Storability of 'Galant®' and 'Natyra': Two New Apple Cultivars for Organic Fruit Production

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Abstract

Results from storage studies conducted at the Competence Centre for Fruit Growing at Lake Constance (KOB) in 2014 with the new resistant apple cultivars 'Galant®' and 'Natyra' are presented. Both these cultivars have been breed for resistance to apple scab and are of interest to organic fruit growers. 'Galant®' softens quickly after harvest and seems suitable only for short term storage. 'Natyra' maintained excellent fruit firmness (FF) during storage 7 months CA storage and showed no physiological disorders.

Keywords: Apple scab resistance, controlled atmosphere storage (CA), fruit quality

Introduction

Disease resistance cultivars provide the organic fruit grower with considerable economic advantages. 'Topaz' has become the standard organic cultivar in Germany primarily based on its resistance to apple scab. Of great interest are alternative cultivars suitable for organic production that eat well and have disease resistance as well as good productivity and storage characteristics. 'Galant®' and 'Natyra' are two new disease resistant cultivars with many interesting attributes.

'Galant®' ('Lumaga' A 913) was developed in Switzerland as a cross between Resi x Delbar Jubilée. It is a promising cultivar suitable for organic production with resistance to apple scab, a good tree growth habit and yield potential, but little is known about its postharvest behaviour. 'Natyra' was developed in The Netherlands from a cross between 'Elise' and a code named resistant selection that provided the Vf scab resistant gene. 'Natyra' appears to be grower friendly with good productivity and an excellent taste (Baab & Korsten, 2015) as well as showing very good storage characteristics.

Storage studies were conducted with 'Natyra' apples sourced from the Lake Constance region of Germany by Kittemann & Neuwald (2014) and additional results are now available for this cultivar from the 2014/15 season together with the first storage experience with 'Galant®'.

'Galant®' Storage Studies: Results and Discussion

'Galant' apples were harvested in 2014 from young trees at the Competence Centre for Fruit Growing (KOB) organic demonstration orchard at Eschau located in the Lake Constance region of Germany. At-harvest on 02.10.2014, the maturity parameters were as follows: fruit firmness (FF) of 8.8 kg/cm^2, total soluble solids (TSS) of 12.7 °Brix, starch-index of 6.2 (scale 1 to 10) and a resulting Streif-Index of 0.11.

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Fruit were stored at either 1 or 3 °C under CA conditions of 1 % O_2 with CO_2 concentrations of <0.7 or 3.0 %. Two storage outturn assessments were conducted, the first in January after 3 months and a second assessment in May after 7 months storage. After removal from CA storage, fruit were held at 20 °C for a 7 d shelf-life. At the first outturn assessment, FF after shelf-life was stable and comparable with the values at-harvest. At the second assessment FF was clearly lower (Table 1) and the fruit softened rapidly by ~1 kg/cm_2 during shelf-life.

Table 1: Fruit Firmness [kg/cm²] of 'Galant' apples after 3 or 7 months in CA-storage at 1 % O_2 and <0.7 % or 3 % CO_2 at 1 °C or 3 °C. Assessments were made directly after storage removal and after 7 d shelf-life at 20 °C.

Treatment		**FF after 3 months storage**		**FF after 7 months storage**	
		Direct	After shelf-life	Direct	After shelf-life
1°C	1.0 % O_2 / 0.7 % CO_2	8.9	8.5	6.0	5.0
	1.0 % O_2 / 3.0 % CO_2	9.0	8.5	6.6	5.6
3°C	1.0 % O_2 / 0.7 % CO_2	7.6	7.2	5.6	5.0
	1.0 % O_2 / 3.0 % CO_2	8.6	8.5	6.4	5.1
FF at-harvest (8.8)					

The incidence of physiological disorders was observed in a small sample of 'Galant' fruit (8x fruit per treatment) after storage and after shelf-life. At the second assessment after 7 months CA storage the incidence of internal browning was 80 % to 100 % in all treatments.

Experience from the 2014/15 season shows that 'Galant' has a limited postharvest storage life, it softens quickly with the development of internal browning in the period between January and May. Internal physiological disorders (flesh browning, core browning and cavity formation) were markedly present in all longer-term storage treatments. Based on these initial results, the storage life of 'Galant' under CA conditions is limited to January. Studies in 2014/15 used only one harvest due to the limited availability of fruit from young plantings. Further studies will be necessary to better define an optimum harvest window and test the postharvest behaviour of this cultivar under a range of different storage conditions.

'Natyra' Storage Studies: Results and Discussion

In addition to orchard productivity trials, storage studies on 'Natyra' have been conducted at the KOB. In each of the three seasons, 2011/12 to 2013/14 'Natyra' showed very good storage ability characterised by a minimal loss of FF. An elevated storage temperature of 3 °C compared to 1 °C showed no negative effects on FF, TSS or acidity content. However, the recommended storage temperature has been set at 1 °C to reduce the risk of storage rots developing. No physiological disorders have been observed and we can conclude that 'Natyra' is not either temperature (chilling) or CO_2 sensitive. CA conditions with increased CO_2 concentrations (2.5 to 3.0 %) can be used safely to help inhibit fruit ripening processes without causing damage to the fruit.

In the 2014/15 storage season further studies were undertaken at the KOB to determine the optimal harvest window for 'Natyra'. In addition, the influence of storage conditions on fruit quality parameters and the incidence of physiological disorders from three different harvest dates was investigated.

Fruit were harvested from the KOB organic demonstration orchard at Eschau. In 2014, the FF as well as the refractometer values (TSS) for 'Natyra' were lower than in previous years, as found for most other cultivars in this season. The studies from 2010/11 to 2013/14 showed FF values between 8.2 and 8.3 kg/cm^2 and TSS values of 12.8 to 14.7 °Brix. Table 2 shows the maturity parameters at the time of harvest in 2014. The three harvests were conducted at Streif-Indexes of 0.17, 0.13 and 0.12, respectively.

Table 2: Maturity parameters at-harvest for 'Natyra' from three different harvest dates in 2014.

Harvest	Date	Firmness (kg.cm^{-2})	Starch Index (1 to 10)	TSS (°Brix)	Streif Index
1	01.10.2014	8.4	4.2	11.7	0.17
2	09.10.2014	7.7	4.8	12.3	0.13
3	15.10.2014	7.4	5.1	12.4	0.12

Previous work with 'Natyra' had shown it can maintain good FF values during storage and in 2014/15 no appreciable differences were observed in FF between storage at 1 ° or 3 °C (Table 3). During 7 months CA storage plus 7 d shelf-life at 20 °C, FF only decreased slightly when compared to the FF values at-harvest.

Table 3: Fruit firmness [kg.cm²] of 'Natyra' apples from three harvest dates in 2014 after 7 months CA storage at 1.0 % O_2 and <0.7 % or 3.0 % CO_2 and 7 d shelf-life at 20 °C. Storage at 1 °C or 3 °C.

Harvest	FF at-harvest	FF after storage & shelf-life			
		1°C		3°C	
		0.7 % CO_2	3.0 % CO_2	0.7 % CO_2	3.0 % CO_2
1	8.4	8.3	8.1	7.4	7.6
2	7.7	8.0	7.5	6.9	7.4
3	7.4	7.6	7.5	6.8	7.0

Table 4: TSS [° Brix]) of 'Natyra' apples from three harvest dates in 2014 after 7 months CA storage at 1.0 % O_2 and <0.7 % or 3.0 % CO_2 and 7 d shelf-life at 20 °C. Storage at 1 °C or 3 °C.

Harvest	TSS at-harvest	TSS after storage & shelf-life			
		1°C		3°C	
		0.7 % CO_2	3.0 % CO_2	0.7 % CO_2	3.0 % CO_2
1	11.7	13.5	13.1	12.9	12.9
2	12.3	12.9	13.0	12.9	13.0
3	12.4	13.2	13.2	12.9	12.7

Table 5: Titratable acidity (g/l) of ‘Natyra’ apples from three harvest dates in 2014 after 7 months CA storage at 1.0 % O_2 and <0.7 % or 3.0 % CO_2 and 7 d shelf-life at 20 °C. Storage at 1 °C or 3 °C.

Harvest	TA at-harvest	TA after storage & shelf-life			
		1°C		3°C	
		0.7 % CO_2	3.0 % CO_2	0.7 % CO_2	3.0 % CO_2
1	8.3	5.0	4.9	4.2	4.2
2	7.9	4.9	4.8	4.1	4.1
3	7.0	4.9	4.6	4.1	3.8

In the 2014/15 storage studies ‘Natyra’ showed little change in the TSS content either at 1 °C or 3 °C when compared to the values at-harvest (Table 4). However, the acid content strongly decreased during the storage, in a manner similar to other apple cultivars, with a minimal difference between the two storage temperatures (Table 5). No physiological disorders were observed at storage outturn or after shelf-life in any of the treatments. When stored under 1 % O_2 ‘Natyra’ showed no sensitivity to the higher CO_2 conditions (3.0 %) compared to the <0.7 % CO_2 treatment.

In 2014, fruit picked from within a harvest window from Streif-Index 0.17 to 0.12 maintained FF values at storage outturn and even under an elevated storage temperature of 3 °C there were no adverse effects on the fruit quality parameters FF, TSS or TA. In the 2014/15 studies no physiological disorders were observed, it can be assumed that ‘Natyra’ is not temperature (chilling) or CO_2 sensitive. The inhibitory effect on ripening of increased CO_2 concentrations (3 %) during CA storage can be used without risk of fruit damage.

It is possible to store ‘Natyra’ in regular air at 1 °C for a short period (up to end of December). For medium to long term storage in CA, based on the experience to date, a storage temperature of 1 °C and conditions of 1.0 to 1.5 % O_2 and 2.5 to 3.0 % CO_2 are suitable. Based on the harvest period and storage requirements of ‘Natyra’, storage with other cultivars in mixed CA rooms is possible with less CO_2 sensitive cultivars such as ‘Golden Delicious’ or ‘Pinova’ as well as more sensitive cultivars such as ‘Braeburn’ or ‘Rubinette’. When stored in mixed rooms with other late season CO_2 sensitive cultivars, the storage conditions must be matched to the most sensitive cultivar. ‘Natyra’ also offers the possibility to save energy when stored under elevated temperatures i.e. 3 °C instead of 1 °C. However, the incidence and growth of storage rots are strongly affected by the storage temperature. To keep the incidence of storage rots as low as possible, it is currently recommended that organic grown fruit to be stored at a temperature as low as possible while respecting the cultivar specific tolerance for chilling injury. This is in contrast to study results for the apple cultivar ‘Pinova’, where it has been shown that the incidence bitter rots (*Neofabraea* spp., syn. *Gloeosporium*) can be reduced at increased storage temperatures. Further storage experiments are planned for ‘Natyra’ under different storage temperatures.

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