

Evaluation of apple cultivars for scab resistance in Estonia

K. Tiirmaa, N. Univer and T. Univer

Polli Horticultural Research Centre of the Institute of Agricultural and Environmental Sciences, Estonian University of Life Science, 69104Karksi-Nuia, Estonia; e-mail: krista.tiirmaa@emu.ee

Abstract. In the economic sense, apple scab caused by *Venturia inaequalis* (Cke.) Wint. is a most dangerous disease of apple trees in Estonia. Control of the disease is of major concern to apple growers and lack of control results in unmarketable fruit. Therefore it is very important for growers to know the apple scab resistance of the cultivars in the orchard, since the most susceptible ones should be avoided. Cultivating disease-resistant varieties seems to be an optimum alternative to chemical control. In 2002, 2003 and 2005 susceptibility to apple scab of 102 apple cultivars was evaluated in the apple collection garden at the Polli Horticultural Research Centre. The purpose of the study was to identify cultivars in the Polli apple collection that have good scab resistance. About 30% of the cultivars assessed had very little or no disease incidence. Among the genetically resistant cultivars were 'Imrus', 'Chistotel', 'Orlovim', 'Orlovskij Pioneer', 'Pamjat Isajeva', 'Pervinka', 'Slavyanin', 'Liberty' and 'Freedom'. Many old and local cultivars showed low incidence of disease. Rapid development of the infection was recorded on five cultivars: 'Borovinka Ananasnaya', 'Pirja', 'Maikki', 'Mantet', and 'Red Atlas'.

Key words: disease resistance, *Venturia inaequalis*, cultivars, Estonia

INTRODUCTION

The most prevalent and damaging apple disease worldwide, apple scab caused by *Venturia inaequalis* (Cke.) Wint., plays a significant role, with serious economic consequences for apple growers (MacHardy, 1996). It is controlled with multiple application of chemical fungicides. In commercial apple orchards in Estonia, the fungicide sprays are applied no more than 3–5 times because of limited financial means. In years with high disease pressure, poor disease control causes a large proportion of scabby fruits and an apple yield that is suitable only for processing. An alternative solution for spraying is the cultivation of resistant cultivars, which can be grown with no fungicide application (Crosby et al., 1992; Janick, 2002). For growers it is very important to know the apple scab resistance of the cultivars in the orchard, so the most susceptible ones can be avoided (Sandskär & Gustafsson, 2004).

The aim of this research was to evaluate scab resistance of apple cultivars and selections that grow in the apple collection garden in Polli.

MATERIALS AND METHODS

The experiment took place at the Polli Horticultural Research Centre, South-Estonia in 2002, 2003 and 2005. There was no yield in 2004, because severe frosts

occurring during the flowering time killed most flowers.. The apple collection was established in 1987 and by 1990 there were more than 400 accessions, consisting of one to five trees of each cultivar, representing a range of material from older cultivars, current commercial cultivars, as well as some local selections. The rootstock used was MM106, except for trees planted in 1987 where trees were grafted on seedling rootstocks. The planting scheme is 4×7 m. One hundred two (102) apple cultivars were studied for their response to the apple scab attack.

The response of cultivars to apple scab attack was assessed in natural conditions of infection; 2–3 fungicide treatments per year were applied to all the cultivars. The degree of apple scab damage were assessed on 100 fruits per tree, at the beginning of August, using the following scale: 0 = no visible symptoms; 1 = a few small spots (0.2 cm²) are detectable on the fruit; 2 = 0.3–0.5 cm² lesions on the fruit; 3 = at least one lesion with diameter 0.5–1 cm² on the fruit, some fruits with skin cracks in scabbed lesions; 4 = scab symptoms 5–10% on the fruit and some fruits with skin cracks; 5 = scab symptoms > 10% of the fruit. The disease index was calculated with a formula:

$$\text{Disease index} = (\sum vn)/(N)$$

where v represents the numeric value corresponding to the class; n is the number of fruits assigned to the class; N is the total number of the fruits.

The cultivars were grouped on the basis of disease index values in 6 classes of scab infection: without (disease index = 0), very low (0.1–0.19), low (0.2–0.44), medium (0.45–0.69), strong (0.7–0.99) and very strong (>1.0).

RESULTS AND DISCUSSION

The incidence of fruit scab was affected by the agroclimatic conditions of the growing season (Fig. 1). Summer 2002 was extremely dry -- the sum of precipitation from May to August was 191 mm. -- and the growing season showed generally lower disease incidence compared to 2003 and 2005. In 2003 and 2005 weather conditions were very favourable for development of apple scab. The sum of precipitation from May to August was 348 mm in 2003 and 340 mm in 2005.

In 2002 the cultivars ‘Antej’, ‘Alesja’, ‘Talvenauding’, ‘Kaja’ and ‘Tiina’ were practically free from scab, but in 2003 ‘Tiina’ and ‘Kaja’ had about 10% of fruits damaged by scab; in 2005 about 35% of fruits were infected. Serious infection -- approximately 50% of fruit -- was recorded on cultivars ‘Make’, ‘Koit’ and ‘Cortland’ in 2005. Cultivar ‘Red Atlas’ was highly susceptible in all three years, especially in 2005, when 99% of fruits were damaged by scab.

Among 102 cultivars, 9 genetically scab-resistant cultivars did not present symptoms of apple scab attack (Table 1). Cultivars ‘Chistotel’, ‘Orlovim’, ‘Orlovskij Pioner’, ‘Pamjat Isajeva’, ‘Pervinka’, ‘Slavyanin’ contain *Vm* resistance gene, and ‘Imrus’, ‘Liberty’, ‘Freedom’ contain *Vf* gene. Good resistance to apple scab showed several local landraces, such as ‘Talipirnõun’, ‘Karksi Renett’, ‘Paide Taliõun’, ‘Koidurennett’. Cultivars ‘Antej’ and ‘Alesja’ have displayed very low incidence of scab. Yet Sasnauskas et al. (2005) showed that ‘Antej’ is quite sensitive to apple scab. Many of the current commercial cultivars recorded medium to high levels of scab infection: ‘Cortland’, ‘Koit’, ‘Melba’, ‘Wealthy’. High levels of apple scab infection were recorded in Finnish cultivars ‘Make’, ‘Jaspi’ and ‘Samo’. The most susceptible cultivars were ‘Borovinka Ananasnaya’, ‘Pirja’, ‘Maikki’, ‘Mantet’ and ‘Red Atlas’.

Among the Estonian varieties evaluated, ‘Talvenauding’, ‘Kaja’, ‘Tiina’, ‘Maimu’, ‘Koidurenett’ and ‘Vahur’ exhibit high resistance to apple scab, concurring with an earlier report (Pärtel, 1988). Pärtel investigated apple scab injuries in 1962–1985 and found the most resistant cultivars to injury were: ‘Koidurenett’, ‘Maimu’, ‘Polli Kaunitar’, ‘Talvenauding’, ‘Tiina’, ‘Vahur’.

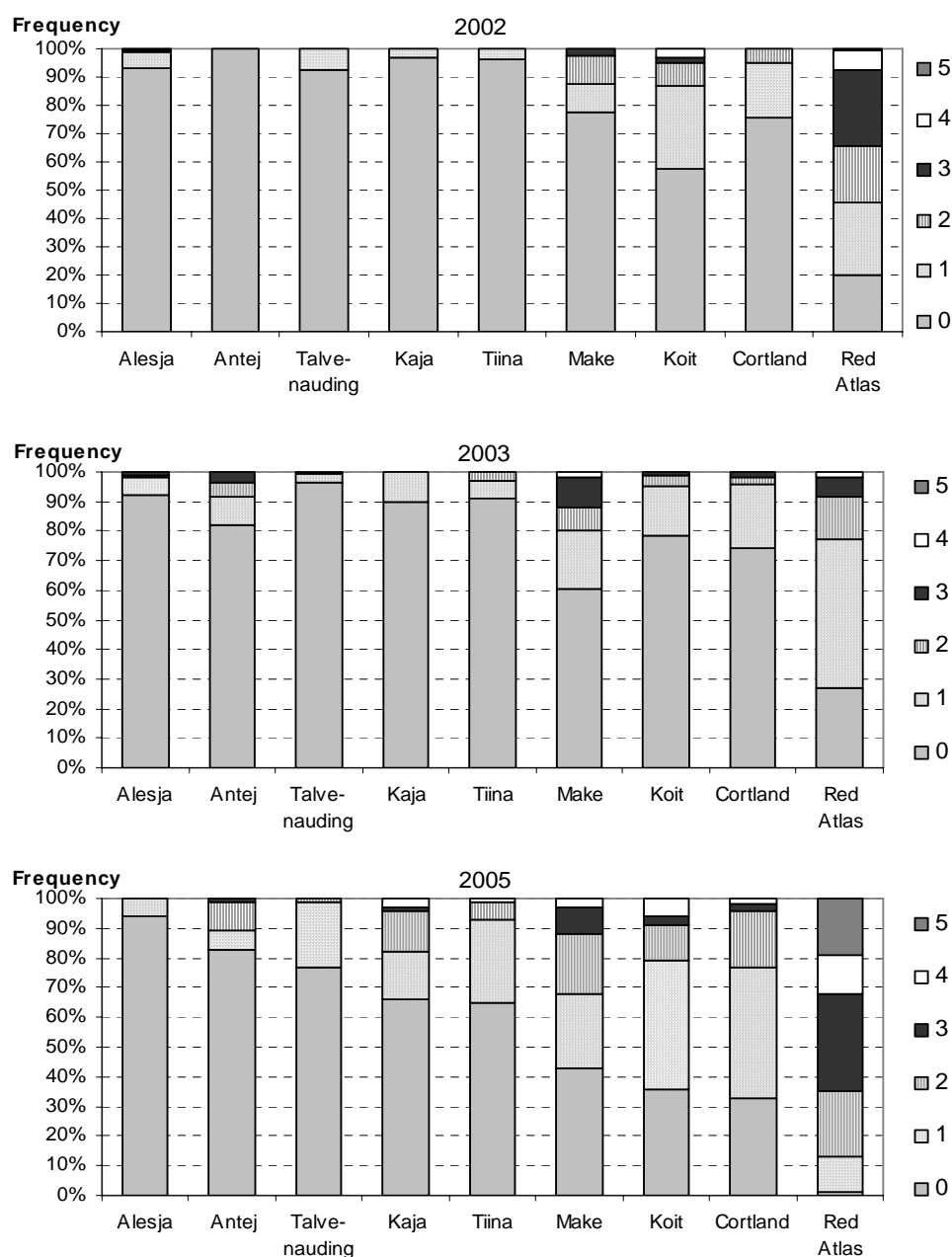


Fig. 1. Percentage of fruits in the different apple scab classes in Polli, 2002, 2003 and 2005. (Class 0 = no scab, Class 5 = scab symptoms 5–10% on the fruit).

Table 1. Scab infection on apple cultivars and selections at Polli Horticultural Research Centre (average of 2002, 2003 and 2005).

Scab infection	Cultivars and selections
Without	Chistotel, Imrus, Liberty, Orlovim, Orlovskij Pioner, Pamjat Isajeva, Pervinka, Slavjanin, Freedom
Very low	Borovka, Unison, Teremok, Neva, Alesja, Talipirnõun, Ringstad Apple, Potichok, Kuma, Talvenauding, Rigas rozu, Riia pirnõun, Karksi Renett, Rusikaõun, Maimu, Vahur, Kramer 25, Bystritsa, Paide Taliõun, Koidurennett, Korobovka, Tiina, Korichnoye Novoye, Antej
Low	Wealthy tetraploid, Ranneje Sladkoje, Kaja, Livländischer Borsdorfer, Zagrava, Sõstraroosa, Croncels, Pobeda, Anis Polosatyi, Forele, Nitschners Erdbeerapfel, Minskoje, Anis Barkhatnyi, Smugljanka, Lembitu, Snogg, Severnyi Sinap, Kordonovka, Limonka, Antonovka Ploskaya, Pepin Litowska, Raeda 1048, Porjavinskoje, Raeda 1003, Suurvalge Tõrvast, Prof. Hrebnickas Renette, Selgu Zelta Renette, Aamisepa 14, McIntosh, Aia ilu, Lindi kalvill, Baldwin, Polli Kaunitar
Medium	Krügeri Tuviõun, Raeda Suviõun, Yellow Transparent, Sügisdessert, Lobo, Martsipan, Cortland, Lemmikõun, Zhigulevskoye, Sidrunkollane Taliõun, Jyulskoye, Skryzhapel, Arkad novõi, Suislepp, Koit, Close, Baltika, Milton, Grushovka Moskovskaja, Treboux Sämling
Strong	Melba, Make, Wealthy, Wealthy Red, Kremovoye, Samo, Borovinka, Jaspi, Early Red Richard, Ottawa, Chulanovka
Very strong	Borovinka Ananasnaja, Pirja, Maikki, Mantet, Red Atlas

CONCLUSIONS

1. Since many of the old cultivars possessed a high level of resistance it is very important that they are preserved as a genetic resource .
2. Cultivars with low incidence of apple scab ('Talvenauding', 'Alesja', 'Anteij') may have potential for growing in integrated or organic apple orchards in Estonia.
3. Highly susceptible cultivars ('Red Atlas', 'Mantet', 'Pirja') were infected strongly even in years where conditions were unfavourable for spreading of apple scab.

REFERENCES

- Crosby, J. A., Janick, J., Pecknold, P.C., Korban, S.S., O'Connor, P.A., Ries, S.M., Goffreda, J. & Voordeckers, A. 1992. Breeding apples for scab resistance: 1945 – 1990. *Acta Hort.* **317**, 43–70.
- Janick, J. 2002. History of the PRI Apple Breeding Program. *Acta Hort.* **595**, 55–60.
- McHardy, W. E. 1996. *Apple scab: Biology, Epidemiology and Management*. APS Press, Minnesota, pp. 545.
- Pärtel, E. 1988. Scab resistance of apple cultivars. *Proceedings of the Estonian Research Institute Agricultural and Land Improvement LXI*, 64–75 (in Russian).
- Sandskär, B. & Gustafsson, M. 2004. Classification of apple scab resistance in two assortment orchards. *Genetic Resources and Crop Evolution* **51**(2), 197–203.
- Sasnauskas, A., Gelvonauskienė, D., Gelvonauskis, B., Duchovskis, P., Viškelis, P., Šikšnianienė, J., Bobinas, Č. & Šabajevienė, G. 2005. Evaluation of new introduced apple cultivars. In Libek, A., Kaufmane, E. & Sasnauskas, A. (eds): *Environmentally Friendly Fruit Growing. Int. Sc. Conf.* Tartu University Press, Tartu, pp. 20–25.