Field and storage evaluation of new supersweet sweet corn cultivars

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Abstract

Field performance and storage potential of nine supersweet sweet corn cultivars were compared for fresh-market use. Field experiments were carried out at two sites, Hastings and Matamata, and cobs from the Hastings site were stored for up to 3½ weeks at 0°C to assess storage potential. Establishment, yield and cob quality were measured in the field and husk leaf quality and sensory quality were assessed during storage and shelf-life.

Honey 'n' Pearl, the standard bi-coloured cultivar (yellow dominant), had the best combination of field and storage performance although some cultivars retained husk leaf quality better in storage. Silver Xtrasweet, a white dominant bi-coloured cultivar was next best. SCH 5017 was the best yellow cultivar. Chilling injury to husk leaves, rather than sensory quality, limited shelf-life after storage at 0°C.

Additional key words: Zea mays, *shelf-life, shrunken-2*

Introduction

Honey 'n' Pearl is the most widely grown supersweet sweet corn cultivar for the fresh market in New Zealand. Supersweet sweet corn cultivars incorporate the mutant shrunken-2 (sh2) gene into standard sweet corn and can be yellow or bi-coloured. Honey 'n' Pearl is a bi-coloured cultivar, with yellow dominant over white kernels.

The cultivar is popular in Asian markets where sweet corn is a staple vegetable. The main limitations for fresh export of Honey 'n' Pearl are either the high cost of airfreight or the maintenance of quality during the three weeks required for seafreight. Experiments simulating seafreight showed a decline in cob eating quality after 3 weeks storage at 0°C and rapid loss of husk leaf quality after removal from storage (Brash *et al.*, 1992).

New cultivars with superior postharvest qualities to Honey 'n' Pearl could enable sweet corn to be sent by seafreight to Asian markets. Supersweet cultivars maintain sugar content and sensory qualities better than standard cultivars when stored at temperatures close to 0°C (Wann *et al.*, 1971, Olsen and Jordan, 1989, Geeson *et al.*, 1991). Brecht *et al.* (1990) examined many aspects of the postharvest quality of 30 supersweet cultivars after 9 days at 5°C.. They found cultivar differences in husk colour and husk drying rating and concluded husk drying limited storage life at 5°C.

Our experiments examined the field and storage performance of the standard cultivar, Honey 'n' Pearl, with eight other cultivars. Field performance is important because although Honey 'n' Pearl produces large, attractive cobs problems of poor seed establishment and incomplete filling of cob tips (tip blanking) detract from this cultivar.

Field experiments were carried out at two sites and sweet corn from one site was used to examine storage and shelf-life potential after up to 3½ weeks at 0°C.

Materials and Methods

Field experiments were carried out in New Zealand at the Hawkes Bay Research Centre, near Hastings, and on a grower's property at Matamata. Both sites are in important sweet corn growing districts.

Nine cultivars (Table 1) were sown by hand on 9 November 1990 at Hastings and 19 November 1990 at Matamata. Plots were 4 x 3 m in size with 4 rows per plot, 0.75 m between rows and 0.2 m within-row seed spacing. There were four replicate plots for each cultivar in a randomised block design at each site.

Fertiliser base dressings of 12-10-10 NPK were applied at 400 kg/ha at Hastings and 500 kg/ha at Matamata.

Table 1 shows harvest details. Harvest maturity was assessed on the basis of kernel dry matter content (DM)

Table 1. Cultivars and harvest description.

Cultivar[1]	Colour[2]	Harvest Date Hastings	Kernel DM% at harvest[3] Hastings	Matamata
Honey 'n' Pearl	Bi(y)	18 Feb	22.4	21.2
SCH 4430	Bi(y)	16 Feb	22.9	23.0
SCH 5419	Bi(y)	20 Feb	22.1	17.9
SCH 5425	Bi(y)	13 Feb	21.8	23.0
Silver Xtrasweet	Bi(w)	16 Feb	22.2	23.3
Florida Staysweet	Ye	20 Feb	22.0	18.4
SCH 5005	Ye	13 Feb	19.8	21.1
SCH 5017	Ye	18 Feb	21.9	19.8
SCH 5277	Ye	18 Feb	21.2	20.8

[1] Seed supplied by Illinois Foundation Seeds Inc, Champaign, USA.
[2] Bi = bicoloured, Ye = yellow, (y) = yellow dominant, (w) = white dominant.
[3] Samples were oven-dried at 60°C for 24 hours.

Table 2. Rating criteria for sweet corn.

Tip blanking

Score	Description
1	Over 25 mm of cob tip without kernels.
2	12 - 25 mm of cob tip without kernels.
3	Up to 12 mm of cob tip without kernels.
4	Completely filled cob tip, with slight taper.
5	Perfect blunt tips.

Husk leaf quality

Score	Description
1	Severe wilt, brown dry leaves, mould.
2	Some wilting, discoloured leaves, slight mould.
3	Leaves starting to discolour.
4	Medium green colour.
5	Fresh even dark green.

at Hastings to achieve close to 22% DM. The harvest at Matamata was made on 1 March 1991 at a mean harvest maturity of 21% DM.

Plant density and yield of cobs with husks was measured from the middle two rows of each plot. Cob size without husk leaves (weight and length) measurements and tip blanking scores (Table 2) were made on five cobs per plot.

Forty cobs of each cultivar (10 per plot) from the Hastings experiment were harvested with a 5 cm stalk attached. They were cooled immediately after harvest to 5°C, bulked for each cultivar and transported to Levin Research Centre. Cobs were hydro-cooled on arrival, subdivided into five groups of 8, wrapped in polythene liners and placed in boxes in a coolstore at 0°C. The sweet corn was in storage within 24 hours of harvest and held for up to 25 days. Cobs were removed from storage as required after 0, 18 and 25 days and held at 15°C to simulate shelf-life. Cobs were held in boxes and wrapped in polythene liners during shelf-life.

Sensory assessments were carried out by a panel of 8-10 experienced panellists. All cultivars were assessed after 0 and 18 days storage followed by 3 days at 15°C. The four best cultivars after 18 days were assessed again after 25 days storage and 3 days at 15°C. Actual storage times varied ±2 days depending on panellist availability. Ten cobs from each cultivar were trimmed (middle third retained) and cooked for 4 minutes in rapidly boiling unsalted water. Cobs were drained after cooking and served immediately. Cobs were presented singly and where possible only one cultivar was assessed per day. If more than one cultivar was assessed on a day, separate panels were run for each cultivar to prevent direct comparisons between the cobs.

Cobs were rated for sweetness, flavour, off flavours, texture and acceptability by the panel. Panellists marked a 150 mm unstructured linear scale where the left hand of the scale represented a low intensity of a characteristic and the right hand end a high intensity. Scores were taken by measuring the distance of the mark from the left hand anchor point of the scale.

Husk leaf quality was rated visually on 5 cobs per plot on a 5 point scale (Table 2) at the end of 18 days storage and again after 3 days at 15°C.

Results from the field and for husk leaf quality were analysed by the ANOVA procedure and LSD values ($P<0.05$) calculated. Sensory measurements cannot be compared statistically because the cultivars were assessed on different days.

Results

Establishment was poorer at Hastings (42-59%) than at Matamata (58-83%) (Fig. 1). Insect and bird damage lowered establishment at Hastings. Honey 'n' Pearl had the lowest plant stand at both sites.

Cob yields followed the establishment trends (Fig. 2). Covariate analysis carried out in cobs yields using establishment as the covariate showed yields at Hastings

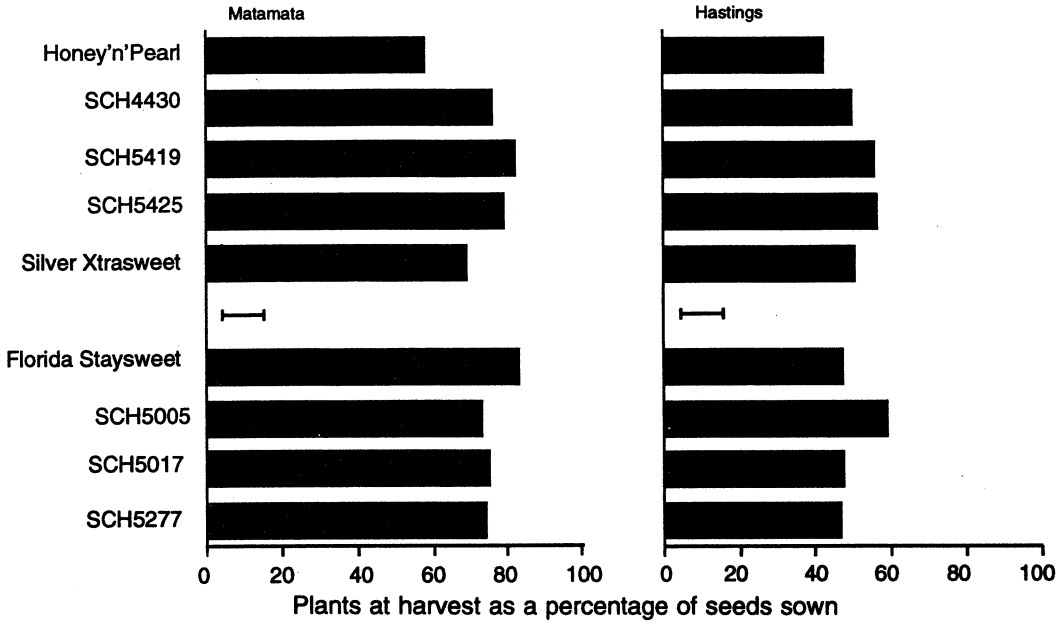

Figure 1. Establishment of sweet corn cultivars at Hastings and Matamata. LSDs ($p<0.05$) are indicated ($p=0.002$ at Hastings and $p=0.005$ at Matamata).

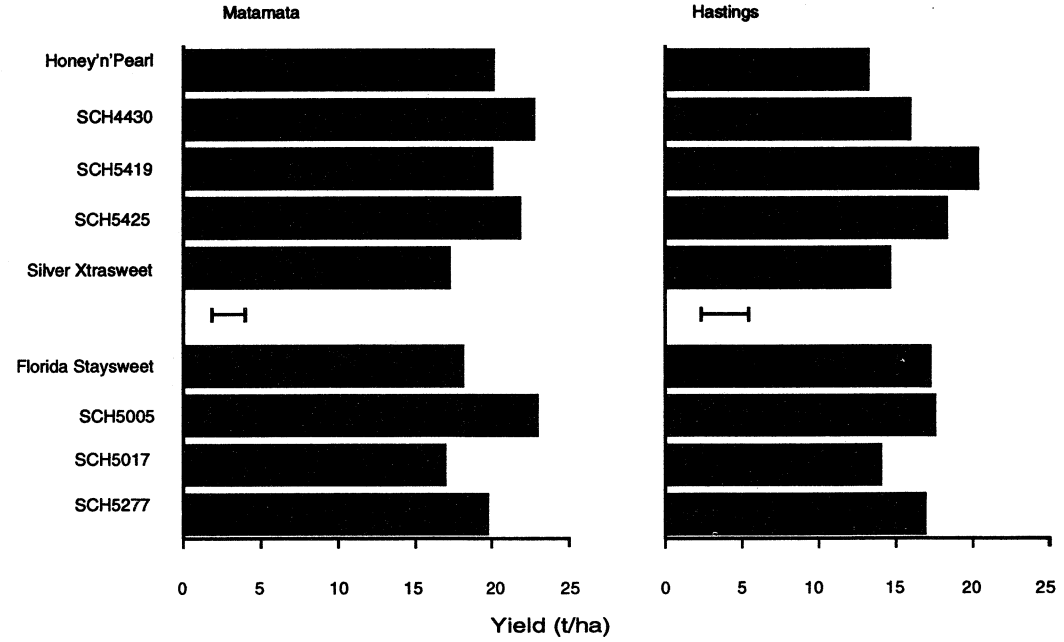

Figure 2. Cob yields (husk attached) of sweet corn cultivars at Hastings and Matamata. LSD ($p<0.05$) are indicated ($p=0.004$ at Hastings and $p=0.05$ at Matamata).

were not significantly different among cultivars after adjusting for covariate (P = 0.004 without covariate analysis and P = 0.07 with covariate analysis). At Matamata cultivar differences became more pronounced after covariate analysis (P = 0.05 to P = 0.001) and Honey 'n' Pearl had the highest yield (24.3 t/ha). One possible explanation for the difference between sites is harvest date. At Hastings, harvest dates were matched to maturity while at Matamata all cultivars were harvested on one day.

Cob weights (without husk leaves) and weight/length ratio for the Hastings experiment are shown in Figure 3. Heaviest cobs at Matamata were SCH 5005 (328 g) Honey 'n' Pearl (286 g) and Silver Xtrasweet (281 g). Details of cob quality for the Matamata experiment have not been given because of the range of maturities at the single harvest date (Table 1).

Many cultivars at both sites had cobs with poorly filled tips (Fig. 4). Low ratings for tip blanking of Honey 'n' Pearl cobs occurred at Matamata but not Hastings.

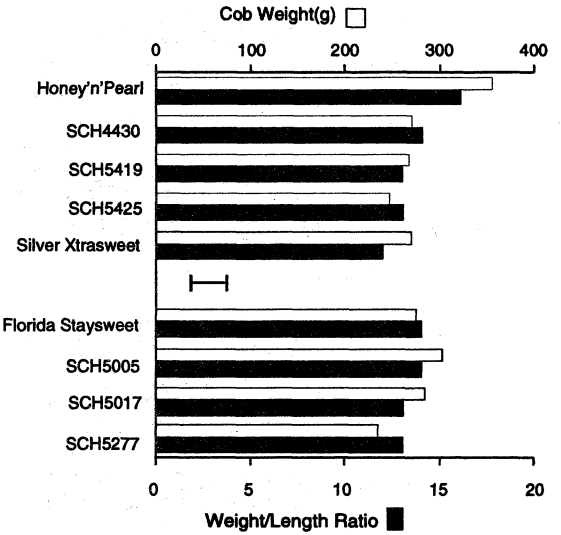

Figure 3. Cob size (husk removed) at Hastings. LSD (p<0.05) is indicated (p=0.0001).

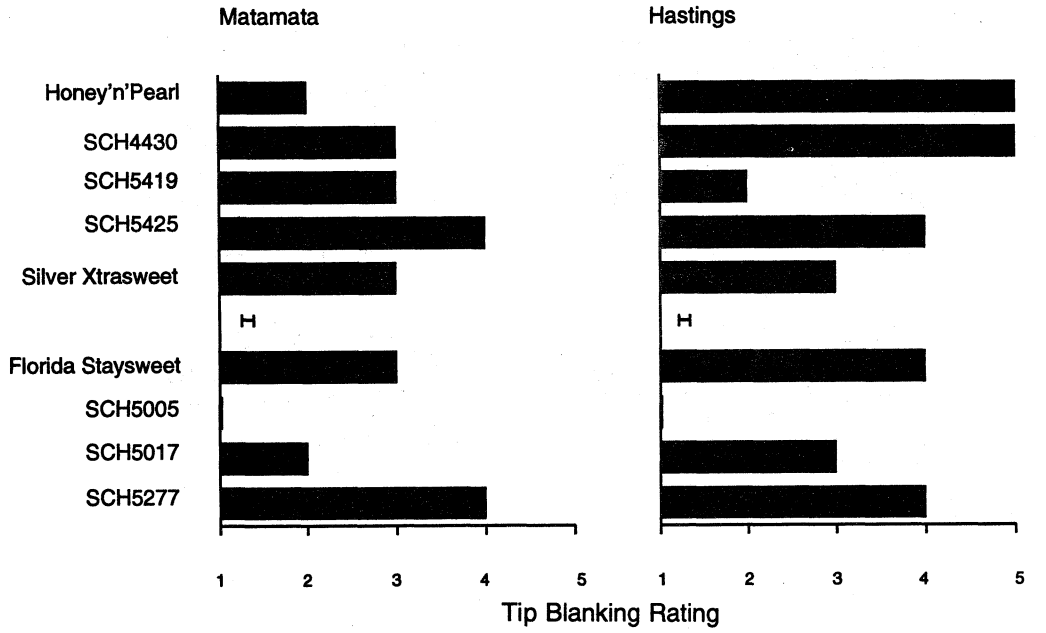

Figure 4. Tip blanking of cobs at Hastings and Matamata. LSDs (p<0.05) are indicated (p=0.0001 at both sites).

Four cultivars (Honey 'n' Pearl, SCH 5419, Silver Xtrasweet and SCH 5017) stood out in sensory assessment for acceptability after 18 days at 0°C and 3 days at 15°C (Fig. 5). Changes in sensory qualities of acceptability, sweetness and texture for these cultivars during storage are shown in Figures 6, 7 and 8, respectively. There were no differences between cultivars in flavour or off flavour ratings so results are not shown. Honey 'n' Pearl was the best storing cultivar. Silver Xtrasweet was next best but developed high texture (toughness) ratings in storage. SCH 5017 was the best yellow cultivar.

Husk leaf quality deteriorated quickly during shelf-life (Figs. 9 and 10). SCH 5419, Silver Xtrasweet, Florida Staysweet and SCH 5017 were the best cultivars at the end of shelf-life but all had low ratings. Fresh Honey'n' Pearl has a husk quality rating close to 3 after 3 days at 15°C (Brash, unpublished).

Discussion

Choice of cultivar depends on the end use of the sweet corn. These experiments have shown Honey 'n'

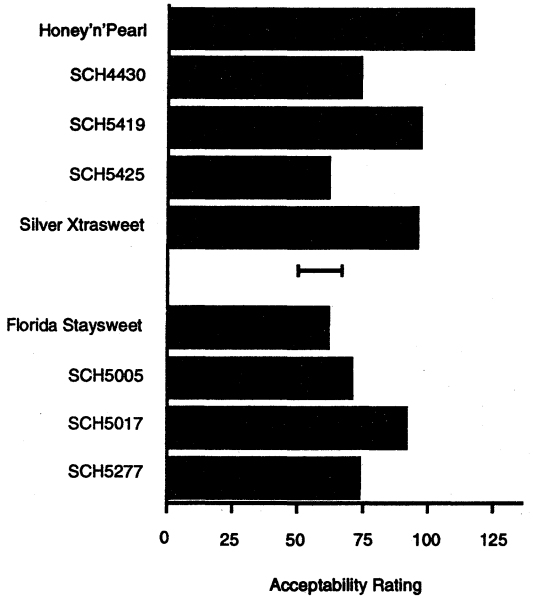

Figure 5. Sensory assessment: Acceptability ratings for sweet corn cultivars after 18 days storage and three days at 15°C.

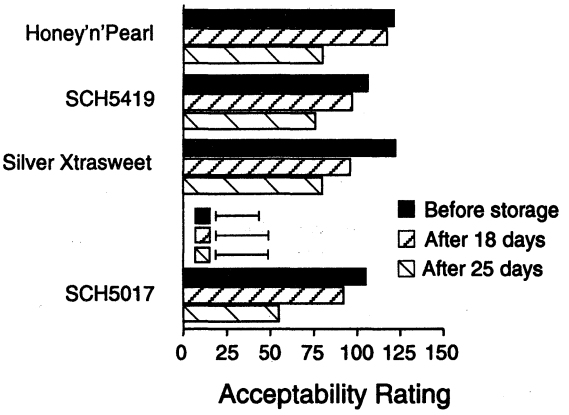

Figure 6. Sensory assessment: Acceptability rating for the 4 best cultivars during storage.

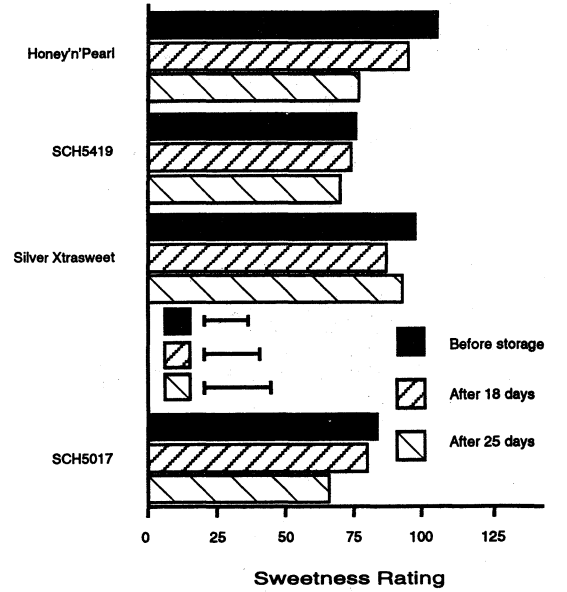

Figure 7. Sensory assessment: Sweetness ratings for the 4 best cultivars during storage.

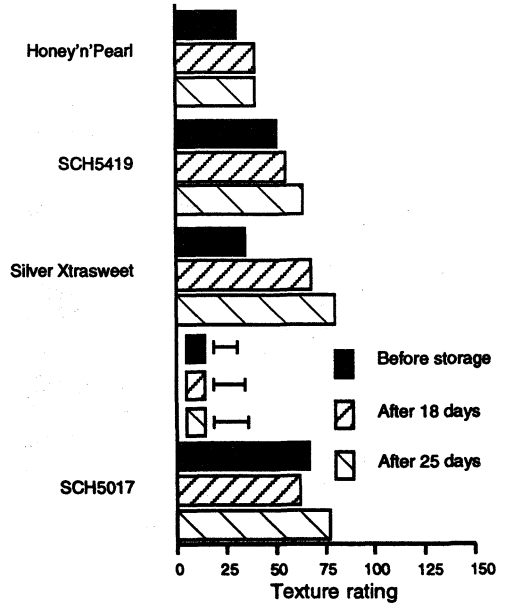

Figure 8. Sensory assessment: Texture ratings for the 4 best cultivars during storage.

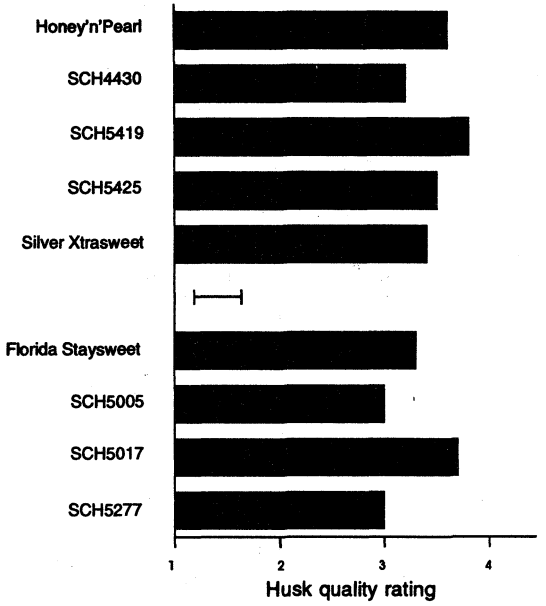

Figure 9. Husk leaf quality ratings of sweet corn cultivars after 18 days storage. LSD ($p<0.05$) is indicated ($p=0.007$).

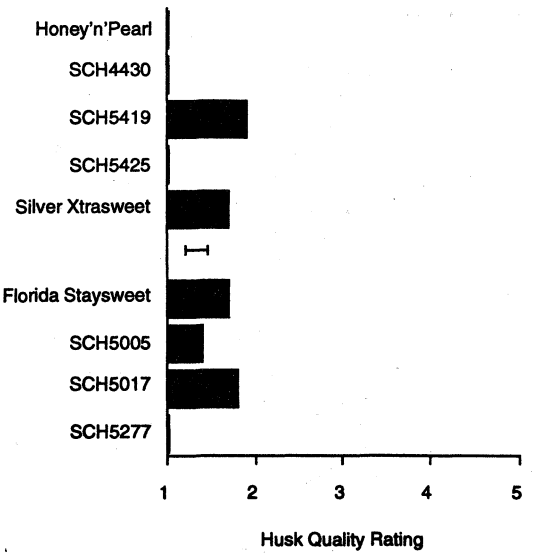

Figure 10. Husk leaf quality ratings of sweet corn cultivars after 18 days storage and 3 days at 15°C. LSD ($p<0.05$) is indicated ($p=0.0001$).

Pearl is well-suited to storage as it retains sensory quality in storage better than other cultivars tested. Although some cultivars retain husk leaf quality better than Honey 'n' Pearl none match Honey 'n' Pearl's other attributes of a large, attractive cob and retention of sensory quality in storage. Cultural approaches rather than a change of cultivar will be required if the problems of poor establishment and filling of cobs are to be overcome in Honey 'n' Pearl.

Our results confirm those of Brecht *et al.* (1990) who concluded storage life (at 5°C) was limited by husk drying. Husk drying is related to "chilling injury" at low temperatures. A storage temperature of 0°C is recommended to retain sensory quality but this temperature induces chilling injury. Our results show the potential benefits of screening new cultivars for retention of husk leaf quality after storage. Controlled atmosphere storage has shown some potential for reducing development of chilling injury symptoms after storage (Brash *et al.*, 1992). Neither choice of cultivar nor use of CA has allowed stored sweet corn to match the retention of husk leaf quality of fresh sweet corn. Loss of husk quality after storage at 0°C will continue to limit the prospects

for seafreight to distant markets of fresh sweet corn with husk leaves attached.

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References

Brash, D.W., Corrigan, V.K. and Hurst, P.L. 1992. Controlled atmosphere storage of 'Honey 'n' Pearl' Sweet Corn. *Proceedings Agronomy Society of New Zealand* **22**, 35-40.

Brecht, J.K., Sargent, S.A., Hochmuth, R.C., Tervola, R.S. 1990. Postharvest quality of supersweet (sh2) sweet corn cultivars. *Proceedings Florida State Horticultural Society* **103**, 283-288.

Geeson, J.D., Browne, K.M. and Griffiths, N.M. 1991. Quality changes in sweetcorn cobs of several cultivars during short-term ice-bank storage. *Journal of Horticultural Science* **66(4)**, 405-414.

Olsen, J.K. and Jordan, R. 1989. Quality deterioration of postharvest sweet corn. *Acta Horticulturae* **247**, 369-372.

Wann, E.V., Brown, G.B. and Hills, W.A. 1971. Genetic modifications of sweet corn quality. *Journal of the American Society of Horticultural Science* **96**, 441-444.