in potato collections make it possible to find new sources of high resistance, both hypersensitive type and broad-spectrum (horizontal) type. Therefore, apart from the species that have already been discovered, namely *S. berthaulti, S. bulbocastanum, S. demissum, S. fendlerii, S. medians, S. microdontum, S. michoacanum, S. pinnatisectum, S. polyadenium* and *S.polytrichon,* which have a lot of resistant genotypes, we found genotypes, which had not been identified before as possessing resistant forms: *S. albicans* k-9813, *S. cardiophyllum* k-16828, k-17380, *S. dodsii* k-20705, k-20709, ***S.*** *hougasii* k-10515, k-12165, k-18886, *S. okadae* k-20175. It needs to be mentioned that the following samples can be characterized as being highly late blight-resistant: *S. cardiophylum* k-16828, k-10456 and *S. ocadae* k-20177.

Five years of studies have shown that the following species are highly resistant to late blight: *S. albornzii* k-17621, *S. avilesii* k-20410, *S. berthaultiik* k-7637, k-8787, k-23047, *S. brachycarpum* k-21258, *S. capsicibaccatum* k-15155, *S. immite* k-12168, k-16564, k-18109, *S. microdontum* k-19136, *S. ruiz-ceballosii* k-7370, *S. simplicifolium* k-5399, *S. vernei* k-18158, *k-18161,* k-20125 and North-American species: *S. demissum k-23306, k-2332, S. bulbocastanum* k-19048, k-21275, k-21278, k-22677, k-22998, *S. hougasii* k-18886, *S.iopetalum* k-1052, *S. papita* k-16888, k-9145, k-17454, k-21547, k-22592, *S. pinnatisectum* k-17463, k-19758, k-15252, k-15253, *S. polyadenium* k-15256, k-18139, k-19330, *S. polytrichon k-18925, S. stoloniferum* k-19200, k-19201, *S. verrucosum* k-22609. Accessions *S. berthaultii* k-23047, *S. cardiophyllum* k-16828, *S. neoantipovichii* k-8505, *S. ruiz-ceballosii* k-7370 combine foliage and tuber resistance to late blight (Zoteyeva et al., 2004).

It is important to emphasize the high value of accessions of wild species that are resistant to several pathogens. Accession of *S. pinnatisectum* k-15253 combines resistance to late blight and to three pathotypes of PVY, Colorado beetle and potato tuber moth (Zoteyeva et al., 2004).

An evaluation of breeding varieties identified accessions with high field resistance to late blight (7–8 points). These are Aspiya, Vestnik, Loukyanovskii, Nikulinskii, Udacha, Charodey (Russia); Zdabytak, Lasunak, Souzor'e (Byelorussia); Zarevo, Lugovskoy, Lybid' (Ukraine); Ania, Baszta, Dunajec, Grot, Jantar, Klepa, Koga, Lawina, Meduza, Omulev, Triada, Vistula (Poland), Clarissa (Germany); hybrid clones from USA LBR-1, LBR-7, LBR-18, LBR-46, LBR-47.

Resistance to other fungal diseasess. Studies on more than 600 accessions of wild and cultivated species from the VIR potato collection that were carried out in cooperation with researchers from Petrozavodsk State University and were aimed at assessing their resistance to common scab and rhizoctonia showed that the following accessions are highly resistant to these diseases: *S. chacoense* k-21321, *S. kurtzianum* k-20038, *S.fendlerii* k-20011, *S. oplocense* k-19145, S. polytrichon k-20087, *S.andigenum* k-1752, k-764, k-3191, k-3895, k-4709, k-4713, k-4716, *S.rybinii* k-9087, k-16534, k-1815, k-9276, k-3375. On resistance to coomon scab and silver scurf a sources of these traits are revealed among species *S. boliviense (*k-18766), *S. cardiophylum*, (k-21835), *S. hondelmanii* k-20773, *S. jamesii* k-9155, *S. andigenum*: k-11856 (Zoteyeva et al., 2004).

Resistance to potato viral diseases (PVY)**.** Studies on accessions from the VIR potato collection conducted in cooperation with the All-Russian Plant Protection Institute and Institute of Plant Acclimatization and Breeding (IHAR, Mlohov, Poland) over the past few years made it possible to single out new genetic sources of resistance to PVY and PVX.

<u>High resistance to PVX</u> was shown by accessions of samples *S. acaule* k-10678, k-10679, k-18002, k-18007, k-18021, *S. bulbocastanum* k-23167, k-24200, *S. microdontum* k-23434, *S. chacoense* k-23232, *S. demissum* k-23321, *S. fendlerii* k-12158, k-23841, *S. cardiophylum* k-21954, k-23278, k-24203, k-24375, *S. jamesii* k-21456. The accessions of *S. acaule* k-9794, *S. berthaultii* k-23047, *S. demissum* k-3345, k-3362, k-3540, *S. polytrichon*, k-5347, k-5682, *S. pinnatisectum* k-4459 and *S. guerreroense* k-18407 combine resistance to PVX and late blight. The latter showed resistance to all three strains of PVY).

<u>*Resistance to PVY*</u>. The screening on resistance to PVY made it possible to identify highly resistant accessions of *S. chacoense* k-2731, k-2926, k-3678, k-4236, *S. demissum* k-3362, k-3540, *S. dolychostigma* k-7610, k-7613, *S. guerreroense* k-18407, *S. michoacanum* k-5763, S. *neoantipovitczii* k-8505, *S. pinnatisectum* k-4455, k-4459, k-19157, *S. stoloniferum*, k-3533, k-3554, k-4226, *S. polytrichon* k-5682. Resistance to three strains of PVY was revealed in the samples of wild species *S. stoloniferum* k-5682, *S.neoantipovichii* k-8505, *S.chacoense* k-4236, *S.dolichostigma* k-7610, *S. pinnatisectum* k-4459, *S. polytrichon* k-5347, k-5682 (Zoteyeva et al., 2004).

Many of the accessions identified as being resistant to viruses combine this trait with resistance to other pathogens. Accession k-7610 of *S. dolichostigma* Buk. was shown to be resistant to PVY and highly resistant to Colorado beetle. Resistance to PVY and late blight was shown by accessions of *S. stoloniferum* k-2534, k-3326, k-3527, *S. neoantipovichii* k-8505, *S. pinnatisectum* k-4459 and *S. polytrichon* k-5347. Accession *S. stoloniferum* k-3326 combines high resistance to late blight with resistance to PVY and partial resistance to PVX.

<u>*Resistance to golden potato cyst nematode*</u> <u>(*G.rostochiensis* Woll.)</u> remains a priority objective in potato breeding in the nearest years. According to L.Kostina et al. (2007), now the total number of breeding cultivars resistant to *G. rostochiensis* in the world is more than 600. For example, 240 resistant cultivars have been created in Germany, more than 180 in the Netherlands, 40 in Poland, 24 in England, 40 in Byelorussia, 19 in Russia, 5 in Lithuania, 4 in

Ukraine, etc. In 2006, the State Register List of the Russian Federation included only 12 Russian varieties (Aspiya, Desnitza, Zhukovskii rannii, Zavorovskii, Krepysh, Kristall, Loukjanovskii, Pushkinetz etc.). Given a significant decrease in the level of quarantine control over the distribution of potato cyst nematode (PCN), the problem of breeding varieties resistant to this pathogen in Russia remains crucial. In Russia, the pathotype Ro_1 of *G. rosthochiensis* is common. However, since other pathotypes are common in Europe, it is quite probable that eventually they will spread to Russia (Ro_2, Ro_3, Ro_4, Ro_5). Therefore, Russian breeders should work not only on resistance to Ro_1 patotype, but start to use in breeding initial material possessing resistance to various pathotypes of *G. rostochiensis* and of other species - *G. pallida* (Pa_1, Pa_2, Pa_3). As an initial material it is recommended to use varieties which transfer in sexual progeny not only genes of resistance to few pathotypes, but also such commercial traits as high yield, earliness, high content of dry matter, table qualities, etc. The pathotypes are: 1) resistant to pathotypes $Ro_{1,\ 2,\ 3}$ - Allure, Amalfy, Belita, Cordia, Liseta, Mara, Platina, Producent, Red Scarlett, Vebeca, Veenster; (2) – resistant to $Ro_{1,\ 2,\ 3,\ 4}$ - Amera, Elkana; (3) - resistant to $Ro_{1,\ 3,\ 5}$ - Roeslau; (4) to $_{Ro1,\ 4,\ 5}$ - Esta; (5) resistant to $Ro_{1,5}$ - Lyra, Wega; (6) resistant to $_{Ro1,2,3,5}$ - Fox, Hilta, Ute; (7) resistant to $Ro_{1\text{-}5}$ - Aiko, Arnika, Franzi, Miranda, Ponto; (8) resistant to $Ro_{1,\ 2,\ 4,\ 5}$ - Turbo etc. Varieties resistant to two species of nematode *G. rostochiensis* and *G. pallida* have particular significance in terms of breeding: Ro_1, Pa_2 - Maritima, Ramos; Ro_1, Pa_3 - Drop; Ro_1, $Pa_{1,\ 3}$ - Vantage; $Ro_{1,5}$, Pa_2 - Heidrun; $Ro_{1,\ 2,\ 5}$, Pa_2 - Benol; $Ro_{1,\ 3,\ 4}$, Pa_2 - Danva; $Ro_{1\text{-}3}$, Pa_2 - Karida, Karnico, Pansta; $Ro_{1\text{-}3}$, $Pa_{2,\ 3}$ - Kantara; $Ro_{1\text{-}4}$, Pa_2 - Atrela, Elles, Producent, Promesse, Sante; $Ro_{1,\ 2,\ 3,\ 5,}$ Pa_2 - Tanja; $Ro_{1\text{-}5}$, Pa_2 - Darwina, Proton. These varieties are also valuable because they combine resistance to PCN with others valuable traits (high yield, resistance to viral diseases or late blight). Evaluation of their progeny from self-pollination made it possible to identify a high share of resistant seedlings in a segregating population. PCN-resistant seedlings of cultivars Alcmaria, Granola, Provita, Quarta, Sagitta and hybrid clone SVP (VTN) 2 62-33-3 account to more than 60 %. Varieties Agria, Amigo, Berber, Elcana, Panda, Ukama, Van Gog (Netherlands), Drop, Grot, Koga, Lawina (Poland), Juliver (Germany) also showed a high degree of inheritance of resistant cultivars.

Studies of crossability of wild and cutivated species

One of the basic characteristics directly determining the suitability of wild species for breeding is their crossability with a common potato. Currently, the Department of Potato Genetic Resources is focusing on studying the crossability of wild potato species and interspecific hybrids obtained with their use. The VIR Potato Germplasm was studied and used for the purposes of breeding immediately after the first potato accessions had been obtained by expeditions organized in 1925–1927. The first results of these investigations were described by A.J. Kameraz in 1936. At the VIR, studies in interspecific hybridization using species with various levels of ploidy and aimed at improving crossability of species were started before the Second World War. It was then that the polyploid forms of tetraploid species *S. acaule* and diploid *S. rybinii* were created. Later polyploid plants of 30 potato species of 18 series (Bukasov, Kameraz, 1972) were obtained. The polyploid forms of a wild potatoes were for the first time used for the purposes of practical breeding by N. Lebedeva. Hybrid combinations with polyploid forms of species from series *Transaequatorialia* Buk., *Cuneolata* Hawk., *Megistacroloba* Card. et Hawk. *Longipedicellata* Buk., *Verrucosa* Buk. were synthesized by N.A. Zhitlova. Some of them were subsequently used as an initial material for creating new potato varieties in Russia, Byelorussia and Kazakhstan. M.A.Vavilova created hybrids by crossing *S. tuberosum* with species *S. commersonii* (series *Commersoniana* Buk.) and *S. chomatophilum* (series *Chomatophila* Gorbat.) and evaluated them for valuable breeding properties. In order to make diploid wild species suitable for breeding, K.Z. Budin and T.I. Soboleva hybridized them with dihaploids of breeding varieties and *S. andigenum* Juz. et Buk. clones (Budin et al., 1984; 1988; Soboleva, 1984).

Wild species of the distantly related series *Pinnatisecta* Rydb., *Bulbocastana* Rydb., *Etuberosa* were hybridized through protoplast fusion. In some combinations, interspecific somatic hybrids were successfully crossed with *S. tuberosum* (Gavrilenko, 2005).

This long and comprehensive research work aimed at using various *Solanum* species in breeding resulted in the creation of several interspecific hybrids that were subsequently used in breeding. Clones of hybrids, in which valuable traits of wild species are combined with valuable commercial traits of cultivated potato, were widely requested by breeding centers. Table 1 shows the wild potato species that were used as sources of resistance to pathogens and the hybrid clones that were created on their basis.

Table 1. Use of wild potato species from the VIR Collection in creation of initial material for breeding on resistance to pathogens

Series	Species	Interspecific hybrids	Authors
		Resistance to *Phytophthora infestans*	
Demissa	*S. demissum*	Y9-95	Kameraz, Patrikeyeva, 1980*
Longipedicellata	*S. stoloniferum*	458-1	Budin, 1989
	S. polytrichon	P-33-1, P-32-13, P-34-6, P-38-3	Zhitlova, Kotova, 1984
	S. vallis-mexici	X9-30, X9-32	Kameraz, Patrikeyeva,1980
Verrucosa	*S. verrucosum*	B_1 (*S.verrucosum* (2n=48) × *S.tuberosum*) × *S.tuberosum*	Zhitlova, 1989
Transaequatorialia	*S. vernei*	c1-102, c1-103	Bukasov, Kameraz, 1972
Simpliciora	*S. simplicifolium*	B_1 (*S.simplicifolium* 2n=48) × *S.tuberosum*) × *S.tuberosum*	Kameraz, Vavilova, Zhitlova, Ivanova, 1974
		Resistance to PVY	
Longipedicellata	*S. stoloniferum*	76-534…542 1980	Naidanova, 1974,
		Resistance to PVX	
Acaulia	*S. acaule*	B_1 (*S.acaule*(2n=96) × *S.tuberosum*) × *S.tuberosum*	Kameraz, Vavilova, Zhitlova, Ivanova, 1978
		Resistance to PVM	
Transaequatorialia	*S. gourlayi*	B_1 (*S.gourlayi* × *S.tuberosum*) × *S.tuberosum*	Zhitlova, Truskinov, 1984
Megistacroloba	*S. megistacrolob.*	B_1 (*S. megistacrolobum*(2n=48) × *S.tuberosum*) × *S.tuberosum*	Zhitlova 1989
		Resistance to *Globodera rostochiensis*	
Transaequatorialia	*S. famatinae*	Л 65/26	Osipova, Evdokimova, 1980
	S. kurtzianum	B_1 (*S.kurtzianum* × *S.tuberosum*) × *S.tuberosum*	Zhitlova 1989
	S. leptophyes	Л 48/67	Osipova, Evdokimova, 1980
	S. multidissectum	B_1 *S.multidissectum*(2n=48) × *S.tuberosum*) × *S.tuberosum*	Zhitlova 1989
	S. vernei	23/71, 25/71-2,11,12	Ponin, 1984

Increased harmfulness of common potato pathogens and threats from previously insignificant potato pathogens dictate the need to constantly expand the germplasm and search new sources of resistance to extreme environmental factors. In 2004 – 2006. *Solanum* species from South America quite recently described by K. Ochoa that previously had not been sufficiently studied or used in breeding were for the first time used in hybridization by researchers from the N.I.Vavilov Institute. These are species belonging to series *Tuberosa* Rydb. (Hawkes) or *Bukasoviana* Gorbat. The first generation of hybrids from crossing species *S. alandiae, S. doddsii, S. gandarillasii* with a common potato has been obtained. A number of potentially important hybrid clones (Rogozina 2005) have been selected for breeding purposes. Studies of inheritance of resistance to late blight and PCN in generative progeny of separate clones are now being carried out.

Conclusions

The world potato collection of the N. Vavilov Institute is the basic source of initial material for all breeding purposes. Thanks to the rich diversity of wild and cultivated species made achievable by modern technologies, it is now possible to involve useful traits in breeding in relatively short periods of time. Comprehensive evaluation of collection samples makes it possible to identify and create a highly effective initial material for the creation of new cultivars having a complex of valuable properties, including high and stable resistance to the main pathogens. By using the new *Solanum* species in hybridization, initial breeding material can be created.

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