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STORAGE ROTS OF *VACCINIUM MACROCARPON* SPREAD AND DEVELOPMENT IN LATVIA
VACCINIUM MACROCARPON OGU PUVES IZPLATĪBA LATVIJĀ

Liga Vilka, Regina Rancane, Maija Eihe
Latvian Plant Protection Research Centre, Lielvardes 36/36, Riga, LV – 1006, Latvia
e-mail: regina.rancane@laapc.lv

Abstract
American cranberries (*Vaccinium macrocarpon* Ait.) have been cultivated for ten years in Latvia and their plantations have a tendency to enlarge every year. Latvian cranberry growers realize mainly fresh berries, because it is difficult to keep quality during prolonged storage. One of the main why quality is reduced is berry rot caused by different fungi. Berries from six cranberry plantations in different regions in Latvia for rot detection were taken at harvest time.
Different berry rot appeared on 61 % of all berries in storage. In the berries *Botrytis cinerea* (yellow rot), *Allantophomopsis cytisporea* (black rot), *Fusiccocum putrefaciens* (end rot), *Phyllosticta elongata* (Botryosphaeria fruit rot), *Physalopora vaccinii* (blotch rot), *Phomopsis vaccinii* (viscid rot), *Pestalotia vaccinii* (Pestalotia fruit rot), *Coleophoma empetri* (ripe rot), *Discosia artocreas* (Discosia fruit rot) were detected. Causal agents of berry rot had different dynamics of development. These fungi had different incubation periods. This is important information for the growers that helps to determine the real time for realization, before rotting is started. After four months of storage, the amount of causal agents was different from each plantation area.
In further investigations it is necessary to establish conditions influencing the development of causal agents.

Kopsavilkums
Lielogu dzērvenes (*Vaccinium macrocarpon* Ait.) Latvijā ir zināmas jau piecpadsmit gadus un to platības turpina palielināties. Latvijas lielogu dzērveņu audzētāji saražoto produkciju realizē svaigā veidā, pārstrādā un, ja iespējams, sasaldē, jo galvenokārt puve uz ogām parādās jau līdz decembrim. Ražas laikā 2007. gadā, lai noteiktu ogu puves ierosinātājus, tika ievāktas ogas no sešām dažādām lielogu dzērveņu audzēšanas vietām Latvjā.
Uzglabāšanas laikā 61 % ogu bija puves bojātas. No puves bojātām ogām, galvenokārt, tika konstatētas: *Allantophomopsis cytisporea* (ogu melnā puve), *Fusiccocum putrefaciens* (ogu galotnes puve), *Phyllosticta elongata* (Botryosphaeria ierosinātā ogu puve), *Physalopora vaccinii* (ogu gaišā puve), *Phomopsis vaccinii* (viskozā ogu puve), *Coleophoma empetri* (gatavo ogu puve). Ogu puves ierosinātājiem glabāšanas laikā ir atšķirīga attīstības dinamika, tas nozīmē, ka sēnēm ir

dažādi inkubācijas periodi. Šī informācija būtu nozīmīga lielogu dzērveņu audzētājiem, jo tā varētu palīdzēt realizēt produkciju pirms puves parādīšanās. Nosakot puves ierosinātājus glabāšanas laikā, varēja secināt, ka dažādos Latvijas audzēšanas rajonos to izplatība ir atšķirīga.
Turpmāk būtu vēl jāveic pētījumi par ogu puves ierosinātāju izplatības veicinošiem iemesliem Latvijā.

Key words: cranberry, storage rot, dynamics

Introduction
Cranberries are a well known crop in world over 200 years, but for only 10 years in Latvia. Cranberry plantations in Latvia are up to 100 ha. Growers are interested to know how to keep fresh berries in good condition during the storage time and what are the reasons for the yield losses. Storage rot fungi are those species that reduce fruit quality during storage.
According to literature in the USA and Canada *Colletotrichum acutatum, Pestalotia vaccinii, Phyllosticta vaccinii, Physalospora vaccinii, Phomopsis vaccinii* and *Coleophoma empetri* are the most common fungi of sound fruit in storage (Olatinwo *et al.* 2003; Oudemans *et al.*, 1999; Stiles *et al.*, 1999). The fungus *Fusicoccum putrefaciens* was recovered in less than 1% of the total isolations. It is the minor fungal pathogen in the USA according to investigations carried out in Michigan (1999 – 2001) and New Jersey (1994 – 1996) (Olatinwo *et al.* 2003; Stiles *et al.*, 1999).
Investigations on the fungal diseases of American cranberries have been carried out since 2004 in Latvia, but storage rotting has not been investigated until 2007.

Materials and methods
Six cranberry plantations (Talsi, Riga, Kuldiga, Liepaja, Aluksne, and Cesis districts) were inspected during harvesting time in 2007. From each cranberry plantation in different regions in Latvia (Figure 1) 200 sound berries (in total 1200 berries) were taken at harvest for causal agent detection. The cultivar 'Stevens' was used for the observations.

Figure 1. Inspected cranberry plantations in Latvia.

Berries were held in cold camera (+5 °C, RH – 50 %) in plastic boxes until March for causal agents of storage rot detection. Berries damaged by rotting at the end of each month for four months were counted. The causal agents of berry rot were isolated only in a pure culture, using potato dextrose agar (PDA). Plates were incubated at room temperature (20 – 25 °C) for 3 to 4 weeks. Fungi were identified directly on the isolation plates by comparing the morphological characteristics of the spores and spore bearing structures with descriptions in the literature (Caruso *et al.*, 1995; Kačergius *et al.*, 2004; Горленко *et al.*, 1996). The discovered fungi were identified in the laboratory of Latvian Plant Protection Research Centre. All calculations were performed using Microsoft Excel 2003.

Results und Discussion

Berries were taken from the field at the end of October or in the beginning of November. For the first time berries were evaluated at the end of December and on average 12% of all berries were rotted. The assessment of rotted berries was continued for the next three months until the end of March. Spread of berry rot made equal progress during all the storage time (Figure 2).

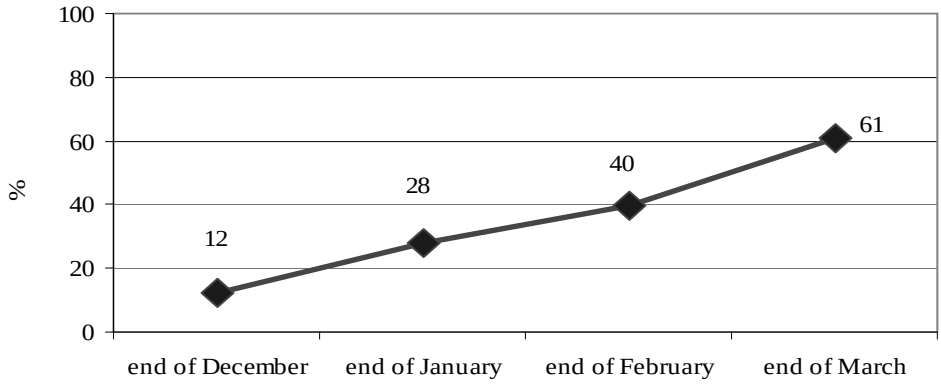

Figure 2. Dynamics of fruit rot during storage, %.

At the end of March berry rot was on average 61 % of all collected berries from the inspected cranberry plantations in Latvia. This means, berries should be very quickly realized, before they are damaged by storage rot. It is very difficult to store fresh cranberry in cold cameras without freezing.

All rotted berries at the end of each month were sorted and put on the pure culture (used PDA) for causal agent detection.

The spread of berry rot from different growing regions in Latvia where berries were collected differed. Most of all of the rotted berries – 74 % were in the Riga district, but only 52 % of the damaged berries were in Talsi district (Figure 3). Probably weather conditions and plantation age had a significant influence on the spread of the berry rot. The cranberry plantation in the Talsi district was younger and the climate was optimal in comparison with the plantation in Riga district.

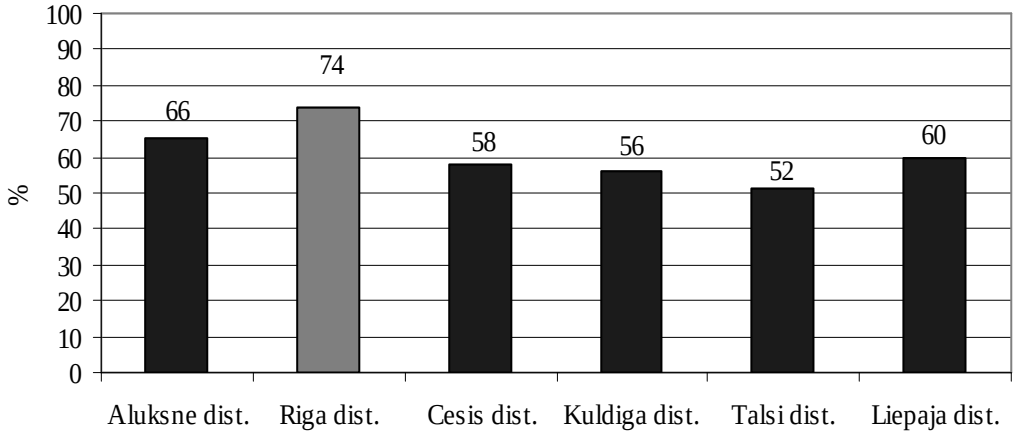

Figure 3. Berry rot spread from different cranberry growing districts during storage, %.

Climate has a strong influence on berry rot caused by different fungi. The winter 2006 was the warmest of the last 84 years in Latvia. In November, December and January the air temperature exceeded +10 – 12 °C and was 7 – 13 °C above normal. Usually such temperatures are found in September or May. February was the coldest month. In the Aluksne district the air temperature fell

to – 30°C and the snow layer was very thin, in some places it did not exist at all. March was very warm in Latvia (the warmest of the last 100 years). The air temperature was +17 – 19 °C, but at the end of month snow in the Aluksne district was observed. After such changeable weather conditions during the winter uprights were damaged very hard in the Aluksne district in comparison with other inspected cranberry plantations in Latvia. In April there was very little rainfall in the Liepaja and Riga districts. May was very hot (25 – 30 °C) and dry in the Riga district, but in other cranberry plantations was rich rainfall. In June the temperature throughout Latvia was very high up to 5 – 6 °C over the average standard and significant rain was observed in the Liepaja, Kuldiga and Talsi districts, but in the Riga and Aluksne districts first rainfall was only June 14th and 17th. Although all inspected cranberry plantations had irrigation systems, probably drought affected growth of the upright and development of the blossoms. During the cranberry flowering time in the Liepaja district it was very hot 27 – 30 °C and wet. The rainfall exceeded three times norm of the month, rainfall was in the Kuldiga and Cesis districts as well. These conditions were favorable for parasitic diseases, including flower blight and berry rot in the field and in storage. Berry formation was affected by heat in August in the Cesis and Aluksne districts, but beneficial conditions for the cranberry growth were in the Talsi and Kuldiga districts. There was rainfall in September in the Talsi, Kuldiga and Riga districts, but in the Aluksne was very dry and hot up to 6 – 7 °C over the standard norm. High rainfall amount could increase infection by fungi for berry rot development in the Riga, Kuldiga and Talsi districts. (www.meteo.lv)

From rotted berries in storage fungi *Fusiccocum putrefaciens* (end rot), *Physalopora vaccinii* (blotch rot), *Phyllosticta elongata* (botryosphaeria fruit rot), *Allantophomopsis cytisporea* (black rot), *Phomopsis vaccinii* (viscid rot), *Coleophoma empetri* (ripe rot), *Botrytis cinerea* (yellow rot), *Discosia artocreas* (discosia fruit rot), *Pestalotia vaccinii* (pestalotia fruit rot) were detected.

From inspected cranberry plantations in storage end rot caused by *Fusicoccum putrefaciens* was the most widespread (Figure 4). End rot developed very quickly during first months (December – January) in storage, and further incidence of berry rot decreased. The ripe rot (causal agent *Coleophoma empetri*) mostly developed during the first months as well, but botryosphaeria fruit rot caused by *Phyllosticta elongata* and blotch rot caused by *Physalopora vaccinii* mostly appeared in March. Causal agents of berry rot had different incubation periods. It is important for cranberry growers, if the end rot, which is economically the most important disease, was not spread during the previously year, fresh berries could be stored until January, other berry rots did not produce important material loses.

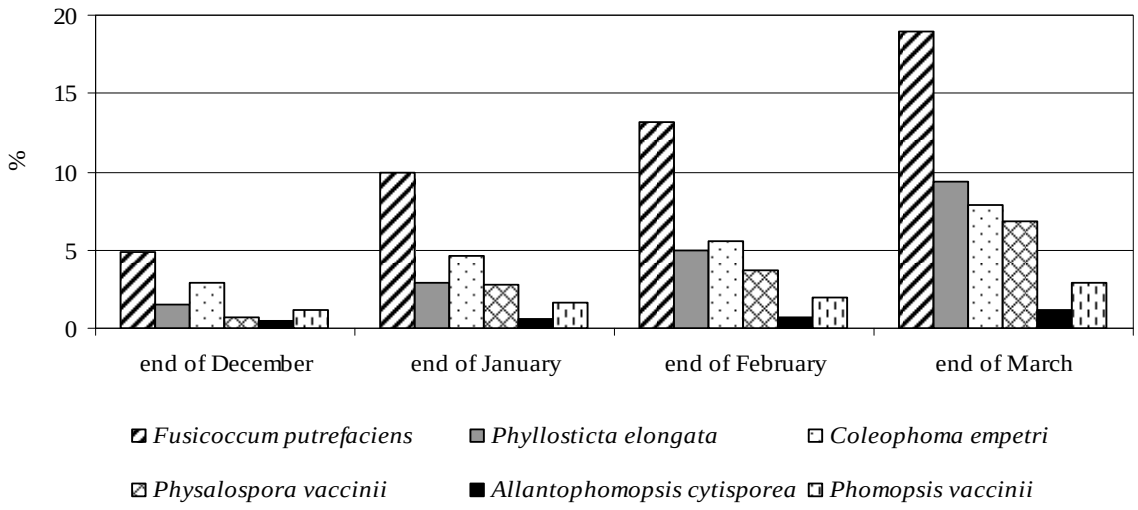

Figure 4. Causal agents of berry rot spread during storage, %.

In literature Caruso eds. and Горленко wrote, the black rot (causal agent *Allantophomopsis cytisporea*) is common in the field or during the first months in storage (Caruso *et al.*, 1995; Горленко *et al.*, 1996) but in Latvia, black rot was common till the end of March.
The incidence level of berry rot was different in each inspected cranberry plantation. End rot (*Fusicoccum putrefaciens)* was common in the Aluksne, Kuldiga and Cesis districts, but in the Riga and Liepaja districts pathogen was spread very infrequent (Fig. 5). In the cranberry plantation of the Riga district ripe rot (causal agent *Coleophoma empetri*) was widely spread and in Liepaja district botryosphaeria fruit rot (*Phyllosticta elongata*) and viscid rot (*Phomopsis vaccinii*) which is a quarantine organism were found. *Phomopsis vaccinii* was identified in Lithuania in 2002 as well (Kačergius *et al.*, 2004). Blotch rot caused by *Physalospora vaccinii* in the cranberry plantation located in the Talsi district was widely spread, but this rot in the Liepaja district was not observed. In the cranberry plantations were common 5 - 6 causal agents of berry rot, but from samples taken in the cranberry plantation in the Cesis district, developed only three rots - end rot, botryosphaeria fruit rot and blotch rot.

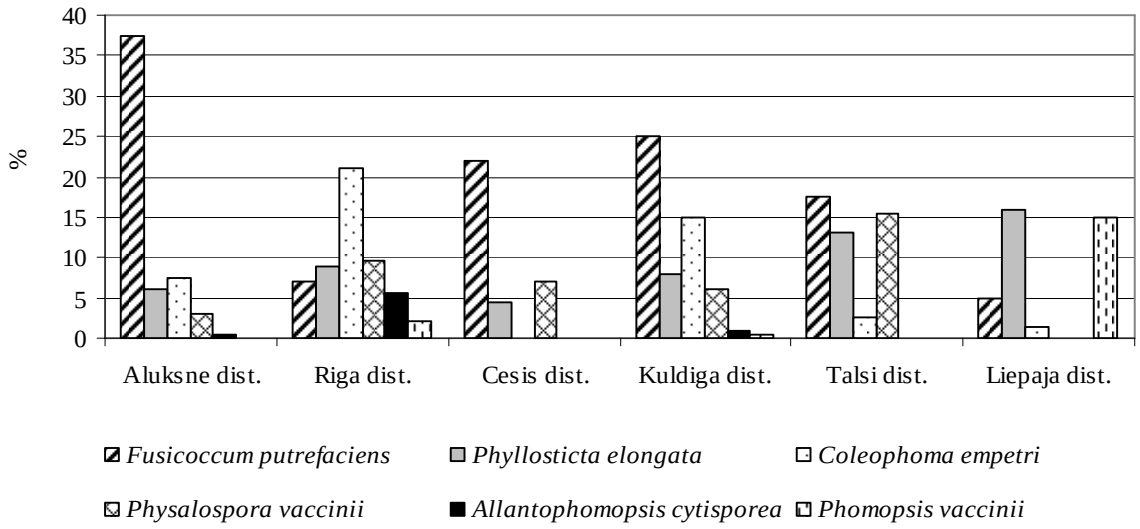

Figure 5. Causal agents of berry rot spread in different regions in Latvia during storage, %.

Conclusion

From 6 inspected cranberry plantations in Latvia six causal agents of berry rot were detected in the storage berries. The end rot caused by *Fusicoccum putrefaciens* was the most widespread.
The incidence level of berry rot in all cranberry plantations was not similar; therefore in future investigations should focus on what promotes the fungi in each cranberry plantation.

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