

Evaluation of storage ability for fresh market red raspberries

Vurdering af hindbærs opbevaringsevne som friskvare

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Summary

In order to find out more about potential fresh market cultivars of red raspberry, storage experiments were carried out in 1984, 1985 and 1986. The 1984/85 experiments were considered as preliminary and were carried out for 48 hours at 10°C followed by 24 hours at 20°C. In 1986 the conditions were 96 hours at 5°C, to imitate a sales situation where berries are transported under refrigeration. 29 cultivars were investigated.

In 1984/85 samples were evaluated for overall appearance and in 1986 the rating was given for keeping ability alone.

Storage at 10°C gave an unsatisfactory quality, however several cultivars did well for 96 hours at 5°C. The best ratings were given to 'Meeker', 'Chilcotin', 'Glen Prosen', 'Nootka' and 'Skeena'. The best fruit rot resistance was found in 'Nootka', 'Meeker', 'Rutrago', 'Skeena', 'Chilcotin' and 'Veten'.

Key words: Red raspberry, storage, cultivars, fruit rot, fruit size.

Resumé

For at få bedre kendskab til, hvilke hindbærarter der er bedst til friskvaremarkedet blev der udført opbevaringsforsøg med i alt 29 sorter i 1984, 1985 og 1986.

Forsøgene i 1984-85 blev betragtet som indledende forsøg, der skulle vise mulighederne, og de viste resultater er fra forsøg med opbevaring ved 10°C i 48 timer plus 20 °C i 24 timer. 1986 forsøgene blev udført ved 5°C i 96 timer for at simulere en salgssituation med krav om konstant køling af varen.

Alle prøver blev plukket i forsøgsparcer i Årslev, og alle viste resultater er for bær plukket i tørvejrr.

1984-85 resultaterne blev bedømt efter en skala for udseendet, hvilket inkluderer form, farve, størrelse og fejl, mens bærrene i 1986 blev bedømt efter en holdbarhedsskala, som kun tager hensyn til fejl på bærrene.

Resultaterne af opbevaring ved 10°C gav utilfredsstillende holdbarhed, da ingen sorter levede op til de krav, der blev sat på forhånd. Opbevaring ved 5°C i 96 timer viste, at mange sorter havde et tilfredsstillende udseende, men at nogle havde over 5% mugne bær, hvilket er sat som grænsen for det acceptable.

Det bedste udseende efter opbevaring havde 'Meeker', 'Chilcotin', 'Glen Prosen', 'Nootka' og 'Skeena'.

Den mindste tendens til frugtråd blev fundet for 'Nootka', 'Meeker', 'Rutrago', 'Skeena', 'Chilcotin' og 'Veten'.

Nøgleord: Hindbær, sorter, opbevaring, friskvare, holdbarhed, frugtråd, frugtstørrelse.

Introduction

Fresh raspberries are considered a luxury fruit, expensive and difficult to handle, due to problems with postharvest rot. It is very important, that fresh market cultivars have some days of shelf life. In 1984 and 1985 preliminary storage experiments were made with 21 cultivars. The storage temperature was 10°C, but the shelf life was not good enough. Therefore it was decided to lower the temperature to 5°C in 1986, and storage requirement was extended to 4 days.

In this paper the results of 29 cultivars are presented. The main object of the experiment was to select cultivars with low fruit rot tendency and a good appearance when they reach the consumer.

Most literature dealing with storage life of raspberries is mainly based on fruit rot resistance (1,3,7) and on firmness (2,5,6). However, besides fruit rot, the overall appearance of the berries is very important for the market.

Other important characteristics as yield, ease of picking, taste and number of spines are not dealt with in this investigation.

Increased consumption of fresh raspberries may be expected if supermarkets have fresh berries of good quality, therefore it is important to grow cultivars which can withstand storage.

Methods

The raspberry cultivars were planted in the field in April 1983 and in May 1985. The plants were grown in rows with a distance of 3 m and with a density of 10–12 canes per m. Water was supplied daily with 4 mm as drip irrigation and adjusted for precipitation. Fertilizers were given in the irrigation water, which contained 102 mg N, 30 mg P, 69 mg K and 46 mg Mg per litre.

Totylfluamid was applied at bloom to protect against fungi infections. No fungicides were used during the picking season.

Preliminary trials were run in July 1984 and 1985, where berries were picked dry, evaluated and transferred to store at 10°C. After 48 hours the samples were evaluated and transferred to 20°C and after 24 hours at 20°C the final evaluation

was done. The 1984–85 experiments were run with single trays and repeated 3–5 times depending on the cultivar. The rating is expressed as general appearance, which includes berry size, colour, uniformity and defects.

The main experiment ran from 21 July to 8 August 1986. Berries were picked dry and transferred into cool storage at 5°C between 2 and 4 hours after picking.

Berries were picked on four dates for most cultivars and each pick had four 250 g trays as replicates.

Berries were assessed using a scale from 1 to 10 for defects, which means that whole undamaged berries received a high rating.

10 – Berries without any damage and with their natural form.

8 – Whole berries, but few drupelets may fall off. Dry berries.

6 – Whole berries with some discoloured drupelets, some crumpled, but still dry berries.

4 – Some deformed berries moist with juice leaking.

2 – Many berries collapsed and free running juice in the tray.

Before assessment of the berries rotten specimens were removed and the number registered. The rating was given for the remainder berries.

Results

The 1984/85 results are shown in Table 1. Appearance at picking differed and 'Chilcotin', 'Glen Prosen', 'Glen Isla', 'Meeker', 'Årslev 1413/67', 'Nootka' and 'Rucami' obtained the highest rating.

After 48 hours at 10°C the highest ratings were found for 'Glen Prosen', 'Willamette', 'Glen Isla', 'Meeker', 'Årslev 1413/67' and 'Rucami', all with a low depreciation in rating, while 'Chilcotin' still is among the best, but with a considerable depreciation.

After another 24 hours at 20°C there was a considerable depreciation in the quality of all cultivars, and none had an acceptable appearance.

Table 1. Results from preliminary storage experiments in 1984 and 1985. Berries stored 48 hours at 10°C and evaluated again after 24 hours at 20°C.

Resultater af foreløbige opbevaringsforsøg med hindbær i 1984 og 1985. Bær opbevaret 48 timer ved 10°C og vurderet igen efter 24 timer ved 20°C.

Cultivar Sort	n	picking date ved plukning	Ratings ¹⁾ point	
			after 48 hours at 10°C efter 48 timer ved 10°C	after 24 hours at 20°C efter 24 timer ved 20°C
'Glen Prosen'	5	8.0	7.8	5.6
'Willamette'	5	7.0	6.8	5.0
'Glen Isla'	3	7.7	7.3	4.7
'Meeker'	5	7.8	7.3	4.5
Årslev 1413/67	4	7.3	7.3	4.5
'Nootka'	4	7.5	5.8	4.0
'Skeena'	5	7.0	6.2	3.8
'Rucami'	5	7.6	7.3	3.8
'Glen Moy'	5	7.0	6.0	3.6
'Ruku'	3	5.7	5.3	3.3
'Malling Jewel'	5	7.0	5.4	3.2
'Chilcotin'	3	8.3	6.7	3.0
'Rutrago'	5	6.4	5.0	2.8
'Zenith'	5	6.2	5.2	2.8
'Canby'	4	6.0	4.5	2.8
'Rumiloba'	4	7.0	5.8	2.8
Årslev 265/66	5	5.4	6.2	2.6
'Veten'	5	6.2	4.2	2.6
'Haida'	3	6.0	5.3	2.3
'Futura'	4	4.5	4.3	2.0
'Camenzind'	4	4.5	4.0	1.5
LSD		2.6-3.9	2.7-4.4	2.6-4.1

1) Ratings using a scale 1-10 (10 best). The scores reflect the general appearance of the berries, which include size, form, crumpling, colour and rot.

This should have been at least 6 according to the applied scale. 'Glen Prosen', 'Willamette', 'Glen Isla', Årslev 1413/67 and 'Meeker' had the highest ratings.

Results of the 1986 experiment is shown in Table 2. Ratings of 6 and above are considered as acceptable. The highest score was found for 'Meeker' followed by 'Chilcotin', 'Glen Prosen', 'Nootka' and 'Skeena'. The poorest quality was found for 'Delight', 'Orion', 'Admiral', Årslev 856/60 and Årslev 5857/61. The present main cultivar in Denmark, 'Veten' ranges in the middle as acceptable.

The number of rotten berries differed between the cultivars (Table 2). The lowest fruit rot ten-

dency was found for 'Nootka' with 2.6% moulded berries per 250 g.

As long as berries are dry after storage, it is considered acceptable with up to 5% moulded berries. This requirement is met for 'Nootka', 'Meeker', 'Rutrago', 'Chilcotin' and 'Skeena', which means that these cultivars can be stored for about 96 hours, with a good result when picked dry. The Malling cultivars 'Delight', 'Orion' and 'Admiral' and the two Danish breeds have a very high rot tendency and may be considered as poor fresh market cultivars.

As further description of the cultivars Table 2 shows the fruit sizes obtained from the field from which the experimental fruit was harvested. It is

Table 2. Quality and fruit size of raspberry cultivars stored 4 days at 5°C.

Hindbærsorters kvalitet efter 4 døgn ved 5°C, samt frugtstørrelse.

Cultivar Sort	Rating Point	g/100 fruits g/100 frugter	% rotten % rådne
'Meeker'	8.00	335	3.2
'Chilcotin'	7.50	345	5.0
'Glen Prosen'	7.42	275	7.0
'Nootka'	7.21	280	2.6
'Skeena'	7.00	250	4.4
'Ruku'	6.83	315	9.1
'Willamette'	6.57	340	5.8
'Haida'	6.42	270	7.4
'Rutrago'	6.33	330	4.0
'Leo'	6.30	360	10.2
'Glen Clova'	6.29	290	6.0
'Canby'	6.29	265	5.4
'Veten'	6.25	360	5.0
'Glen Moy'	6.14	350	5.7
'Rucami'	6.08	380	10.5
'Malling Jewel'	6.07	240	5.1
'Joy'	5.00	320	7.5
'Multiraspa'	4.86	400	19.0
'Camenzind'	4.75	260	9.5
Årslev 5857/61	4.64	385	24.1
Årslev 856/60	4.62	405	20.6
'Malling Admiral'	4.50	405	17.3
'Malling Orion'	3.11	360	23.2
'Delight'	2.71	435	33.1
LSD	1.00		4.7

For rating 'F'-ratio was 13.11 and for % rotten 'F'-ratio was 19.59. $P < 0.0001$.

seen that all the big fruited cultivars are also the cultivars mentioned as having poor storage capability (Fig. 1).

The correlation coefficient between % rotten berries and berry size was 0.55 with a 'F'-ratio of 121.9 and 289 d.f., which is highly significant. Fig. 1 indicates that bigger fruited cultivars have a higher fruit rot tendency.

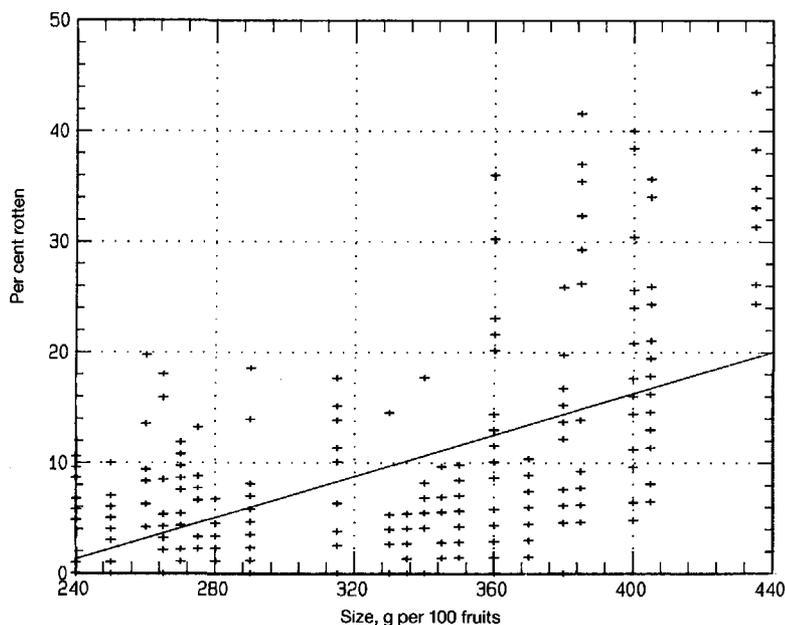
Discussion

The preliminary results are evaluated using a scale for overall appearance. The best ratings at picking of 'Chilcotin', 'Meeker' and 'Nootka' are in agreement with *Daubeny* (3). 'Glen Prosen' was not present in the referred experiment.

The ratings after storage for 2 and 3 days (Table 1) are to some extent in agreement with the results after 4 days of storage (Table 2). 'Glen Prosen', 'Meeker', 'Nootka', 'Skeena' and 'Willamette' were among the best cultivars in both experiments.

The good keeping quality of 'Nootka' found in the 1986 experiment is characterised by a high fruit rot resistance (Table 2). This is in agreement with *Øydvin* (9), *Barritt and Torre* (1), *Daubeny* (3) and *Daubeny* (4), who found higher rot resistance

Fig. 1. Relation between fruit size and fruit rot tendency. *Sammenhæng mellem frugtstørrelse og frugtrådstens.*



in 'Nootka' than in 'Willamette', 'Meeker', 'Skeena' and 'Canby'.

Both Øydivin (9), Daubeny (3) and Barritt and Torre (1) found 'Meeker' to possess the second highest rot resistance, which is also the case in the present experiments.

'Meeker' had the best appearance after 96 hours at 5°C followed by 'Chilcotin', 'Glen Prosen', 'Nootka' and 'Skeena', however there were no significant differences between these cultivars.

In experiments by Terrettaz and Carron (8) 'Meeker' was evaluated as the best shipping cultivar which is also the case in the present investigation.

Terrettaz and Carron (8) found 'Delight', 'Admiral', 'Jewel' and 'Leo' to be poor shipping cultivars. This is in agreement with the present findings where the same cultivars have a very high fruit rot tendency.

'Chilcotin' got a high score for appearance and had a high rot resistance too.

All experiments were run on dry picked berries. However a test was made after four days with rain. No cultivar could stand this and all berries were rotten after two days storage. The correlation between size and rot (Fig. 1) – is of the same magnitude as found by Knight (7).

Acceptable appearance in this evaluation ought to be higher than 6.0, which means that two thirds of the cultivars should be acceptable. The rot resistance is also important and it is considered that up to 5% berries with rot is acceptable. Both requirements are met by 'Meeker',

'Nootka', 'Rutrago', 'Chilcotin', 'Malling Jewel' and 'Skeena'. No rot at all is of course the ideal situation, but none of the cultivars could meet this when not sprayed with fungicides during harvest.

Of the cultivars with best shelf life 'Malling Jewel' has fruits which are too small while the others may be recommended as fresh market cultivars from a fruit quality point of view.

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