NEW POTATO VARIETIES RESEARCH IN LITHUANIA

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Abstract
Potato breeding and seed production in Lithuania is carried out at the Voke Branch of the Lithuanian Institute of Agriculture. Potato breeding work involved Lithuanian potato varieties, varieties from various collection and hybrids. Potato crosses were done at the autotetraploid level in the glasshouse and potato variety collection field. Up to two million hybrids were tested in the trial fields. The key objective was to select the varieties immune to wart disease, cyst nematodes, with high resistance to other diseases, with exellent agronomic and cooking qualities, suitable for the processing industry. As the result of breeding work five new varieties were produced: Venta, VB Rasa, VB Liepa, Goda and VB Aista. They all are immune to the worst potato disease - wart (*Synchtrium endobioticum* Schilb.). Most of them are resistant to a local patotype of nematodes (*Globodera rostochiensis* Woll.). Other advantages such as good yield, excellent cooking qualities, good taste or attractive shape were the main items in producing Lithuanian potato varieties as well. Potato seed production from meristem tissue at biotechnologic laboratory is carried out in the Voke branch of Lithuanian Institute of Agriculture. It is the centre for potato seed production in Lithuania.

Key words: potatoes, potato breeding, resistance to nematodes and diseases

Introduction
For years potatoes have been a staple food crop in Lithuania. Potatoes were grown on every farm by everyone who had land for agricultural purposes. The main potato uses in Lithuania are for human consumption, livestock feeding and manufacturing.
Potatoes are usually bred using the hybridization method (Chauvin *et al*., 2003). Parental plants which have perfect quality features such as high yielding, earliness, resistance to diseases and pests, dry matter content and can pass on these traits to their progeny are the desired ones. In the potato breeding process the most important are the varieties and hybrids which belong to or have progeny of nine systematic groups: *Comersoniana, Glabresantia, Acaulia,* and *Transa equaatorialia, Andigena, Tuberosa*, *Longipedicellata*, *Demissa* and *Pinnatisecta*. They give proper genetic diversity for the cultivated potato varieties (Lough *et al*., 2001).
The most effective and most expensive way to fight nematodes is by breeding new varieties, resistant to nematodes. Potato varieties which have no resistance against nematodes die without yield production in soils with high number of nematodes. Resistant varieties in the infected fields decrease the number of nematodes in the soil (Razukas, 2002). Resistant variety can decrease the number of the nematodes up to 70 %. Potato nematodes are quarantined in Lithuania. The import and export of infected tubers is strictly forbidden.
Another very important quarantined potato disease is wart disease (*Synchtrium endobioticum* Schilb.). The best way to fight wart disease is to grow resistant varieties. The growing of resistant varieties decreases wart infection in the field. The infection usually disappears after ten years. It is obligatory for all new potato varieties to have wart resistance for growers in the Republic of Lithuania.
In Lithuania and in all European countries it is quite important to secure a potato harvest in order to bring it to a summer market as soon as possible, when prices are higher (Bradshaw *et al*., 2006). The developing Lithuanian potato industry also needs potatoes suitable for chips production, because the main crop variety after a long storage time. From the agrotechnic point of view potatoes are also greatly valued because of their short growing period. In crop rotation, the field

after potatoes can be sown with winter crops. As the result of the breeding work the new varieties Venta, VB Rasa, VB Liepa, Goda and VB Aista were bred.
The aim of many years of research was to breed new potato varieties, immune to wart disease, potato cyst nematodes and with other advantages - good resistance to diseases, resistant to mechanical injuries, with good agronomic and cookery qualities and suitability for the processing industry.

Materials and Methods

Research on Lithuanian new potato varieties was carried out at the Voke Branch of the Lithuanian Institute of Agriculture during the period 1992-2007. The potato varieties were bred using the hybrid cross method. The variety Venta was obtained after crossing Priekulu visagrie x Pirmūnės. The variety VB Rasa – Cardinal x Viola. The variety VB Liepa - No 34/36 x Pirmūnės. The cutivars Goda – Ausonia x Franzi and VB Aista - No 263 x No 476-9.
For the crossing, tubers of parents varieties were planted in the greenhouse in the peat and organic manure mixture on the top of a brick. The first variety was a mother plant and the second one - a father plant. The hybrid berries were collected, planted in the peat pots next year and transplanted to the potato selection field after the spring freezing danger was over. The best potato clone was selected from many others. Selection of the clone resistant to late blight and other diseases in the field and during potato storage gave the expected results. The resistance to wart disease and potato cyst nematodes was tested at the Institute of Plant Protection in Byelorussia.
The varieties plots were established on sandy loam on carbonaceous fluvial-glacial gravel eluviated soil (IDp), according to FAO-UNESCO classification *Haplic Luvisols* (*LVh*). All four varieties were tested and grown on soddy podzolic sandy loam soil in a crop rotation field of the breeding department of grasses. The trial field was fertilized with organic manure - 50 t ha^{-1} and the mineral fertilizers 90 g kg^{-1} N, 90 g kg^{-1} P, 90 g kg^{-1} K. Tubers were planted by hands into the rows. All plots of the field were fully randomized, the number of replications in different years was up to four. The size of the plots was also different, but each plant feeding plot always was 0.7 x 0.35 m^2. In the first three years potatoes were harvested by hand, later with a potato digging machine. Tubers were stored in the underground potato storage at natural conditions: +1 to +2 ^{0}C and 80-90 % humidity in the winter season (Ražukas *et al*., 2001).
Statistical data analysis
The results were analyzed statistically for randomized split-plot design and the Tukey test was used to verify the significance of differences at $\alpha = 0.05$. All data were subjected to ANOVA.

Results and Discussion

Maincrop varieties produce the highest potato yield in Lithuania. There are donors with resistance to late blight in this group. The genetic material of early and late maturity groups is used for breeding maincrop maturity potato varieties. Special methods were used to prevent discrepancies in the flowering time.
Potato variety Venta (Priekulu visagrie x Pirmūnės)**.** The variety Venta was bred at the Vokė Branch of the Lithuanian Institute of Agriculture. It has been the Lithuanian National Variety List since 1997. Venta matures very early. The tubers are round, with medium-deep eyes. Skin and flesh colour is light yellow. Cooking characteristics are perfect. There is no browning after peeling. The taste is excellent. The variety is the salad type. The starch content is to 14-16 %. The variety Venta is resistant to wart disease; it possesses good field resistance to the black leg and potato leafroll virus. Storage characters under controlled conditions are excellent**.**
Potato variety VB Rasa (Cardinal x Viola). The variety is late. The plants are compact, the flowers are violet. VB Rasa has high yielding and starch content characteristics, field resistance to common scab, immunity to wart disease and to the Ro1 patotype of golden nematodes.
Potato variety VB Liepa (No 34/36 x Pirmūnės). The variety is early. The plants are compact, flowers are violet. Tubers are round, medium in size, with shallow eyes. Flesh and skin colours is light yellow. Sugar content is low. No browning after peeling and cooking. Starch content is to 20 %. Resistant to potato cyst nematode. Tubers are fully resistant to late blight.

Potato variety Goda (Ausonia x Franzi). The potato variety Goda was bred at the Vokė Branch of the Lithuanian Institute of Agriculture. It has in the Lithuanian potato list since 2001. The variety is early. Tubers are oval round, medium in size, with shallow eyes. Flesh and skin colour is light yellow. The sugar content is low. No browbibg after peeling and cooking. Suitable for the chips industry. Starch content is to 16-17 %. The variety is resistant to potato cyst nematode Ro_1, and wart disease. Foliage is fairly resistant and tubers fully resistant to late blight and to tuber blight. Storage is good.

Potato variety VB Aista (No 263 x No 476-9). The variety was bred at the Vokė Branch of the Lithuanian Institute of Agriculture. VB Aista has been on the Lithuanian potato list since 1999. The bush is stretched out, the stems are tall. The flowers are white, of medium size. The variety flowers abundantly and for a long time. The tubers are big, yellowish, flat round with shallow eyes. The output of commercial tubers is 90 %. Starch content is high, to 21 %. The variety is good for the starch industry. The potatoes are palatable. The boiled potatoes do not get dark. The variety is resistant to wart disease, potato cyst nematode Ro_1, late blight. The variety is resistant to drought, can be grown in all kinds of soil using proper cultivation techniques. The variety is resistant to mechanical injuries while harvesting; is of good storage quality.

Potato varietys Venta, VB Rasa, VB Liepa, Goda and VB Aista main features description is presented in Table 1.

Table 1. The main feature varieties of Lithuanian potato

Characters	Potato varietys				
	Venta	VB Rasa	VB Liepa	Goda	VB Aista
Parantage	Priekulu visagrie x Pirmūnės	Cardinal x Viola	No 34/36 x Pirmūnės	Ausonia x Franzi	No 263 x No 476-9
Lightsprout: anthocyanin coloration of base[1]	2	1	2	2	1
Plant: frequency of flowers[2]	3	7	7	3	7
Flower corolla: color of inner side[3]	2	2	2	1	1
Tuber: shape[4]	1	3	1	1	1
Tuber: color of skin[5]	1	2	1	1	1
Tuber: color of flesh[6]	3	4	3	4	1
Plant: time of maturity[7]	1	7	3	3	9
Cooking type[8]	A	BC	BC	BC	BC
Resistance to leaf blight[9]	4	8	4	7	8
Resistance to tuber blight[9]	8	9	9	9	9
Resistance to nematode[10]	4	r	r	r	r

[1]anthocyanin coloration of base: 1 – red-violet and 2 – blue-violet; [2]frequency of flowers: 3 – low and 7 – high; [3]color of inner side: 1 – white and 2 – red-violet; [4]shape of tubers: 1 – round and 3 – oval; [5]color of skin: 1 – yellow and 2 – red; [6]color of flesh: 1 – white, 3 – light yellow and 4 – yellow; [7]maturity: 1 – very early, 3 – early, 7 – late and 9 – very late; [8]cooking type: A – firm , B – fairly firm and C – floury; [9]resistance to blight: 9 – very good, 8 – good, 7 – rather good and 5 – rather susceptible; [10]resistance to nematode: r – resistant and 4 – susceptible.

Concentrated attention is given to the disease and pest resistance of the new varieties. Such diseases as wart, nematodes and viruses can be eliminated partially or fully by producing new potato varieties using genetic material which has high resistance or are immune to one or another disease and pest (Asakaviciute *et al*., 2006).

In Lithuania the most harmful potato disease is late blight (*Phytophthora infestans)*. The disease decreases the plant leaf assimilation area and destroys potato foliage at potato tuberization. Virus infection affects the potato yield and during storage period causes different rots. Comparatively late maturity potato varieties such as VB Aista exhibited the highest resistance to late blight

At the present time there are eight potato varieties bred at the Vokė Branch of the Lithuanian Institute of Agriculture in the Lithuanian potato list. Mean quality data is presented in table 2.

Table 2. Lithuanian new potato varieties main quality points in competitive trials (Trakų Vokė, 2002–2007)

Potato varietys	Vegetation	Yield, t ha^{-1}	Starch, g kg^{-1}	Dry matter, g kg^{-1}	Taste, points[1]
Venta	very early	27.9 ± 0.88	150.1 ± 6.71	202.4 ± 7.46	8.0 ± 0.09
VB Rasa	Late	24.6 ± 0.74	198.8 ± 8.60	236.6 ± 7.82	7.0 ± 0.04
VB Liepa	Early	29.3 ± 0.92	185.3 ± 7.44	224.1 ± 5.73	8.1 ± 0.07
Goda	Early	35.2 ± 1.21	170.4 ± 6.19	210.7 ± 4.91	8.6 ± 0.08
VB Aista	very late	28.4 ± 0.84	203.6 ± 9.75	247.3 ± 8.40	7.2 ± 0.05
LSD_{05}		0.861	6.068	7.548	0.143

[1] taste point -.0 (bad) – 9 (good)

Last five years of testing in the competitive potato comparison trials show that the lowest potato yield was from the VB Rasa variety. The mean data show that yields have reached 24.6 tones per hectare, the when longer maturity potato varietys – Goda – produced over 30 tones per hectare. The highest mean potato yield was from the potato variety Goda. It has reached 35,2 tones per hectare seed potatoe yield. The potato quality data show that the potato starch depended on the potato variety's. So the highest starch amount was produced by the special potato variety for the starch industry – VB Aista. It was over 20 percent, when shorter maturity potato varietys had a starch amount up to 18 percent. The best taste over 8 points belonged to the main table potato variety – Goda.

Conclusions

The potato varietys Venta, VB Rasa, VB Liepa, Goda and VB Aista were breed at the Vokė Branch of the Lithuanian Institute of Agriculture. Varieties give good quality yield not only in the big farms but also in small potato garden plots.

All varietys are immune to the main quarantine object in Lithuania – wart disease. The potato varieties Goda, VB Liepa, VB Rasa and VB Aista are immune to the potato cyst nematode *Globodera rostochiensis* R_{O1} patotype. All varieties have good field resistance against the most widely spread diseases – black leg, viruses, common scab, rizoctonia and etc. Their foliage have a fair resistance and tubers a good resistance to late blight. Storage characteristics under controlled conditions are good.

The Lithuanian potato breeding program's main research object was and in the near future will be early and maincrop, immune to wart and nematodes potato selection. Due to ther high resistance to disease and pests all Lithuanian potato varieties are exhalent for growing in ecological farms.

References

1. Asakaviciute R., Razukas A. Jundulas J. (2006) Lithuanian potato varietys resistance to late blight (*Phytophthora infestans*). In: *Third International Conference on Non Chemical Crop Protection Methods*, Lille, France, 705–708.
2. Bradshaw J. E., Bryan G. J., Ramsay G. (2006) Genetic Resources (Including Wild and Cultivated *Solanum* Species) and Progress in their Utilisation in Potato Breeding, *Potato Research*, 49, 49–65
3. Chauvin J. E., Souchet C., Dantec J. P. Ellisseche D. (2003) Chromosome doubling of 2x *Solanum* species by oryzalin: method development and comparison with spontaneous chromosome doubling *in vitro*, *Plant Cell. Tissue and Organ Culture*, 73, 65–73.
4. Lough R. C., Varrieur J. M. Veilleux R. E. (2001) Selection inherent in monoploid derivation mechanisms for potato, *Theor Appl Genet*, 103, 178–184.
5. Razukas A. (2002) Effect of genotype on distribution of diseases and viruses in potato, *Biologija*, 1, 38–42.
6. Razukas A., Ceponiene S. Jundulas J. (2001) Selection of potato species more resistant to pests and immune to main potato diseases in collection, *Biologija*, 4, 77–78.

JAUNU KARTUPEĻU ŠĶIRŅU PĒTĪJUMI LIETUVĀ

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Kartupeļu selekcija un sēklaudzēšana Lietuvā tiek veikta Lietuvas zemkopības institūta Vokes nodaļā. Kartupeļu selekcijas darbs aptver Lietuvas kartupeļu šķirnes, kolekcijas šķirnes un klonus. Kartupeļu krustošana tetraploīdā līmenī tiek veikta siltumnīcās un lauka kolekcijā. Vairāk kā divi miljoni hibrīdu (klonu) tiek izvērtēti izmēģinājumu laukā. Galvenais mērķis ir veidot jaunas kartupeļu šķirnes, kas ir izturīgas pret vēzi un nematodēm, kurām ir augsts izturības līmenis pret citām slimībām, izcilas agronomiskās un garšas īpašības, kā arī piemērotība pārstrādei. Selekcijas darba rezultātā izveidotas piecas jaunas kartupeļu šķirnes: Venta, VB Rasa, VB Liepa, Goda un VB Aista. Tās visas ir izturīgas pret bīstamāko kartupeļu slimību – kartupeļu vēzi (*Synchtrium endobioticum* Schilb), vairākas no tām ir izturīgas pret vietējo nematodes patotipu (*Globodera rostochiensis* Woll.). Citas pazīmes kā augsta raža, izcilas garšas īpašības, kā arī pievilcīga forma bija galvenie iemesli šo šķirņu atlasē.

Kartupeļu sēklaudzēšana ar meristēmu metodi tiek veikta Lietuvas zemkopības institūta Vokes nodaļas biotehnoloģiskajā laboratorijā. Tas ir kartupeļu sēklaudzēšanas centrs Lietuvā.

APPLYING COLCHICINE AND ORYZALIN IN LILIUM L. POLYPLOIDISATION

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Abstract

The genus Lilium (*Lilium* L.) is a vegetatively propagated bulbous plant – one of the economically most important of bulb flowers. To obtain new varieties with a wide range of colors and resistance to grey mold caused by fungi *Botrytis* Micheli ex Fr. a breeding program was carried out. The spreading of this fungus disease causes heavy losses as plants loose their general attractiveness. In lily breeding current activities are directed towards the development of disease resistant cultivars to avoid the use of chemicals to be economically sound and ecologically safe. The goal of this research was to investigate and to optimize polyploidy in the breeding of lilies. Several biotechnological methods were used to obtain new lily varieties. A crossing between different hybrid groups of lilies is not possible under natural conditions therefore embryo cultivation techniques are being developed to overcome incompatibility between plants and limiting factors after fertilisation. Mitotic and meiotic polyploidisations are applied and can result in fertile allopolyploids. The chromosome count of the varieties can be changed by treating bulb scales with a 0.1, 0.5 and 1 g kg^{-1} colchicine solution and 0.05, 0.1 and 0.5 g kg^{-1} oryzalin solution.

Key words: chromosomes, mitotic and meiotic polyploidisations

Introduction

The genus *Lilium* L. includes approximately 100 species, subspecies and varieties of species distributed throughout the cold and temperate parts of the Northern Hemisphere (McRae, 1998). The overall appearance of all plants is controlled largely by their genes that are packaged in chromosomes. Each species has a fixed number of chromosomes in their cells, but the number may differ between species. Each cell of *Lilium* species has 24 chromosomes, or 12 pairs of different chromosomes (2n = 2x = 24). These plants with their paired chromosomes are termed diploid, from the Greek word for ‘double’ (McRae, 1998). Polyploids have more chromosomes in every cell than others. The offspring of a tetraploid parent and a diploid parent is a triploid; this results from a failure of meiosis in one of the parents. With their 36 chromosomes, triploid lilies are difficult to cross with others. Tetraploid lilies have 48 chromosomes; this is double the normal number of diploids.

The reasons for using polyploidy in lily breeding are the larger flowers, the stronger stems and in interspecific hybridization the restoration of F1-sterility at the tetraploid level (Van Holsteijn,