

APRC Project Report

Project SP117: Maximise the potential of A931/15 (Meridian) and E11/20 for UK conditions.

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Optimum picking dates and storage regimes for Meridian.

As described in the report for September 2000, the storage regimes and harvesting dates evaluated were as follows:

Air-stored fruits:

Fruits from the same two sites used in 1999 were harvested on two occasions. The first harvest was timed to coincide with fruit firmness values of just over 70 Newtons (7.1 kg) and the second harvest date 9 days later. Three temperature regimes were evaluated, 0°C, 1.5°C and 3.0°C. Fruits from these regimes were removed on 31/10 and 28/11/00.

CA-stored fruits

Fruits from the same two sites were harvested and placed into two different CA regimes at 3.5-4°C. These were <1% CO₂ + 1.2% O₂ and 5% CO₂ + 1% O₂. Fruits were removed on 9/1 and 12/3/01.

The results at the time of harvesting are shown in Table 1.

Table 1. Weight, size, firmness, % soluble solids and % starch in Meridian apples harvested from two sites in 2000

Site	Picking date	Individual fruit weight (g)	Fruit diameter (mm)	Firmness (Newtons)	Soluble solids (%)	Starch (%)
East Kent	6/9/00	135.8	69.2	69.2	13.3	92.5
	15/9/00	144.8	70.4	66.6	13.4	92.0
Suffolk	8/9/00	127.4	67.4	73.8	11.7	94.5
	17/9/00*	143.2	70.8	65.4	13.2	75.5

* Fruit harvested on 17/9/00 and assessed on 22/9/00

Firmness of apples from air and CA storage

Firmness was measured in Newtons (N) using an automated penetrometer. Firmness in Kg can be derived approximately by dividing Newtons by 10 (1 Kg = 9.81 N).

Fruits from the three air storage regimes were first examined on 31st October 2000. It can be seen from Table 2 that all fruits lost firmness in air storage, irrespective of the temperature. However, the least loss of firmness occurred when fruits were held at 0°C and most loss when held at 3°C. Although fruits from the first harvest date at each site were slightly firmer than those from the second harvest date at the commencement of storage, these differences were not sustained during the period in storage, especially with fruit from the Kent site. The firmest fruits were those picked at the earliest date from the Suffolk site and stored at 0°C.

Table 2. Influence of picking date and storage temperature on the firmness (Newtons) of Meridian fruits harvested from an East Kent and Suffolk site and stored in air until 31/10/00

Site	Harvest date	At harvest	Air stored – 1st removal		
			0°C	1.5°C	3°C
East Kent					
	6/9/00	69	63	58	54
	15/9/00	67	62	58	56
Suffolk					
	8/9/00	74	65	62	57
	17/9/00	65	62	59	56

By the second removal from air storage on 28/11/00 the firmness of all fruits was below 60 Newtons and fruits stored at 3°C were very soft (<50 Newtons) (Table 3). Fruits stored at 0°C and harvested at the earlier date were the firmest albeit probably softer than desired by the markets.

Table 3. Influence of picking date and storage temperature on the firmness (Newtons) of Meridian fruits harvested from an East Kent and Suffolk site and stored in air until 28/11/00

Site	Harvest date	At harvest	Air stored – 2nd removal		
			0°C	1.5°C	3°C
East Kent					
	6/9/00	69	59	52	49
	15/9/00	67	57	51	48
Suffolk					
	8/9/00	74	59	53	50
	17/9/00	65	57	53	49

The first CA-stored fruits were removed from store and evaluated on 9/01/01. It can be seen from Table 4 that all fruits lost firmness in store but fruits from the earlier harvest were generally better in this respect than fruits from the later harvest. Firmness was retained better in the 5+1 (CO₂ + O₂) regime than in the <1+1.2 regime and the fruit from the Suffolk site was firmer than that from the East Kent site.

Table 4. Influence of picking date and storage regime on the firmness (Newtons) of Meridian fruits harvested from an East Kent and Suffolk site and stored in CA conditions at 3.5°C until 9/01/01

Site	Harvest date	At harvest	CA stored – 1st removal	
			5% CO ₂ + 1% O ₂	<1% CO ₂ + 1.2% O ₂
East Kent	6/9/00	69	63	61
	15/9/00	67	60	59
Suffolk	8/9/00	74	67	63
	17/9/00	65	64	62

The final examination of fruits from CA storage was carried out on 12/03/01. Fruits stored in 5+1 were similar in firmness to the fruits removed at the end of January (Table 5). However, fruits in the <1+1.2 regime had continued to soften.

Table 5. Influence of picking date and storage regime on the firmness (Newtons) of Meridian fruits harvested from an East Kent and Suffolk site and stored in CA conditions at 3.5°C until 12/03/01

Site	Harvest date	At harvest	CA stored – 2nd removal	
			5% CO ₂ + 1% O ₂	<1% CO ₂ + 1.2% O ₂
East Kent	6/9/00	69	63	59
	15/9/00	67	60	57
Suffolk	8/9/00	74	65	57
	17/9/00	65	67	56

Fruits from the earlier pick at the East Kent site were marginally firmer than fruits from the later pick and fruits from the Suffolk site were firmer than fruits from the East Kent site when stored in the 5+1 (CO₂ + O₂) regime.

Soluble Solids

At harvest most of the fruits had soluble solids values in excess of 13%. When removed from air storage, either in late October or November, these values had risen to 14% and 15% respectively. Similarly, in January or March fruits removed from CA storage had soluble solids values of 14% to 15%. No differences were noted in fruit from the two CA regimes or from the two sites.

Bitter Pit

Fruits harvested at the earlier date from the East Kent site had developed 5-15% bitter pit after 6 weeks air storage (Table 6). The incidence of bitter pit was worse in fruits stored at

progressively higher temperatures. Fruits picked one week later from the same site also developed bitter pit and this was again most severe following storage at 3°C. At the second removal from air storage (18/11/00) similar levels of bitter pit were recorded in fruits from the East Kent site. Fruits from the Suffolk site showed almost no bitter pit irrespective of the harvest date, storage temperature or date of removal from store.

Table 6. Influence of picking date and storage temperature on the incidence of bitter pit in Meridian fruits harvested from an East Kent and Suffolk site and stored in air until 31/10/00 and 28/11/00

Site	Harvest date	Air stored – 1st removal			Air stored – 2nd removal		
		0°C	1.5°C	3°C	0°C	1.5°C	3°C
East Kent	6/9/00	5	10	15	3	20	15
	15/9/00	3	5	13	8	8	28
Suffolk	8/9/00	0	0	3	0	0	0
	17/9/00	3	0	3	0	0	0

Following CA storage, fruits from the East Kent site were found to be affected significantly by bitter pit (Table 7). The lowest incidence was recorded in fruits from the earlier harvest stored in <1+1.2 (3%); fruits harvested later showed much higher values (13%-18%) when stored in the same regime. Fruits from the first East Kent harvest stored in 5+1 showed more bitter pit than fruits stored in <1+1.

Table 7. Influence of picking date and storage regime on the incidence of bitter pit in Meridian fruits harvested from an East Kent and Suffolk site and stored in CA conditions at 3.5°C until 9/01/01 (1st removal) and 12/3/01 (2nd removal)

Site	Harvest date	CA stored 1st removal		CA stored 2nd removal	
		5% CO ₂ + 1% O ₂	<1% CO ₂ + 1.2% O ₂	5% CO ₂ + 1% O ₂	<1% CO ₂ + 1.2% O ₂
East Kent	6/9/00	10	3	17	3
	15/9/00	5	13	20	18
Suffolk	8/9/00	0	0	0	0
	17/9/00	0	0	0	0

East Kent fruit from the second harvest showed more variable amounts of bitter pit, but was generally worse in fruit stored for the longest period. Fruit from the Suffolk site did not develop bitter pit in either CA regime regardless of harvest date or storage duration.

Conclusion

Evidence from the 2000 harvest of Meridian indicates that:

- Firmness declines rapidly in air-stored fruits and this is associated with storage temperature. Fruits held at 0°C are firmer after 6 weeks air storage than fruits held at 3°C.
- The firmest fruits ex CA storage were those held at 5% CO₂ and 1% O₂ as opposed to <1% CO₂ and 1.2% O₂.
- Early picking is essential if adequate firmness is to be sustained in storage. Penetrometer readings plus fruit colour assessments may provide the best indicators of optimum harvest date. Fruits should be picked when firmness has declined to 70-75 Newtons (7.1-7.6 kg).
- Starch pattern and internal ethylene concentration (data not presented) are poor indicators of optimum harvest date.
- Fruits grown at an East Kent site were consistently softer and developed more bitter pit than fruits produced in a Suffolk orchard.
- The cultivar has the potential to store for 6 months in 5% CO₂ + 1.2% O₂ at 3.5°C but for shorter periods in <1% CO₂ + 1.2% O₂. CA storage at temperatures below 3.5°C may improve storage quality but this aspect has not been investigated.
- It is important to apply a full calcium spray programme to offset the risk of bitter pit.

Trials on E11/20

Trees are being grown on to provide fruits for future evaluation of this selection, should APRC decide to select it for release. Visual observations conducted on small numbers of trees in 2000 showed fruit cracking to be a problem on one site. Taste evaluations conducted by retailers were not promising. The selection was considered attractive but with a slightly tough skin. It has performed quite well on a site where no pesticides are applied and the selection may have potential for use in organic orchards.