

New cultivars and future perspectives in professional fruit breeding in Estonia

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Abstract. During 2001–2010, the following cultivars from the breeding programme of the Polli Horticultural Research Centre of the Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences were registered: the apples ‘Kaari’, ‘Kaimo’, ‘Karamba’, ‘Katre’, ‘Kikitiinu’, ‘Krista’, and ‘Liivika’, the crab apples ‘Kuku’, ‘Ritika’, and ‘Ruti’, the sweet cherries ‘Elle’, ‘Karmel’, ‘Piret’ and ‘Tontu’, the raspberries ‘Aita’ and ‘Alvi’, and the black currants ‘Almo’, ‘Ats’, ‘Elo’ and ‘Karri’. Since 2004, applications for registration and DUS testing have been submitted for the new apple cultivar ‘Els’, pear cultivars ‘Kadi’ and ‘Polli Punane’, sweet cherry cultivars ‘Anu’, ‘Ene’, ‘Irma’, ‘Kaspar’, ‘Mupi’, ‘Polli Murel’ and ‘Tõmmu’. Apple, plum, sweet cherry, black currant and raspberry breeding programmes are going on as part of the public breeding program. Winter hardiness is the first-rate goal in all crops. In apple, breeding for scab resistance is now the main task. In the nearest future, some new plum, apple and black currant cultivars will supplement the breeding results of the institution at Polli.

Key words: fruit breeding, apple, pear, plum, sweet cherry, black currant, raspberry

INTRODUCTION

The first information on breeding results in Estonia has been traced back to the 18th century, when apple landrace-cultivars ‘Suislepp’ (‘Suislepper’) and ‘Tallinna Pirnõun’ (‘Revalisher Birnapfel’) were bred (Aamisepp, 1939; Kask, 1984). Some landraces of apple, plum and bullace had arisen in the 19th century. In turn of the 19th/20th century the first description of an amateur apple cultivar ‘Treboux Sämling’ (after the World War II renamed ‘Pärnu Tuviõun’) was composed. This cultivar was bred by a schoolteacher Jules Treboux (1834–1915) in the town Pärnu in the second half of the 19th century. The amateur breeding flourished through the 20th century. Among amateur breeders the most successful were Otto Kramer (1883–1972), Aleksander Kurvits (1885–1970), Martin Liias (1910–1991), Uno Kivistik (1932–1998) and Asta Kask (1934).

Professional fruit breeding, financed by the government, started in 1945 at the horticultural institution in Polli, then named the Polli Research Institute for Horticulture and Apiculture. Up to 2000, 16 apple cultivars, 1 pear, 15 plum, 1 sour

cherry, 5 sweet cherry, 4 strawberry, 4 raspberry, 3 white currant, 1 red currant, 9 black currant, 1 gooseberry cultivar, 10 apple vegetative rootstocks and 2 pear seedling rootstocks were released (Jänes et al., 2006). Among them seven outstanding **apple** cultivars 'Kaja', 'Koit', 'Lembitu', 'Sidrunkollane Taliõun', 'Sügisdessert', 'Talvenauding', and 'Tiina', **pear** 'Pepi', **plum** cultivars 'Ave', 'Julius', 'Kadri', 'Kressu', 'Liisu', 'Polli Munaploom', and 'Suhkruploom', **sweet cherry** cultivars 'Arthur', 'Johan', 'Meelika', 'Norri', and 'Polli Rubiin', **raspberry** cultivars 'Helkal' and 'Tomo', **white currant** cultivars 'Hele' and 'Valko', **black currant** cultivar 'Varmas' and **gooseberry** 'Polli Esmik' are found. Ten apple vegetative rootstocks were released (Veidenberg, 1985; Univer & Haak, 2001), from which three (E20, E53 and E56) are recommended for growing in Estonia at present.

The most outstanding professional breeders of the 20th century were Aleksander Siimon (1900–1970), Julius Eslon (1894–1982), Johannes Parksepp (1925–1988), Arthur Jaama (1914–1995), Eevi Jaama (1926–1999), and Jakob Palk (1908–1991).

Good quality of fruit has always been the most important goal. However, good winter hardiness is the first-place target. There are many examples when cultivars with extraordinary fruit quality cannot be used in Estonian horticulture due to frequent winter damages. The disease-damage is the problem of the same importance (Jänes, 1996; Jänes & Pae, 1998; Kask & Jänes, 1998; Kikas et al., 2002; Libek & Kikas, 2002).

Special breeding programme for apple scab resistance started with the financial help of government about ten years ago and only the first fruits has been picked since 2007. The pear scab resistance is also a problem, not solved in Polli. The extensive breeding programme is carried out in black currant for selecting seedlings resistant to powdery mildew and gall mite.

During last decades, sour cherry, strawberry, white currant, red currant and gooseberry breeding was cut off. Pear breeding will be also soon terminated. The efforts at present are concentrated on apple, sweet cherry, black currant and raspberry breeding. Some work has been done with plum breeding. New crossings for apple vegetative rootstocks are not made; however, evaluation of 43 selections, bred in earlier decades, will be continued.

Crossbreeding was the main conventional method used in the programme. Various parents from local breeding results, cultivars of western or eastern origin were used as (1) sources for good winter hardiness, (2) sources for good fruit quality, (3) regularly high yield, and (4) sources for disease resistance. Part of the fruit tree seedlings sprang from the open-pollinated seeds.

Climatic conditions. Estonia is located in the extreme northwestern part of the great Eurasian landmass in the neighbourhood of the North Atlantic. The region is actively influenced by cyclones. Local climatic differences are due above all to the vicinity of the Baltic Sea. During 1961–2005, in the eastern part of Estonia minimum temperatures in the air (2 m high) were –35 up to –43°C (in lower places sporadically –44 up to –46°C), and in western part –33 up to –35°C (on the islands –28 up to –32°C). On the same day and moment (and the same latitude) the difference in winter temperature between western and eastern Estonia may be 20 degrees. However, in some winters, the average air temperature does not drop below 0°C permanently (Keppart et al., 2006).

Duration of the vegetation period (air temperature permanently above 5 degrees) is 175–195 days. The sum of effective air temperatures above 5 degrees is 1400–1550°C, but in the warmest years up to 1700°C, and in the coolest years only 1200 °C, in the period May 1 – August 31 even below 1000°C. The average period without night frosts lasts for 4 months or more in most part of Estonia. On the western coast and the islands the last frosts occur towards the end of April, on the North Estonian Plateau and the Pandivere Upland frosts continue for a month longer. Sum of precipitation of the year is in average 550–770 mm, which of the period April 1 – October 30, is 350–500 mm (Keppart et al., 2006). Polli Horticultural Research Centre is located rather close to the southern borderline of Estonia and its climate is more similar to that of the eastern part of the country.

NEW CULTIVARS

Since 2001, the following new cultivars of the Polli Horticultural Research Centre breeding programme were released. The apple cultivars are: ‘Els’, ‘Kaari’, ‘Kaimo’, ‘Karamba’, ‘Katre’, ‘Kikitriinu’, ‘Krista’, and ‘Liivika’. They were bred before the scab resistance-breeding programme started. The crab apple cultivars are ‘Kuku’, ‘Ritika’, and ‘Ruti’. The pear cultivars are ‘Kadi’ and ‘Polli Punane’. The sweet cherry cultivars are ‘Anu’, ‘Elle’, ‘Ene’, ‘Irma’, ‘Karmel’, ‘Kaspar’, ‘Mupi’, ‘Piret’, ‘Polli Murel’, ‘Tontu’, and ‘Tõmmu’. The raspberry cultivars are ‘Aita’ and ‘Alvi’ (Kikas et al., 2002). The black currant cultivars are ‘Almo’, ‘Ats’, ‘Elo’ and ‘Karri’ (Kask & Jänes, 2005; Libek et al., 2005).

Apple

All the new apple cultivars, originated in Polli, are bred by Kalju Kask.

‘Els’. The cross between ‘Cortland’ x ‘Tellissaare’ was made in 1980. Fruit is round, skin attractive red. Flesh is sweet, good dessert quality, autumn-season. The end of storage must be specified. Application for registration under plant breeder’s rights (PBR) submitted in 2007.

‘Kaari’. The mother tree has been grown from a seed of open pollination (1967) of ‘Antonovka’. Fruit is round or ovoid, most of the skin is attractive red. Flesh is sour and sweet. Dessert quality fruit is consumable from November to February. Registered and PBR protected since 2010.

‘Kaimo’. The cross ‘Cortland’ x L8 (a large fruited selection) was made in 1982. Fruit is round, skin red. Flesh is sweet, only dessert quality, autumn-season. Registered and PBR protected since 2007.

‘Karamba’. The cross ‘Talvenauding’ x ‘Cortland’ was made in 1969. Fruit is round, skin attractive red. Flesh is sweet, good dessert quality, autumn-season. Registered and PBR protected since 2007. Included into the List of recommended fruit cultivars for growing in Latvia since 2002.

‘Katre’. The cross ‘Tiina’ x L8 (see ‘Kaimo’) was made in 1982. Fruit is roundish, skin partly red. Flesh is sour and sweet. It is a winter-season cultivar with a long storage time. Registered and PBR protected since 2007. Included into the List of fruit cultivars recommended for growing in Estonia since 2005.

‘Kikitriinu’. The cross ‘Tiina’ x ‘Talipirnõun’ was made in 1978. Fruit is roundish or roundish-oblate, skin partly red. Flesh is sweet, spicy, good quality. Consumption season is from October till February. Registered and PBR protected since 2009.

‘Krista’. The mother tree is grown from a seed of open pollination (1978) of the selection L25. Fruit is roundish, skin is partly red on the yellow ground colour. Flesh is sour and sweet. Consumption season is from October till December. However, the cold storage has been successful till March in many years. Registered and PBR protected since 2007. Included into the List of fruit cultivars recommended for growing in Estonia since 2004.

‘Liivika’. The cross L8 x L25 was made in 1983. Both parents were selected by the breeder in 1970. Fruit oval or longer, with red over-colour in one side. Flesh sour and sweet. Consumption season is in autumn and winter (the end of storage is not yet definitively fixed). It is registered in 2009.

Crab apples

Three crab apple cultivars **‘Kuku’**, **‘Ritika’**, and **‘Ruti’** have been bred by K. Kask, crossing in 1986 ‘Cortland’ with a scab resistant berry-apple type seedling No 23, found incidentally. Fruits are small, 20 g (sometimes 30 g). Flesh is sour and sweet. Juice of ‘Kuku’ is very tasty. All have been registered in 2009. ‘Kuku’ is included into the List of fruit cultivars recommended for growing in Estonia (crab-apple for salad) since 2005.

Pear

Two new pear cultivars have been bred by K. Kask.

‘Kadi’. The mother tree is grown from a seed of open pollination (1978) of ‘Fondante des Bois’. The fruit is pear-shaped, medium size, colouring dark red in two-third-extent or entirely. Flesh sweet, juicy, ripens depending on weather in the middle of August or in the first half of September. Keeps some weeks in refrigerated storage. It is registered in 2004.

‘Polli Punane’. The cross ‘Sanitätsrat Butterbirne’ x ‘Saaremaa Punane’ was made in 1973. Fruit is pear-shaped, red over-colour may be very bright. Flesh is red in core and beneath the rind. It should be used in August during few days. The taste is sweet with slight acid. Registered in 2004.

Sweet cherry

Eleven sweet cherry cultivars were submitted for registration in 2004. Breeding of some cultivars started many decades ago. But the registering was postponed due to the transition of Estonia from soviet regime to independent republic.

‘Anu’ (breeders’ selection Polli 6-2) is bred by H. Jänes. Grown from a seed of open pollination (1984) of ‘Leningradskaya Chernaya’. Medium size or large (5.4 g) fruit is reddish black. Flesh sweet and sour. Juice dark red. Ripens late.

‘Elle’ is bred by H. Jänes (80% authorship), A. Jaama (10%) and E. Jaama (10%). Grown from a seed of open pollination (1977) of Juku, which is a selection of the small fruit breeder J. Parksepp at Polli. Medium size or large (4.8 g) fruit is dark red. Flesh sweet and sour. Juice – dark red. Ripens early. Registered in 2010. Included into the List of fruit cultivars recommended for growing in Estonia since 2005.

‘Ene’ is bred by H. Jänes (80%), A. Jaama (10%) and E. Jaama (10%). Parents unknown. Medium (3.6 g) size, fruit is dark red. Flesh sweet and sour. Ripening time – midseason.

‘Irma’ (breeders’ selection Polli 10-8) is bred by H. Jänes (80%), A. Jaama (10%) and E. Jaama (10%). Grown from a seed of open pollination (1981) of ‘Leningradskaya Chernaya’. Medium size or large (5.2 g) fruit is reddish black. Juice is dark red. Flesh sweet and sour. Ripens late.

‘Karmel’ is bred by K. Kask. Grown from a seed of open pollination (1965) of ‘Norri’. Medium size (3.7 g) fruit is reddish black. Juice is dark red. Flesh sweet and sour. Ripens rather early. Registered in 2009. Included into the List of fruit cultivars recommended for growing in Estonia since 2005.

‘Kaspar’ is bred by K. Kask. Grown from a seed of open pollination (1981) of ‘Norri’. Medium size (3.9 g) fruit is reddish black. Juice is dark red. Flesh is sweet and sour. Ripens in midseason.

‘Mupi’ is bred by K. Kask. Grown from a seed of open pollination (1976) of ‘Kati’. ‘Kati’ is a selection of the same breeder, grown from the seed of open pollinated ‘Norri’. Medium size or large (5.3 g) fruit is dark red or reddish black. Juice – dark red. Flesh sweet and sour. Ripening time – medium. Included into the List of fruit cultivars recommended for growing in Estonia since 2005.

‘Piret’ is bred by K. Kask. Grown from a seed of open pollination (1976) of ‘Norri’. Smallish or medium (3.6 g) fruit is dark red. Flesh is sweet and sour. Ripening time – medium. Tree is more compact and smaller than that of other cultivars. Registered cultivar since 2010.

‘Polli Murel’ is bred by A. Jaama (50%) and E. Jaama (50%). The cross ‘Zorka’ x ‘Zolotaya Loshitskaya’ was made in 1965. Large fruits are whitish yellow, sometimes red striped or dotted. Juice colourless. Flesh sweet and sour. Ripening time – medium. Included into the List of fruit cultivars recommended for growing in Estonia since 2005.

‘Tontu’ is bred by K. Kask. Grown from a seed of open pollination (1978) of ‘Norri’. Medium size or large (4.4 g) fruit is dark red or reddish black. Juice is dark red. Flesh is sweet and sour. Ripening time – early midseason. Tree growth is very vigorous. Registered cultivar since 2010.

‘Tõmmu’ is bred by A. Jaama (50%) and E. Jaama (50%). Grown from a seed of open pollination (1965) of ‘Krasavitsa’. Smallish fruit is dark red or almost black. Juice is dark red. Flesh sweet and sour. Ripens rather early.

Raspberry

Two raspberry cultivars ‘Aita’ and ‘Alvi’ are the newest, released as PBR protected cultivars in 2008. Both are bred by J. Parksepp (60%) and A. Libek (40%).

‘Aita’. The cross was made between seedling 2–64–24 x ‘Glen Clova’. Fruit light red, big (3.7 g), round, drupelets cohering firmly. Early maturing. Winter hardy, rather resistant to cane blight and anthracnose.

‘Alvi’. The cross was made between seedling 67–60–12 x ‘Novost Kuzmina’ was made in 1964. Fruit is dark red, bright, big (3.5 g), conical, drupelets cohering firmly. Rather late. Winter hardy, moderately susceptible to cane blight and anthracnose.

Black currant

There are four new black currant cultivars, released and registered as PBR protected cultivars in 2008. The author of all these cultivars is Asta Libek.

‘Almo’. The cross ‘Kantata’ x ‘Öjebyn’ was made in 1990. Fruit is black, big (1.5 g), in tall racemes, good berry separation from racemes. Midseason. Winter hardy, resistant to mildew (*Sphaerotheca mors-uvae*) and gall mite (*Cecidophyopsis ribis*).

‘Ats’. The cross ‘Öjebyn’ x ‘Varmas’ was made in 1990. Fruit is black, big (1.2 g), in medium racemes, good berry separation from racemes. Midseason. Winter hardy, resistant to mildew and gall mite. Flowers are rather resistant to spring frosts.

‘Elo’. The cross ‘Öjebyn’ x ‘Kantata’ was made in 1990. Fruit is black, big (1.4 g), in medium racemes, good berry separation from racemes. Early maturing. Winter hardy, resistant to mildew and gall mite.

‘Karri’. The cross ‘Mulgi Must’ x ‘Kantata’ was made in 1990. Fruit black, big (1.6 g), in long racemes, good berry separation from racemes. In addition to excellent dessert quality, the berries are very suitable for processing. Winter hardy, resistant to mildew and gall mite.

ONGOING BREEDING ACTIVITIES AND FUTURE PERSPECTIVES

Domestic apple (*Malus domestica*). The main aim is to breed scab resistant cultivars with outstanding winter hardiness, good-quality fruits and good productivity. Since 1999, 55 crossings were made and 5100 seedlings were produced. Scab infected seedlings were determined by the leaf-infection in nursery, in the natural field conditions, and eliminated. 471 non-infected seedlings were selected for further evaluation. In the latest programme, the following sources for apple scab resistance were used: BM 41497 (V_f), ‘Florina’ (V_f), ‘Freedom’ (V_f), ‘Imrus (V_f), ‘Jubilar’ (V_f), ‘Liberty’ (V_f), ‘Mcfree’ (V_f), ‘Redfree’ (V_f), ‘Releta’ (V_{f, a}), ‘Remo’ (V_f), ‘Siostra Liberty’ (V_f) (USA/Poland), ‘Chistotel’ (V_m), ‘Orlovim’ (V_m), and ‘Pamjat Isajeva’ (V_m).

Apple vegetative rootstocks. In 1981–1983, crossings were made by Arvo Veidenberg (Univer, 2000) to produce new material for vegetative apple rootstock breeding. 2720 seedlings were grown up, from which 43 selected seedlings are at present in orchard-evaluation. The experiments have shown that the vegetative rootstocks E20, E26, E53, E56 and E75, originating from Pollis’ earlier breeding programme (since 1954), have produced, as parents in crosses with East Malling’s rootstock MM106, winter hardy and good rooting seedlings. The orchard experiments with the cultivars ‘Pamjat Isajeva’ (Russian origin) and ‘Talvenauding’ (Estonian origin) are in progress.

Sweet cherry (*Prunus avium*). The main breeding goals for sweet cherry are: winter hardiness, moderate or compact growth, high productivity, good fruit quality. Cultivars both with early and late ripening time are expected. The number of seedlings in the breeding programme is 294, including 42 elite seedlings. The parents are ‘Leningradskaja Chernaya’ and Estonian-origin cultivars ‘Arthur’, ‘Ene’, ‘Madissoni Roosa’, ‘Meelika’, and ‘Tontu’.

Domestic plum (*Prunus domestica*). The breeding goals for plum are winter hardiness, high productivity, good fruit quality, early or medium ripening time. The number of

seedlings is 300, including 21 elite seedlings. The best parent appeared to be ‘Vengerka Azhanskaja Sinjaja’, which produced the candidate for the new cultivar ‘Villu’, and the crossing combination ‘Pärnu Sinine’ x ‘Amitar’, which produced ‘Kaidi’. The third selection ‘Reetta’ comes from an open pollination of ‘Liivi Kollane Munaploom’.

Among the mentioned above three selections ‘Villu’ demonstrated somewhat better winter hardiness than others. ‘Kaidi’ ripens in early midseason, ‘Reetta’ and ‘Villu’ in midseason. ‘Kaidi’ produced the highest average yield (28 kg per tree) and the largest fruits (48 g). The most attractive (4.7) and tasty (4.6) fruits (by 1–5 points scale) were picked from ‘Reetta’. According to the investigations, the three domestic plum selections seemed to be promising for registering as new cultivars due to their rather good winter hardiness, yield and fruit quality (Table 1). The other parents in the breeding programme are ‘Ave’ (originating in Estonia), crossed with ‘Eurasia 21’, ‘Zarechnaja Rannaja’ and ‘Renklod Kharitonovoi’ (all are Russian-origin), ‘Liisu’ and ‘Julius’ (both Estonian), crossed with ‘Eurasia 21’.

Table 1. Average content of soluble solids, titratable acids, total sugars and vitamin C in domestic plum selections ‘Kaidi’, ‘Reetta’ and ‘Villu’.

Selection	Years of analyses	Yield, kg/tree	Fruit mass, g	Soluble solids, %	Titratable acids, %	Total sugars, %	Vitamin C mg/100 g
‘Kaidi’	3	28.0	48	12.4 ± 2.5	0.97 ± 0.3	7.9 ± 3.2	8 ± 3
‘Reetta’	1	20.5	33	16.5	1.56	10.3	17
‘Villu’	3	24.2	33	16.0 ± 0.2	1.76 ± 0.1	9.6 ± 0.6	9 ± 0.2
‘Ave’ (control)	3	28.7	43	13.2 ± 1.3	1.40 ± 0.1	8.4 ± 0.6	10 ± 3

Cherry plum (*Prunus cerasifera*). Some work has been done with cherry plum. The parents in crossings are ‘Karminnaja Zhukova’, ‘Kubanskaja Kometa’ (both originating in Russia), and ‘Mara’ (Belarus).

Black currant (*Ribes nigrum*). The aims of breeding are winter hardiness, good productivity, suitability for machine-harvesting, resistance to *Sphaerotheca mors-uvae* and *Cecidophyopsis ribis* (Libek & Kikas, 2002). Self-fertility, hardiness of flowers to night frosts, more berries in the raceme and long axis of raceme, big berries and good taste, also health aspects concerning chemical composition are the objects of the breeding programme. The number of seedlings is 1940, including 66 seedlings selected for further evaluation.

Four elite seedlings, indicated in Table 2, are obtained from the crossings in 1990 between ‘Öjebyn’ x ‘Kantata’, ‘Varmas’ x ‘Dochka’ and ‘Mulgi Must’ x ‘Kantata’. The other crossing-combinations are ‘Elo’ x ‘Öjebyn’, ‘Pamjati N. I. Vavilova’ x ‘Lentjai’, ‘Sejanets Golubki’ x ‘Azhurnaja’. In comparison with the cultivar ‘Öjebyn’, the elite seedling 2–90–19 was much more gall mite-resistant. The elite selections have a smaller percentage of dropping premature flowers (excluding 2–90–19) and their berries are larger, especially the selection 1–90–16. Selection 2–90–19 has longer

racemes. The best yield has been stated in elite selection 2–90–19 (Table 2). Further on, the breeding will concentrate upon dessert berries with higher vitamin C, antioxidants and valuable fatty acids content. More detailed biochemical investigations of the selections are in progress. Further activities in the breeding programme includes genotyping of the cultivars.

Table 2. Yield, number of flowers in raceme, flower dropping and fertility, length of raceme, berry mass, and vitamin C content of black currant in 2003–2005

Elite seedling	Yield per bush, kg	Number of flowers per raceme	Dropping of flowers, % 2004–2005	Fertilized flowers, % in 2006	Length of raceme, cm	Berry mass, g	Vitamin C, mg/100 g
1–90–15	3.0	6.6	12*	79*	4.7*	1.2	112
1–90–16	2.5	7.0	16*	75*	4.3	1.4*	133
2–90–19	3.9	9.0	20	55	6.6*	1.2	130
6–90–5	3.0	8.7	13*	74*	4.6	1.2	138
‘Öjebyn’ (control)	2.7	7.4	24	52	3.9	1.0	134

* significant at 5%

Raspberry (*Rubus idaeus*). The number of raspberry seedlings at present is 70, including 17 elite seedlings. The breeding work will be extended. In the latest crossings the cultivars ‘Aita’, ‘Alvi’ (both Estonian origin), ‘Glen Ample’ (Scotland), ‘Nagrada’ (Russia), ‘Novokitaivska’ (Ukraine), ‘Ottava’ (Canada), ‘Tomo’ (Estonia), and others were used as parents. The whole number of parent cultivars in the latest crossings is 25. The aim is to produce winter hardy cultivars, resistant to diseases (*Didymella applanata*, *Elsinoë veneta*) and pests (*Butyrus tomentosus*, *Anthonomus rubi*), high-yielding, large-fruited, with fruits of good content of vitamins and antioxidants.

SHORT COMPARISON WITH LATVIA AND LITHUANIA

The southernmost Baltic countries have to a certain extent better climatic conditions than Estonia. With the exception of the North and East Latvia, there can be produced bigger pears with longer storage period, the choice of plum and sweet cherry cultivars is more extensive and the potential for intensive fruit production is greater. In southern Latvia and Lithuania, it is possible to grow more tender crops and cultivars than in Estonia. However, good winter hardiness is the problem in all Baltic countries, certainly disease resistance is the main task also everywhere.

Latvia.

There are two fruit breeding institutions in Latvia – the Latvia State Institute of Fruit-Growing and the Pure Horticultural Research Centre. Smallish breeding programmes exist also at the Botanical Gardens of the University of Latvia (Riga) and at the National Botanical Gardens (Salaspils). Latvia's **apple** breeding resulted in registration of 11 cultivars by the first mentioned state institute: 'Agra', 'Ella', 'Magone' in 2002, 'Atmoda' and 'Olga' in 2003, and 'Baiba', 'Dace', 'Edite', 'Gita', 'Ligita' and 'Roberts' in 2006. In addition, 13 cultivars ('Ametist', 'Daina', 'Duets', 'Eksotika', 'Inese', 'Joko', 'Laila', 'Laima', 'Madona', 'Saiva', 'Sapnis', 'Solo', and 'Vasara') and 1 apple rootstock (Pure 1) will be registered by the Pure Horticultural Research Centre. Among the newest cultivars, there are some columnar type apples ('Baiba', 'Duets', 'Inese', and 'Solo') and scab-resistant cultivars ('Dace', 'Edite', 'Gita', 'Roberts') with gene V_f (Drudze, 2004; Ikase, 2005 and 2007; Ikase & Dumbravs, 2001, 2004a and 2004b). In Estonia, the breeding programme for scab-resistance started later and at the moment we have not yet succeeded to register scab-resistant apple varieties. The breeding programme for columnar apples in Estonia has not been the aim.

Pear breeding resulted in registering of one cultivar ('Paulina') at the Latvia State Institute of Fruit-Growing in 2003. In addition, 7 pear cultivars ('Latgale', 'Nova', 'Selija', 'Suvenirs', 'Suvenira Bralis', 'Vilma', and 'Zemgale') and one **strawberry** cultivar ('Suitene') will be registered by the Pure Horticultural Research Centre.

Only one **plum** cultivar ('Zemgale') was registered in 2002. Three **sweet cherry** cultivars were registered in 2002 – 'Aleksandrs', 'Janis' and 'Indra' 'Paula' was registered in 2007. The **black currant** 'Mara' ('Mara Eglite') was registered in 2004 (Strautina & Kampuss, 2004). Two **raspberry** cultivars ('Ina', 'Lina') were registered in 2003. The Botanical Gardens of the University of Latvia has a long-time programme for breeding of exotic fruits (Kaufmane & Lacis, 2004). In 2004, they registered two **apricot** cultivars ('Jausma', 'Rasa') and two **peach** cultivars ('Maira', 'Viktors').

Lithuania.

In the 21st century, three **pear** cultivars were registered by the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry – 'Alnora', 'Aluona' and 'Lukna' (all in 2002). The breeding of the following **plum** cultivars 'Aleksona' (2001), 'Jūrė' and 'Kauno Vengrinė' (both in 2002) was also terminated with the registering of cultivars. One **sour cherry** 'Notė' (2001), and four **sweet cherries** 'Jurgita' (2001), 'Austė', 'Meda', and 'Vasarė' (all in 2002) are now the newest cultivars (Stanys & Sasnauskas, 2006; Šikšnianas et al., 2005). The small fruit breeding resulted in the new **strawberry** cultivar 'Dangė' (2001) (Rugienius et al., 2004) and nine **black currant** cultivars 'Gagatai', 'Joniniai', 'Vyčiai' (2001), 'Blizgiai', 'Kriviai', 'Pilėnai', 'Tauriai' (all 4 in 2002), 'Dainiai' and 'Smaliai' (both in 2007) (Sasnauskas et al., 2004; Sikšnianas et al., 2006).

When comparing the progress in fruit breeding in the three Baltic countries during the last decades, essential similarities can be found. Restoring the state independence brought in transition to new cultivars' registration regulations, which are equivalent worldwide (UPOV-system). Many good selections, which were bred already during the last decades of the soviet regime, were left to wait for the breeders and the institutions to adapt with new regulations. Thus, Lithuanian breeders have not registered in the 21st

century new apple cultivars, and Estonian breeders have not registered new plum cultivars. The results of the breeding activities in all Baltic countries are becoming apparent mainly in pear, sweet cherry, black currant and raspberry. Differently from Lithuania, Estonia and Latvia have registered many new apple cultivars.

CONCLUSIONS

Estonia's climate disposes great risks of cold damages to fruit growing. Therefore, good winter hardiness is the first-rate task to fruit tree and small fruit breeders. Resistance to diseases and pests is the breeding subject worldwide. Breeding for apple scab resistance was started in Estonia about ten years ago. It is too early to report the advances of this project. However, among the latest apple cultivars, registered by the Polli Horticultural Research Centre in the first decade of the 21st century, some cultivars demonstrate rather good field resistance to scab and they seem to be appropriate in organic gardening.

In pear breeding, winter hardy and entirely scab resistant cultivars with good fruit quality and long shelf life have not been achieved. Estonia's new cultivars are early ripening and can be stored only for short time. Due to insufficient importance of the pear crop in Estonia's fruit growing, pear breeding was cut off.

In plum breeding, attaining sufficiently winter hardy cultivars is also a difficult task. At the same time, there are some good tasting and attractive plum selections at the Polli institution ready to be registered as new cultivars. The breeding programme of the other stone fruit, sweet cherry, has been successful, many new cultivars have been released and some of them have been included into the List of recommended cultivars for Estonia and Latvia. Interest in planting the trees of Estonian origin in the domestic gardens of Finland persist stable. However, better winter hardiness is continuously the main problem in the ongoing breeding programme. Estonia's sweet cherries are attractive and tasty but mostly small and soft-flesh. These qualities need to be improved.

In black currant breeding, winter hardiness, disease and pest resistance, erect branches, big berries and their good taste have been always important goals. Now, the breeding will accentuate on dessert berries, their higher vitamin C and antioxidant content. In raspberry breeding, the aim is to produce winter hardy cultivars, resistant to diseases.

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REFERENCES

Aamisepp, J. 1939. Historical review on the origin of our apple cultivars. In: *Year-book 1 of the Pomological Commission*. Aianduse-Mesinduse Keskselts, Tallinn, pp. 18–38 (in Estonian).

- Drudze, I. 2004. New apple and pear selections from hybrid material of “Iedzeni” in Latvia. *Acta Horticulturae* **663**, 895–898.
- Ikase, L. 2005. Disease resistant apple breeding in Latvia. In: *Proceedings of the International scientific conference "Environmentally friendly fruit growing"*. Estonian Agricultural University, Tartu, pp. 10–14.
- Ikase, L. 2007. Evaluation of columnar apple hybrids on dwarfing rootstocks. *Sodininkystē ir daržininkystē*, **26** (3), 40–46.
- Ikase, L. & Dumbravs, R. 2001. Apple breeding for disease resistance in Latvia. *Sodininkystē ir daržininkystē*, **20** (3)-1, pp. 265–274.
- Ikase, L. & Dumbravs, R. 2004a. Breeding of columnar apple trees in Latvia. *Biologija*, **2**, 8–10.
- Ikase, L. & Dumbravs, R. 2004b. Apple breeding for disease resistance in Latvia. *Acta Horticulturae* **663**, pp. 713–716.
- Jānes, H. 1996. Plum breeding at the Polli Horticultural Institute. In: *Problems of fruit plant breeding*. Collection of scientific articles. Dobeles Horticultural Plant Breeding Experimental Station and Latvian University of Agriculture, Jelgava, pp. 107–110.
- Jānes, H., Kask, K., Libek, A.-V., Tiirmaa, K. & Univer, T. 2006. *Estonian fruit and berry cultivars*. Ministry of Agriculture, Tallinn, p. 122.
- Jānes, H. & Pae, A. 1998. Plum breeding at the Polli Horticultural Institute. In: Grzyb Z.S., Zmarlicki, K. & Sitarek, M. (eds.). *Acta Horticulturae* **478**, 301–304.
- Kask, K. 1984. *Estonian fruit and berry cultivars*. Valgus, Tallinn, p. 208 (in Estonian, Russian abstr.).
- Kask, K. & Jānes, H. 1998. Cherry breeding in Estonia. In: Ystaas, J. (ed.). *Proceedings of the Third International Cherry Symposium. Acta Horticulturae* **468** (1); 167–171.
- Kask, K. & Jānes, H. 2005. Tree fruit breeding at the Polli Horticultural Research Centre. In: *Environmentally friendly fruit growing*. Proceedings of the International scientific conference. Estonian Agricultural University, Tartu, pp. 5–9.
- Kaufmane, E. & Lacis, G. 2004. Studies on selection of apricots and peaches with good fruit quality and winter hardiness in Latvia. *Journal of Fruit and Ornamental Plant Research* (Poland), **12**, 321–329.
- Keppart, L., Loodla, K. & Raudsepp, H.-M. 2006. Average and extraordinary agroclimatic parameters in 1961–2005. In: *Agronomy 2006*. Jõgeva Plant Breeding Institute, Estonian University of Life Sciences & Estonian Research Institute of Agriculture, Jõgeva, pp. 253–256 (in Estonian, English abstr.)
- Kikas, A., Libek, A. & Hanni, L. 2002. Evaluation of red raspberry cultivars in Estonia. *Acta Horticulturae*, **585**, (1), 203–207.
- Libek, A. & Kikas, A. 2002. Evaluation of blackcurrant cultivars in Estonia. *Acta Horticulturae*, **585**, (1), 209–213.
- Libek, A., Kikas, A. & Hanni, L. 2005. Small fruit cultivars bred at the Polli Horticultural Research Centre. In: *Environmentally friendly fruit growing*. Proceedings of the international scientific conference. Estonian Agricultural University, Tartu, pp. 98–102.
- Rugienius, R., Sasnauskas, A. & Shiksnianas, T. 2004. ‘Saulene’ and ‘Dange’ – two recent Lithuanian strawberry cultivars. *Acta Horticulturae* **649**, 73–76.
- Sasnauskas, A., Shiksnianas, T. & Rugienius, R. 2004. New black currant cultivars from Lithuania. *Acta Horticulturae* **649**, 323–326.
- Shiksnianas, T., Stanys, V., Sasnauskas, A., Viskelis, P. & Rubinskiene, M. 2006. Fruit quality and processing potential in five new blackcurrant cultivars. *Journal of Fruit and Ornamental Plant Research* (Poland), **14** (2), 265–271.
- Stanys, V. & Sasnauskas, A. 2006. Prunus germplasm status and investigation in Lithuania. In: *Report of a working group on Prunus: Sixth meeting, 20–21 June 2003, Budapest*,

- Hungary and Seventh meeting, 13 December 2005, Larnaka, Cyprus*. Bioversity International, pp. 75–76.
- Šiksnianas, T., Stanys, V. & Sasnauskas, A. 2005. Stambiauges juoduju serbentu veisles. *Sodininkyste ir daržininkyste*, **24** (2), 13–21.
- Strautina, S. & Kampuss, K. 2004. Evaluation of blackcurrant genetic resources for sustainable fruit production. *Journal of Fruit and Ornamental Plant Research* (Poland), **12**, 147–159.
- Univer, T. 2000. The breeding of apple rootstocks in Estonia. *Transactions of the Estonian Agricultural University*, 208. *Agronomy*, Tartu, pp. 180–182.
- Univer, T. & Haak, E. 2001. Apple clonal rootstock breeding in Estonia and evaluation of the perspective E-types in orchard experiments. *Sodininkystė ir daržininkystė*, 20 (3), pp. 240–244.
- Veidenberg, A. 1985. The morphological description of the first ten apple clonal rootstocks selected in Estonia. In: *Results of cultivar evaluation and breeding of fruit crops and clonal rootstocks in Estonia. Collection of scientific papers of the Estonian Institute for Agriculture and Land Reclamation*, 56. Tallinn, pp. 14–48 (in Russian, English abstr.).