

## DEVELOPMENT OF POTATO VARIETIES IN LATVIA

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*The first potato varieties that reached the territory of Latvia were empirically selected clones from genetically diverse material brought from South America to Europe. In the 19<sup>th</sup> century, when agricultural production rapidly developed, the demand for high yielding potato varieties suitable to local growing conditions increased. Therefore, potato variety evaluation trials were set up. Scientifically-based potato breeding in Latvia was launched by P. Knappe. The potato breeding programme in Priekuļi Plant Breeding Station was started in 1931, and has still continued. Several breeding methods were used by potato breeders Ē. Knappe, V. Gaujers, G. Bebre and others in Priekuļi. Potato breeding for short periods was carried out in several other places in Latvia: Stende, Carnikava, and Lejaskurzeme. The method of elimination of diseases in potato seed material and high quality seed material production was implemented in Priekuļi. More than 60 potato varieties have been created in Latvia, some of them were and still are in demand in agricultural production.*

### FIRST POTATO VARIETIES

The potatoes (*Solanum tuberosum*) that reached Europe in the 16<sup>th</sup> century were themselves hybrids, descendents of diverse South American varieties and species. The propagation by true seed provided the diversity of germinated plants. When propagation with tubers was introduced, the selection of the best plants or tubers became possible. Careful selection could provide uniform material with high yield potential, large tubers and similar tuber appearance. The selected material yielded three or four times more than the hybrid population (Salaman, 1949). The first potato varieties widely spread in Europe and North America were created in an empirical way (Salaman, 1949; Bradshaw and Mackay, 1994). Probably, this kind of potato variety was first brought to the territory of Latvia in the 17<sup>th</sup> century (Gaujers, 1969). The introduction of potato crops in agricultural production was very difficult in the territory of Latvia. Only in the 19<sup>th</sup> century did cultivation of potato become a part of farmer crop production. The desire to grow the most suitable varieties for local growing conditions appeared, so farmers became interested in evaluation of available potato varieties. Special trials for evaluation of different varieties brought from European countries were set up in several manors. A large assessment trial of potato varieties was conducted in Priekuļi manor fields in 1838. A total of 119 potato varieties originating from Germany, England, France, the Netherlands, Switzerland, Denmark, Algeria as well as North and South America continents were included in the trial conducted by J. Krēsliņš (Gaujers, 1983; Strods, 1992). The report of this investigation was published in the Vidzeme Agricultural Yearbook 1839, which was printed in Dorpat (today Tartu, Estonia). Later, several publications in popular magazines contained descriptions of potato varieties. An introduction to varieties of different maturity and suitability to ways of utili-

zation was published in the magazine 'Mājas Viesis' by J. Vāgners in 1894, which included the early table varieties 'Early Rose', 'Alpha', and 'Bisquit'; late table varieties 'Magnum Bonum', 'Royal Norfolk', and 'Ruso'; varieties for feeding 'Aurora', 'Champion' and 'Blauie Riesen'; and varieties for alcohol production 'Reichskanzler' and 'Juno' (Gaujers, 1983). During that time the same variety grown in different regions usually had several names, and the practise of giving local names to the same variety was in fashion (Salaman, 1949). The popular potato variety from the Netherlands, 'Zeeuwsche Blauwe', in Vidzeme was called 'Mazie Zilie' or 'Grāpiši', but in Estonia — 'Lilla Pujat'. Several so-called local potato varieties were grown in farmers' fields at the beginning of the 20<sup>th</sup> century: 'Rīgas Vietējie', 'Sarkanie Vecauces', 'Celmiņa sarkanie' and others. However, it is still unclear whether those varieties were local breeds or foreign varieties that had lost their original name (Gaujers, 1983).

The spread of diseases that reduced tuber yield forced development of new varieties resistant to pests. Three most destructive pests for potato in the 19<sup>th</sup> century were the plant degeneration or virus diseases: late blight (*Phytophthora infestans* (Mont.) de Bary) and wart disease (*Synhytrium endobioticum* (Schilb.) (Salaman, 1949). For a long time, potato variety breeding in Europe and North America was conducted by fanciers in an empirical way. Only at the end of the 19<sup>th</sup> century were scientists involved in developing potato varieties with specific traits (Salaman, 1949; Bradshaw and Mackay, 1994).

### CONTRIBUTION OF P. KNAPPE

Pēteris Knappe (1872–1960) was the first person in Latvia who devoted his research to potato breeding. He had received excellent education and worked as a teacher. He went to Paris



Potato breeder Pēteris Knappe, 1950s

as a teacher in 1903. Parallel to teaching, P. Knappe started his studies of natural science at Sorbonne University. He acquired practical breeding skills in several plant breeding enterprises operating at that time in Europe. When P. Knappe returned to Latvia, he decided to develop a similar plant breeding farm to the one existing in Western Europe. He asked scientists from Europe and America to contribute samples of different potato species, and he made collection. The potato samples received from distinguished researchers as Bukasov S. (Leningrad, today St. Petersburg, Russia), Steward W. (Washington, USA), Schik R. (Muncheberg, Germany) as well as from maintainers of potato species collections in Argentina, Chile, Ecuador, Columbia and Uruguay were evaluated and described in field trials. In correspondence with scientists of the N. I. Vavilov Plant Production Institute (Leningrad, Soviet Union, Russia), P. Knappe exchanged species descriptions and classification of wild species. Rewarding P. Knappe's contribution in the description and detection of wild potato species, one of the wild potato forms 'Papa del Cerro' was called *Solanum chacoense f. knappei* Juz. et Buk. (Gaujers, 1983; Bykacov, 1973).

P. Knappe focused his work on introduction of resistance to late blight and other diseases in potato varieties, using hybridisation between cultivated and wild species (Table 1). He used *S. demissum*, *S. maglia*, *S. commesonii*, *S. kesselbrenneri*, *S. ajuscoense* and other species in crosses and obtained several significant hybrids for future implementation in breeding.

The most significant potato variety developed by P. Knappe was 'Vāle', medium late maturity, containing gene R1 which

provides resistance to *P. infestans* race 1. Unfortunately, the variety was not resistant to potato wart disease *Synchytrium endobioticum* (Roze, 1953; Roze and Knappe, 1954; Bykacov, 1973; Gaujers, 1983).

## BEGINNING OF POTATO BREEDING IN PRIEKUĻI

Evaluation trials of potato varieties as well as potato management trials have been carried out at Priekuļi Plant Breeding and Experimental Station since its establishment in 1913. The special department of potato breeding was organised in 1931. Erihs Knappe, previously an agronomist, a known expert in potato crop, was invited to lead the department. E. Knappe had been dealing with potato breeding as an enthusiast since 1922. He brought previously developed potato breeding material, about 1600 samples, to Priekuļi. E. Knappe used a method of hybridisation between varieties and selection of outstanding clones in his breeding work. The tasks of the new department were to develop new varieties suitable to local growing conditions, and propagation and providing seed material of new varieties as well as old varieties with reduced "degenerated" or virus diseased plants and tubers in seed material. E. Knappe devoted a lot of effort to development of potato seed material export. The first stock of qualitative potato seed material from Latvia was exported in 1934. Potatoes were mainly sent to France (varieties 'Bintje', 'Erstling', and 'Juli'), but seed material was demanded in Spain, Portugal, Lithuania and Italy as well.

Several varieties bred in Priekuļi were offered to Latvia farmers in 1930s: 'Agrie Smilšu', 'Liieldienolas', 'Zemgales Milži', 'Eksports', and 'Erna' (later renamed 'Priekuļu Visagrie').

E. Knappe repatriated to Germany in 1939 before the Second World War. Some of the potato varieties developed by him were later widely produced not only in Latvia, but in several regions of the Soviet Union (SU). For example, 'Priekuļu Visagrie' was one of the most well-known varieties in the SU during the 1950s (Table 2) (Holms, 1992).

The breeding work in Priekuļi was continued by E. Knappe confreres Rūdolfs Roze and Emīls Pētersons. During the Second World War, hybridisation and selection were continued, and several new varieties were selected and implemented from breeding material: 'Balva', 'Vidzemes Vēlie', and 'Izstādes'. In 1944, at the end of the war, only E. Pētersons stayed at the Station and tried to save valuable potato seed material.

## CHANGES AND BREEDING METHODS DURING SOVIET TIME

After the Second World War, in 1945, Latvia again became a United Socialist Republic in the Soviet Union. Scientific information mostly came from the SU. At that time, genetics as science and application of hybridisation in plant breeding were strongly denied in the SU. As a special method, the so-called vegetative hybridisation was introduced.

E. Pētersons, who was at that time a potato breeder in Priekuļi Breeding and Experimental Station, using vegetative hybridisation created more than 1000 grafts in 1951, with the aim to

Table 1

PEDIGREE OF SOME SIGNIFICANT POTATO VARIETIES DEVELOPED BY P. KNAPPE, 1913–1950

Type of hybridization	Variety	Pedigree
Hybridization between commercial varieties	Vāle	Zwickauer Fruhe // Wildling VI / Deodara
	Rota	Fortuna / Chance // Konsum
	Baiba	Fortuna / Schlesische Klossel
	Spodra	Reichskanzler / Starkereiche I
Interspecific hybridization	Ausma	<i>S. andigenum f. papa runa</i> / Golden Marvel
	Herters	<i>S. commesonii f. Montevideo</i> / <i>S. tuberosum diversa</i>
	Barbara	Caliban ( <i>S. demissum</i> /...)/ Majestic / Idylle

Table 2

## COMMERCIALY IMPORTANT POTATO VARIETIES DURING 1945–1973 DEVELOPED BY LATVIA POTATO BREEDERS

Variety	Year of realization	Pedigree	Breeders	Included in the list of varieties recommended for production in territory of Latvia
Priekuļu Visagrie (Erna)	1931–1940 <sup>1</sup>	Irish cobbler / Jubel	Priekuļi <sup>2</sup> : E. Knappe, E. Pētersons	1953–2003
Eksports (Zemgales brīnums)	1931–1940	Primadonna / Pepo	Priekuļi: E. Knappe	1956–1969
Zeltīte	1931–1940	Erstling / Eksports	Priekuļi: E. Knappe etc.	1958–1964
Laimdota	1931–1940	Majestic / Export	Priekuļi: E. Knappe, E. Pētersons, V. Gaujers	Since 1957
Agrie Dzeltenie	1931–1940	Zīle (1457.8) / 1649.9	Priekuļi: E. Pētersons, V. Gaujers	Since 1962
Stendes Baltie	1956	Vāle / Hindenburg	Stende <sup>3</sup> : J. Strazds, A. Dance, A. Tumova	1959
Carnikava	1957	Kungla / Oktjabrjonok	Carnikava <sup>4</sup> : A. Aņikijevs	1957–1965
Izstādes	1953	V5018-2 / Agra	Priekuļi: V. Gaujers	1964–1973
Vita	1973	5018-2 / Kameraz	Priekuļi: V. Gaujers, M. Oša, N. Ķesa	1973

<sup>1</sup> The year of realization was not stated; <sup>2</sup> Priekuļi Plant Breeding Station; <sup>3</sup> Stende Plant Breeding Station; <sup>4</sup> Carnikava Potato Breeding and Experimental Station

obtain samples resistant to potato wart from variety 'Vāle', which had been sensitive to wart. These efforts did not bring success.

Besides the work at Priekuļi, potato breeding was conducted in several other institutions in Latvia during the 1940s: Lejaskurzeme Experimental Station (1946–1953), Stende Plant Breeding and Experimental Station (1948–1953) and Soviet Union Alcohol Production Research Institute Latvian Zonal Potato Breeding and Experimental Station at Carnikava (1948–1963) (Holms, 1992).

Hybridisation between potato species and varieties as well as vegetative hybridisation was conducted in Stende by breeders Jānis Strazds and Anna Dance. The breeding material of the remarkable potato breeder P. Knappe was evaluated and also propagated at that time. The period of time was too short to obtain valuable results. The greatest success was the submission of potato variety 'Stendes Baltie' for State evaluation trials (Table 2).

The breeding work in Carnikava was conducted by agronomist Aleksandrs Aņikijevs, who used clonal selection from potato varieties, development of clones from buds, and generative and vegetative hybridisation. The hybridisation between varieties was the most successful method. A. Aņikijevs developed the early maturity variety 'Carnikava', which was accepted for

production in Latvia (Table 2), and in production was used for producing two yields in one season in the Ukraine USSR in 1970s. Later, A. Aņikijevs moved to Priekuļi and continued potato breeding to develop varieties suitable for processing.

At Lejaskurzeme, agronomist Vilis Gaujers started potato breeding, using all known methods of other breeders at that time in SU. The aim of breeding was to develop varieties with excellent culinary traits and high starch content.

## EXTENSION OF WORK IN PRIEKUĻI

V. Gaujers moved to Priekuļi Plant Breeding and Experimental Station to lead potato breeding work in 1953. The evaluation of existing breeding material was continued and resulted in accepted varieties. The potato breeding programme was expanded, and 40 000–100 000 seedlings were produced during the first generation of the breeding programme. Phytopathologists and agrochemists were involved in the breeding work. The evaluation of breeding material resistance to late blight using artificial inoculation was started, and composition of races in the late blight population was determined by Mirdza Bērziņa and Marija Oša (Holms, 1992). The research on potato virus diseases was carried out by Vija Ūdre, but Genoveva Dortāne-Lakše tested resistance to bacterial dis-



Potato breeder Emils Pētersons, during and after the Second World War. 1950s



Potato breeder V. Gaujers (in the centre) with visitors in potato breeding field, 1960s





Potato breeder Marija Oša assessing potato seedlings, 2003

eases of potato. Important studies on potato dry rot (*Fusarium sp.*) were carried out by Gunta Bebre (Bebre, 2003).

Mostly hybridisation between varieties and potato species was used in obtaining genotypic diversity. Several developed varieties were introduced in production and became popular in the second part of the 20th century (Tables 2, 3). Potato varieties 'Agrie Dzeltenie', 'Vita', 'Madara', 'Skaidra' and others were grown for table or market consumption. A part of potato production was used for feed at that time. The high yielding variety 'Laimdota' and variety 'Astra' were offered for this kind of production. For potato starch production, medium late varieties 'Brasla', 'Zile', 'Sarņina' and others were developed.

Technician Alberts Saulīte, working in Priekulī Station, attempted to involve methods of mutagenesis in breeding potato since 1963. He used physical mutagens ( $\gamma$  rays and fast neutrons) and several chemical mutagens in different doses and concentrations for treatment of true seed and tuber. Later, when A. Saulītis left work at Priekulī, he developed several potato varieties from treated breeding material. The early variety 'Mutagenagrie' became popular in Latvia (Table 3).

Potato breeder A. Aņikijevs used methods of mutagenesis in breeding work as well, and later some efforts were made by Jānis Katajs-Paeglis (Holms, 1992; Bebre, 2003).



Potato breeders Jānis Katajs-Paeglis and Nanija Ķesa in potato breeding field, 1980s

The newest methods were involved not only in potato breeding, but also in seed production. The laboratory of tissue culture was established in 1978 with an aim to acquire methods for elimination of virus diseases in potato and to establish production of healthy initial potato seed material. The acquisition and adaptation of a methodology suited to local conditions took ten years. With the support of V. Gaujers and advice of Uldis Miglavs on potato viruses, several researchers — Mirdza Zariņa, Māra Robežniece, Aija Gābere — were involved in the studies and development of the technology. As a result, the potato seed production system where healthy virus free *in vitro* plants were used as initial material, had been developed in Priekulī and in the territory of Latvia since 1985.

The time of generation changes occurred in the 1970s. Breeding material of A. Aņikijevs was taken over by Nanija Ķesa in 1977. Besides breeding, she worked on improvement of seed production. Marija Oša joined potato breeding in 1979; she continued work with potato breeding material developed by V. Gaujers. Later Gunta Bebre replaced N. Ķesa in 1985.

The researchers and breeders participated in scientific conferences within the SU, exchanging experience with researchers of other soviet republics. Cooperation was established with other institutions dealing with potato breeding and research: Jõgeva Plant Breeding and Experimental Station (Estonia), Voke Department of Potato Breeding (Lithuania), Potato Research Institute in Belorussia, Potato Research institute in Ukraine, Potato Production Institute in Moscow (Russia) and others. Germplasm for breeding purposes was received from Vavilov Plant Production Institute in Leningrad (Russia) collections.

The processing of potato chips and crisps began to develop in Latvia in the 1990s; the production of potato starch was enlarged in Latvia. The assessment of specific traits for processing was included in the potato breeding programme. Resistance to nematode *Globodera rostochiensis* became one of the important traits for newly developed varieties. The newest potato varieties (developed in 1990s) were resistant to *G. rostochiensis* pathotype Ro1: 'Brasla', 'Lenora', 'Magdalena', 'Monta', 'Imanta' and others (Table 3).



Potato breeders Gunta Bebre and Ilze Skrabule, 2003

Table 3

## CHARACTERIZATION OF POTATO VARIETIES DEVELOPED AND REGISTERED FROM 1985 TO 2012

Variety	Pedigree	Breeders	Year of registration	Specific traits
<b>Early maturity</b>				
Madara	Amaryl / plantlet10792.2	Priekuļi <sup>1</sup> : V. Gaujers, M. Oša etc.	1992	
Mutagenagrie		A. Saulītis	1993	
Spīdola		A. Saulītis		N <sup>2</sup>
Monta	16934.1/Ausonia	Priekuļi: M. Oša	2003	N
Agrie Baltie		A. Saulītis	2004	N
<b>Medium early maturity</b>				
Skaidra	Frila / Kristal	Priekuļi: M. Oša, V. Gaujers etc.	1988	N
Lenora	15703ks / 15335.9	Priekuļi: V. Gaujers, M. Oša etc.	2002	N
Prelma	Ibis / Rosara	Priekuļi: M. Oša	2010	N
<b>Medium late maturity</b>				
Sarmiņa	Gauja / Soidinskij Rannij	Priekuļi: V. Gaujers, M. Oša etc.	1986	S <sup>3</sup>
Zile	Meta / Maris Piper	Priekuļi: V. Gaujers, M. Oša	1995	N, S
Brasla	15709KS / 15335.9	Priekuļi: M. Oša	1995	N, S
Bete	13108.2 / Wilja	Priekuļi: M. Oša, V. Gaujers	1999	
Magdalena (Magda)	82-28.9 / 15876.41	Priekuļi: G. Bebre	2002	N
Sigunda (Unda)	80-348.16 / 59-99.24	Priekuļi: G. Bebre, N. Ķesa	2002	LB <sup>4</sup>
Sniegoga		A. Saulītis	2005	
Talmuts		A. Saulītis	2005	
Daugava		A. Saulītis	2005	
Imanta	Picaso/Zarevo	Priekuļi: G. Bebre	2008	N, LB, S
Mandaga	Picaso/Zarevo	Priekuļi: G. Bebre	2010	N
Gundega	82-12.32 / Zarevo // Ausonia	Priekuļi: G. Bebre	2011	N, LB

<sup>1</sup> Priekuļi Plant Breeding Station or State Priekuļi Plant Breeding Institute; <sup>2</sup> Resistant to nematode *Globodera rostochinensis* Ro1; <sup>3</sup> High starch content;

<sup>4</sup> High resistance to late blight *Phytophthora infestans*

## NEW CHALLENGES IN POTATO BREEDING

After restoring the independence of the Republic of Latvia in 1991, the opportunity to attend scientific conferences in Europe became possible. The potato breeders participated in the European Association for Potato Research. The newest trends in potato research and breeding were introduced. More attention to quality traits was paid, investigation of content of protein, vitamins, glycoalkaloids and other relevant to human health substances in potato breeding material were introduced (Skrabule *et al.*, 2010; Murniece *et al.*, 2011). Ilze Skrabule joined potato breeding in 1990s and has led the potato breeding programme since 2009.

In 2006, the name of Priekuļi Plant Breeding and Experiment Station was changed to State Priekuļi Plant Breeding Institute. It is the only place in Latvia where potato breeding as well as initial virus free potato seed material production is carried out.

The trends of sustainable agriculture using lower doses of pesticides have been significant for maintenance of the environment for future. Organic farming is a developing sector of agriculture not only in Europe, but in Latvia as well. The demand for varieties suitable for organic and low input agriculture has appeared in recent years. The evaluation of breeding material in organic growing conditions has been conducted and methods for evaluation of specific traits have been developed (Skrabule, 2010). Molecular markers have been used for detection of genes providing resistance to diseases and pests in



Virus-free initial potato seed material propagation in greenhouse, 2012

potato breeding material (Skrabule *et al.*, 2011; Mežaka *et al.*, 2012). The acquiring of near infrared technologies for assessment of potato quality traits has started. The research has been conducted in cooperation with geneticists (I. Mežaka), phytopathologists (G. Ūsele, N. Zoteeva), seed producers (I. Dimante), food technologists, chemists, pharmacists and other specialists not only from Priekuļi Institute, but also from other institutions.

The potato producers in Latvia completely provide the population of the country with potatoes. The potato production area



The stand of potato varieties, developed in Priekule Plant Breeding Institute, International Exhibition RigaFood, 2011

in 2011 was 29.6 thousand ha, the total production was 484 thousand tonnes (Anonymous, 2012). The aim of potato breeding still is to develop varieties suitable to local growing conditions and farming systems and according to consumer requirements. More than 60 potato varieties have been created in Latvia, some of them were and still are demanded in agricultural production. The breeding work is continuing to create potato varieties with resistance to several pathogens and excellent quality traits.

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## KARTUPEĻU ŠĶIRŅU VEIDOŠANA LATVIJĀ

Pirmās kartupeļu šķirnes, kas nonāca Latvijas teritorijā, bija empiriski veiktas klonu izlases no genotipiski daudzveidīga materiāla, kas Eiropā bija iecerējis no Dienvidamerikas. Veidojoties lauksaimnieciskajai ražošanai, radās nepieciešamība audzēt tādas šķirnes, kas būtu augstražīgas vietējos audzēšanas apstākļos. Tāpēc tika iekārtoti ievestie kartupeļu šķirņu salīdzināšanas izmēģinājumi. Zinātniski pamatotu kartupeļu selekcijas darbu Latvijas teritorijā aizsāka P. Knappe. Priekule selekcijas stacijā kartupeļu šķirņu veidošana sākās 1931. gadā, un šis darbs tiek joprojām turpināts. Laika gaitā izmantojot dažādas selekcijas metodes, Priekules strādājuši selekcionāri Ē. Knappe, V. Gaujers, G. Bebre un citi. Kartupeļu selekcijas darbs dažādos periodos veikts arī Stendē, Carnikavā un Lejaskurzēmē. Kartupeļu šķirņu augstvērtīga sēklas materiāla ieguvei Priekules izstrādāta kartupeļu atveseļošanas un vesela izlases sēklas materiāla ieguves metodika. Kopumā kartupeļu selekcionāri Latvijā izaudzējuši vairāk nekā 60 kartupeļu šķirnes, kuras ieguvušas lielāku vai mazāku ievēribu zemnieku vidū.