

Project title: Quality Monitoring in Late Drilled Carrots

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Disease, variety

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Grower Summary

Headlines

- Overall the varieties maintained flavour quite well from this late (5 June) drilling indicating that a combination of late drilling and the right choice of variety does lead to better eating quality following spring harvests.
- Off tastes built up slightly in the April harvests and sweetness decreased slightly by the last harvest. The overall impression was that the taste became blander with time.
- Brix readings showed a steady decline with each harvest.
- **Harvey** was the most resistant to cavity spot in laboratory tests with *Pythium violae* but *Pythium ultimum* was much more virulent than *Pythium violae*.
- Most promising late varieties were **Nipomo** scored well for yield, % prepacks, taste, Brix readings and cavity spot tolerance. **Eskimo** scored well for taste and Brix readings until April. **Harvey** performed well for cavity spot tolerance and % prepacks but was not better than Nairobi for taste.

Background and expected deliverables

Carrots are a major vegetable crop in the UK with an annual production averaging 600,000 tons from an area of 9,000 to 10,000 hectares. Carrots are consumed throughout the year but over 62% (DEFRA Basic Horticultural Statistics) are used in the winter and spring (December to June). Although some of this winter tonnage is met by imports (< 5%), artificial storage and very early polythene mulched cropping, the majority is stored in the ground, usually under polythene and straw applied in late autumn.

While this method of storage produces roots which have a fresh appearance, at least until regrowth takes place in April, the taste of stored roots is often disappointing and can deter customers from repurchasing carrots.

Several classes of compounds contribute to the flavour of carrots but terpenes and sugars have been studied most. Several workers have stated that genetic makeup of the carrot is the most important factor controlling these groups of compounds, however environment including age of roots is also important.

The objective of this trial is to study a range of carrot varieties from late drilling to examine how quality, particularly taste, changes with time.

The expected deliverables are:

- for Growers: information on variety and sowing date to allow choice of better tasting carrots in the winter and spring.
- for Breeders: information on genotypes which are more suitable for "in situ" storage.

Summary of the project and main conclusions Comments on each Variety

Nairobi (Bejo) the control variety. Produced very high yields from high populations, roots were rather short and below average for uniformity and skin smoothness. Taste scores were mostly average as were the Brix readings. Cavity spot inoculation tests showed that it was one of the most susceptible varieties. The percentage of class 1 roots was high.

Newark (Bejo) Yields were high at all harvests. Although it was slightly more uniform and smoother than Nairobi, it shorter than the control. Taste scores were mostly average but it tended to have a weak flavour. Brix scores were mainly lower than Nairobi. It had good cavity spot tolerance in the first test but was below average when more mature in April. The percentage of class 1 roots was high.

Ulyses (Clause) Good yields throughout the trial with uniform, smooth roots. Average taste scores but usually below average strength of flavour. Low Brix scores through out. Susceptible to cavity spot in both assessments.

Harvey (Nunhems) Yields above average at each harvest. Good uniformity and smoothness scores. Taste scores usually with slightly high off taste and lower sweetness than average. Low Brix scores. Outstanding cavity spot tolerance in the January assessment but only average on more mature roots. The percentage of class 1 roots was high especially in the prepack size.

Nipomo (Bejo) Yields usually close to average at each harvest. Good length, uniformity and smoothness scores. Best taste scores at the last harvest with average Brix readings. Good cavity spot tolerance in both assessments. The percentage of class 1 roots was high especially in the prepack size.

Osiris (Clause) Low populations led to large roots, which were rather brittle, and several were oversized. The most brittle variety in the drop test. Poor taste scores with some off flavours and low sweetness scores. The lowest Brix readings and the most susceptible to cavity spot in the last assessment. The percentage of class 1 roots was high.

Eskimo (Nickerson) Deliberately drilled at a lower population so produced bold roots but below average yields at all harvests especially the last when nearly 20% were oversized. Top retained longer than other varieties under straw. Taste scores initially good in January but not maintained. The highest Brix readings at each harvest except the last. Cavity spot resistance above average in both assessments.

55-67RZ (Rijk Zwaan) Yields usually above average. Good uniformity and smoothness. Taste scores mainly above average with a strong flavour. Average Brix scores. Good cavity spot tolerance in January but susceptible in April. The percentage of class 1 roots was high.

CA 1564 (Agriseeds) Below average populations and yields. Several oversized roots and fangs. Moderate uniformity and skin scores. Strong in the drop test. Good taste scores with low off taste and good sweetness scores. Good Brix readings and average cavity spot resistance.

Nepal (Bejo) Yields below average with some rots. Average uniformity usually with good length. Inconsistent taste scores but Brix readings high especially at the last harvest. The percentage of class 1 roots was high.

Torro (Seminis) Low population and yield at all harvests with high levels of oversized and fanged roots. Smooth, uniform roots. Taste and Brix scores mainly above average. Cavity spot resistance average.

Most promising late varieties.

Nipomo scored well for yield, % prepacks, taste, Brix readings and cavity spot tolerance.

Eskimo scored well for taste and Brix readings until April.

Harvey performed well for cavity spot tolerance and % prepacks but was not better than Nairobi for taste.

Financial benefits

Short term choosing the varieties which give highest returns, long term improve the image of "in situ" stored carrots

Action points for growers

Choose late maturing varieties and late drilling dates for stored crops.

Science Section

Introduction

Carrots are a major vegetable crop in the UK with an annual production averaging 600,000 tons from an area of 9,000 to 10,000 hectares. Carrots are consumed throughout the year but over 62% (DEFRA Basic Horticultural Statistics) are used in the winter and spring (December to June). Although some of this winter tonnage is met by imports (< 5%), artificial storage and very early polythene mulched cropping the majority is stored in the ground, usually under polythene and straw applied in late autumn.

While this method of storage produces roots which have a fresh appearance, at least until regrowth takes place in April, the taste of stored roots is often disappointing and can deter customers from repurchasing carrots.

Several classes of compounds contribute to the flavour of carrots but terpenes and sugars have been studied most. Several workers, including Bradley (1965) and Carlton and Peterson (1963) have stated that genetic makeup of the carrot is the most important factor controlling these groups of compounds, however environment including age of roots is also important.

The objective of this trial is to study a range of carrot varieties from late drilling to examine how quality, particularly taste, changes with time.

Materials and Methods

a) Field

Large plots (3 beds x 380m) of 11 varieties of carrots considered suitable for late use following "in situ" storage were drilled in a commercial carrot crop on the 5th June, in north Norfolk using the host growers Stanhay Singulaire drill. Most varieties were drilled at a rate of 820,000 per acre (2.08m/ha); Eskimo was targeted lower at 700,000 per acre (1.78m/ha). Large p-lots were used so that the host grower TBG Ltd could harvest a lorry load from each plot and assess the produce through their commercial packhouse. (see *table 5*)

The varieties were: **Nairobi**, **Newark**, **Nipomo** and **Nepal** from Bejo, **Ulyses** and **Osiris** from Clause, **Harvey** (Nunhems), **55-67RZ** (Rijk Zwaan), **Eskimo** (Nickersons), **Torro** (Seminis) and **CA 1564** (Agriseeds).

The trial plots were treated in the same way as the surrounding commercial crop and were covered for in field storage on the 10th October with black polythene and straw.

b) Sampling and Assessment

Samples from each of the plots were harvested during the first week of each month from January to April and again in late April.

Harvest dates were: 4th January, 31st January, 8th March, 3rd April and 19th April.

Samples were taken to NIAB at Cambridge and assessed for yield, defects, skin quality, uniformity, strength and taste. The taste panel consisted of 6 people and all 11 samples were tested at one sitting each time. Samples were scored for pleasantness, strength of flavour, off tastes, sweetness and texture.

In addition, juice from each variety at each harvest was extracted in a food processor and tested in a hand held Brix refractometer.

At the first and last harvests samples were subjected to a laboratory cavity spot susceptibility test. For the first test in January the roots were inoculated with *Pythium violae*, for the second test in April inoculation was with both *P. violae* and *P. ultimum*.

Results and Discussion

General

Overall the varieties maintained flavour quite well from this late drilling indicating that a combination of late drilling and the right choice of variety does lead to better eating quality following spring harvests.

1. The Effect of Harvest Date and Variety on Yield

see *Table 1*. Marketable Yield and Percentage Marketable at 5 Harvest Dates

for details of each harvest see Annex tables 1a, 1b, 1c, 1d, and 1e

Overall varieties the marketable yield was around 100t/ha for the first three harvests, falling to 95t/ha in early April and 90t/ha in late April as some of the larger roots tended to rot.

Nairobi produced consistent high yields throughout the experiment from the highest populations at each harvest. Root length was below average at around 14cm and uniformity and skin smoothness were both also below average.

Newark, Ulyses, Harvey and **Nipomo** produced above average yields at all harvests. **Torro, Nepal, CA 1564, Osiris** and **Eskimo** had below average yields at all, harvests **55-67RZ** was mainly above average but the last harvest was lost due as it was harvested by the grower.

2. The Effect of Harvest Date and Variety on Taste

see *Table 2* Taste Results

For details of each taste panel see Annex tables 2a, 2b, 2c, 2d, 2e

Overall the taste of the late sown carrots was maintained quite well. Off tastes built up slightly in the April harvests and sweetness decreased slightly by the last harvest. The overall impression was that the taste became blander with time. This is shown in the March scores (harvest 3) but not in the April scores.

Variety differences were not very consistent. **CA 1564** and **55-67RZ** scores were above average at nearly all assessments, **Nipomo** showed up well at the final harvest. **Osiris** scores were mainly below average and **Nairobi** close to average at most harvests. **Eskimo** and **Harvey** started above average but ended up with average scores.

3. The Effect of Harvest Date and Variety on Brix Refractometer readings

see *Table 3* Brix results

Overall the Brix readings were more consistent than the taste assessments. **Eskimo** produced the highest readings at the first 4 harvests, **Nepal, Torro** and **CA 1564** were above average at all or most harvests. **Osiris, Ulyses** and **Newark** were below average in all or most assessments.

4. Cavity Spot Inoculation Tests

see *Table 4* Cavity Spot Index

Two assessments were made after inoculation with *Pythium violae* and incubation of fresh dug and washed roots. At the first assessment following the first harvest in January **Harvey** was significantly better than all other

varieties after 6 days. **55-67RZ** and **Newark** were the next best varieties. **Nepal, Ulyses** and **Nairobi** showed the highest level of infection.

The test was repeated on roots from the last lift in late April and all varieties except for **Nepal** were more susceptible to *Pythium violae*. **Nipomo** and **Eskimo** also showed some resistance **Orisis, Ulyses** and **55-67RZ** were most susceptible in this test.

In addition to the tests with *Pythium violae* an inoculum of *Pythium ultimum* was obtained and tested on roots from the last harvest. This proved very virulent and all varieties were severely infected after 2 days.

Summary

In general late drilling of late maturing varieties produced acceptable tasting carrots in late April. The roots were not very sweet but they did not have high levels of off flavours. The Brix refractometer readings confirmed that the levels of solids in the roots showed a continuous decline throughout the period of this trial.

The yield data showed that the physical condition of the roots was well maintained under the polythene and straw insulation.

The cavity spot tests showed that roots become more susceptible with age and that there are varietal differences. They also showed that different species of *Pythium* have different virulence.

Comments on each Variety

Nairobi (Bejo) the control variety. Produced very high yields from high populations, roots were rather short and below average for uniformity and skin smoothness. Taste scores were mostly average as were the Brix readings. Cavity spot inoculation tests showed that it was one of the most susceptible varieties. The percentage of class 1 roots was high.

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Harvey performed well for cavity spot tolerance and % prepacks but was not better than Nairobi for taste.

Technology Transfer

BCGA open days and committee meetings and the production of an HDC factsheet if required

References

Bradley, G., and D. Smittle. 1965. Carrot quality as affected by variety, planting and harvest dates *Proc. Amer. Soc. Hort. Sci.* 86: 397-405.

Carlton, B. C., and C.E. Peterson. 1963. Breeding carrots for sugar and dry matter content. *Proc. Amer. Soc. Hort. Sci.* 82: 332-340.

Appendices

Tables 1a, 1b, 1c, 1d, 1e Yield details for each harvest

Tables 2a, 2b, 2c, 2d, 2e. Taste panel results for each harvest.

HDC LATE CARROT TRIAL 2005/06 FV 200b - Marketable Yield and Percentage Marketable

Table
1

Site: Southrepps, Cromer, Norfolk

in order of marketable yield at harvest 1

Variety	HARVEST 1		HARVEST 2		HARVEST 3		HARVEST 4		HARVEST 5	
	Marketable yield (t/Ha)	%mark	Marketable yield (t/Ha)	%mark	Marketable yield (t/Ha)	%mark	Marketable yield (t/Ha)	%mark	Marketable yield (t/Ha)	%mark
NAIROBI	128.5	90.3	137.4	95.6	141.5	94.7	144.7	95.4	127.1	89.8
NEWARK	121.0	86.9	104.3	86.6	116.7	86.9	123.0	91.2	115.2	91.1
ULYSES	114.8	88.5	112.4	93.1	121.5	95.4	102.0	93.9	109.0	87.7
HARVEY	108.5	87.1	113.2	82.2	95.6	82.0	96.9	89.3	88.9	84.0
NIPOMO	98.3	90.0	113.5	91.9	110.9	92.4	88.6	89.8	89.0	87.0
OSIRIS	97.8	73.8	90.2	70.3	82.9	69.4	90.9	71.5	77.6	75.8
ESKIMO	95.8	85.7	82.4	81.5	94.2	88.6	84.9	91.7	62.4	86.2
55-67RZ	95.4	74.7	110.0	85.5	103.4	86.2	98.9	82.7	no data	no data
CA 1564	91.0	79.7	87.6	83.3	86.4	80.3	85.3	79.0	67.5	79.0
NEPAL	87.2	82.9	101.9	88.1	79.7	76.8	71.8	73.3	81.3	83.8
TORRO	68.5	53.1	72.4	59.1	82.0	66.7	58.0	54.0	81.8	63.7
means	100.6	81.1	102.3	83.4	101.3	83.6	95.0	82.9	90.0	82.8

HDC LATE CARROT TRIAL 2005/06 FV 200b - Taste Results

Table 2

a) Pleasantness (1-5), 1= least

in order of most pleasant H5

variety	1	2	3	4	5
NIPOMO	2.4	2.5	2.7	2.7	3.8
CA 1564	2.8	3.0	2.0	3.0	3.3
ULYSES	2.3	2.2	2.2	2.5	3.3
ESKIMO	2.8	1.8	2.8	2.5	2.8
HARVEY	2.8	2.3	2.0	1.5	2.8
TORRO	2.7	2.8	3.0	2.8	2.8
NAIROBI	2.8	2.2	2.8	2.5	2.7
NEWARK	2.7	2.5	2.3	3.5	2.7
55-67RZ	2.8	3.0	2.5	3.0	2.3
NEPAL	2.7	3.3	2.8	3.3	2.3
OSIRIS	2.7	3.2	2.3	2.5	2.2
means	2.7	2.6	2.5	2.7	2.8

c) Off taste (1-5) 1=none

in order of least off taste H5

variety	1	2	3	4	5
NIPOMO	1.8	1.7	1.2	1.8	1.0
CA 1564	1.2	1.2	2.0	1.8	1.3
NAIROBI	1.3	1.8	1.7	1.5	1.3
TORRO	1.2	1.5	1.3	1.7	1.3
NEWARK	1.2	1.7	1.3	1.3	1.7
55-67RZ	1.7	1.3	1.7	1.7	1.8
ULYSES	1.5	1.7	1.7	1.7	1.8
ESKIMO	1.5	2.2	1.3	1.8	2.0
HARVEY	1.0	2.0	1.0	2.3	2.0
OSIRIS	1.2	1.0	3.0	2.0	2.0
NEPAL	1.5	1.0	1.8	1.7	2.3
means	1.4	1.5	1.6	1.8	1.7

b) Strength (1-5), 1= weak

in order of strength H5

variety	1	2	3	4	5
55-67RZ	3.2	3.7	2.0	2.8	3.5
CA 1564	3.3	3.0	2.7	2.8	3.3
ESKIMO	2.3	2.5	2.5	3.0	3.2
HARVEY	2.8	3.5	2.3	2.5	3.2
TORRO	2.3	4.2	2.7	3.0	2.7
ULYSES	2.3	2.7	1.8	2.3	2.7
NAIROBI	3.2	2.8	2.8	2.5	2.5
NEPAL	2.5	2.8	3.2	3.0	2.5
NIPOMO	2.5	2.3	2.7	2.5	2.3
OSIRIS	2.5	3.0	2.0	2.2	2.3
NEWARK	2.7	2.5	1.8	3.0	2.0
means	2.7	3.0	2.4	2.7	2.7

d) Sweetness (1-5) 1=not sweet

in order of most sweetness H5

variety	1	2	3	4	5
NIPOMO	2.5	2.5	2.2	2.7	3.0
CA 1564	2.2	2.8	2.3	3.0	2.8
TORRO	2.0	2.8	2.7	2.3	2.5
ULYSES	2.2	2.5	2.0	2.3	2.3
55-67RZ	2.5	2.7	2.0	2.5	2.2
NEPAL	2.2	2.7	2.3	3.0	2.2
NEWARK	2.3	2.5	1.7	3.2	2.2
ESKIMO	2.7	2.0	2.3	2.3	2.0
HARVEY	2.3	2.5	2.0	1.8	2.0
NAIROBI	3.0	2.2	2.8	2.7	2.0
OSIRIS	2.3	2.2	2.2	2.0	1.5
means	2.4	2.5	2.2	2.5	2.2

HDC LATE CARROT TRIAL 2005/06 FV 200b

Site: Southrepps, Cromer, Norfolk

DRILLED: 05/06/2005

HARVESTED: 03-Jan 31-Jan 08-Mar 04-Apr 19-Apr

Variety	H1	H2	H3	H4	H5
	BRIX	BRIX	BRIX	BRIX	BRIX
NEPAL	1.7	1.5	1.7	1.2	1.6
TORRO	1.7	1.5	1.6	1.5	1.3
CA 1564	1.7	1.6	1.2	1.2	1.2
NIPOMO	1.6	1.5	1.4	1.1	1.2
ESKIMO	2.2	1.9	1.8	1.5	1.2
55-67RZ	1.6	1.6	1.2	1.1	1.1
NAIROBI	1.6	1.6	1.3	1.3	1.0
NEWARK	1.5	1.2	1.0	1.0	1.0
HARVEY	1.5	1.6	1.0	0.9	1.0
ULYSES	1.5	1.3	1.1	1.1	0.9
OSIRIS	1.3	1.3	1.5	1.0	0.6
means	1.6	1.5	1.3	1.2	1.1

HDC LATE CARROT TRIAL 2005/06 FV 200b

Table 4

Cavity Spot Index (incidence x Severity)

Site: Southrepps, Cromer, Norfolk

in order of least infection on Day 6 (mean of 2 P.violae trials)

Variety	HARVEST 1 (P.violae)			HARVEST 5 (P.violae)			H 5 (P.ultimum)
	Day 2	Day 4	Day 6	Day 2	Day 4	Day 6	Day 2
HARVEY	8.4	21.6	25.0	52.8	60.6	82.6	100.0
NIPOMO	38.4	50.2	55.0	42.2	51.2	60.2	100.0
ESKIMO	29.0	45.7	58.4	32.4	50.6	65.8	84.0
TORRO	33.0	42.8	61.2	47.3	59.2	71.6	93.0
NEWARK	22.6	36.2	50.2	52.4	67.4	86.0	86.0
CA 1564	31.6	37.8	55.4	55.4	69.4	83.2	97.0
55-67RZ	21.1	33.0	47.9	44.0	71.4	92.3	100.0
NEPAL	63.7	76.8	87.0	28.9	56.4	66.8	100.0
OSIRIS	40.6	50.2	64.6	54.4	89.6	94.4	100.0
NAIROBI	61.2	70.4	74.2	63.2	76.0	86.4	93.0
ULYSES	59.9	66.8	78.8	56.4	81.1	91.8	81.0
means	37.2	48.3	59.8	48.1	66.6	80.1	94.0
lsd 0.05	15.6	16.5	16.5	13.0	10.7	8.5	

HDC LATE CARROT TRIAL 2005/06 FV 200b - Commercial Packhouse Assessment

table 5

Site: Southrepps, Cromer, Norfolk

in order of time of Harvest

VARIETY	PACK% LOOSE	PACK % PPACKS	TOTAL CLASS 1%	LARGE %
55-67 RZ	25.20%	30.37%	55.57%	3.96%
ESKIMO	28.70%	16.32%	45.02%	13.80%
TORRO	25.80%	15.09%	40.89%	27.46%
NEPAL	25.90%	30.03%	55.93%	3.83%
OSIRIS	28.70%	27.15%	55.85%	7.52%
HARVEY	21.76%	33.31%	55.07%	8.44%
NIPOMO	21.08%	34.80%	55.92%	1.38%
CA 1564	18.65%	25.13%	43.78%	12.59%
ULYSES	26.54%	27.51%	54.05%	7.24%
NEWARK	27.60%	25.59%	55.19%	3.49%
NAIROBI	33.90%	21.97%	55.87%	7.95%
means	25.80%	26.12%	52.10%	8.88%

ANNEX

NIAB TRIAL FOR HDC - Harvest 1
Contract no.: FV 200b

table 1a

Site: Southrepps, Cromer, Norfolk

HARVESTED : 04-Jan-06#####

Variety	Population m ²	Marketable yield (t/Ha)	% RECORD ED AS (by wt)												Root quality					Quality
			Under-sized	oversized	broken	harvest cracks	misshapen	Growth split	Fanged	Rot	other defects	%mark	Shape uniformity (1-9)	Skin texture (1-9)	Mean root length (cm)	Mean root breadth (cm)	% Artificial breakage	BRIX		
NAIROBI	214	128.5	0.0	2.1	1.1	0.4	1.0	1.0	3.4	0.7	0.0	90.3	6.0	6.0	12.9	3.0	3.0	1.6		
NEWARK	203	121.0	0.0	1.0	1.8	1.1	3.4	1.8	1.4	1.9	0.7	86.9	7.0	7.0	13.0	3.0	4.0	1.5		
ULYSES	127	114.8	0.0	2.9	2.1	0.3	0.2	0.4	4.6	0.0	1.0	88.5	7.0	8.0	14.7	3.3	3.0	1.5		
CA 1564	116	91.0	0.2	10.6	2.6	0.0	2.3	0.0	4.6	0.0	0.0	79.7	7.0	7.5	15.5	3.6	0.0	1.7		
NIPOMO	122	98.3	0.0	5.3	0.0	0.5	0.0	0.0	4.0	0.0	0.1	90.0	8.0	8.5	16.0	3.4	2.0	1.6		
HARVEY	152	108.5	0.1	2.4	3.8	0.0	0.9	0.0	4.3	1.0	0.3	87.1	7.5	8.0	15.7	3.4	3.0	1.5		
OSIRIS	103	97.8	0.0	14.0	4.4	0.0	0.9	0.4	4.1	2.5	0.0	73.8	8.0	7.5	16.8	3.5	0	1.3		
NEPAL	124	87.2	0.2	2.3	0.8	0.0	1.7	0.0	5.9	3.4	2.9	82.9	7.0	7.5	14.8	3.2	1.0	1.7		
TORRO	75	68.5	0.0	31.7	1.9	0.0	2.5	0.0	10.8	0.0	0.0	53.1	7.0	8.0	16.3	3.6	5.2	1.7		
ESKIMO	89	95.8	0.2	5.8	0.0	0.0	0.4	0.0	7.3	0.6	0.0	85.7	8.0	6.0	16.2	3.6	1.0	2.2		
55-67RZ	114	95.4	0.1	9.5	0.0	0.0	2.6	1.5	8.5	3.0	0.0	74.7	8.0	8.0	15.2	3.5	2.0	1.6		
means	131	100.6	0.1	8.0	1.7	0.2	1.4	0.5	5.4	1.2	0.5	81.1	7.3	7.5	15.2	3.4	3.6	1.6		

Formatted Table

NIAB TRIAL FOR HDC - Harvest 2
Contract no.: FV 200b

table 1b

Site: Southrepps, Cromer, Norfolk

HARVESTED: [###31-Jan-06](#)

Variety	Population m/2	Marketable yield (t/ha)	% RECORDED AS (by wt)										Root quality					Quality
			Under- sized	oversized	broken	harvest cracks	misshapen	Growth split	Fanged	Rot	other defects	%mark	Shape uniformity (1-9)	Skin texture (1-9)	Mean root length (cm)	Mean root breadth (cm)	% Artificial breakage	BRIX
NAIROBI	212	###137.4	0.2	0.0	0.6	0.0	0.0	0.0	3.4	0.0	0.2	95.6	6.0	6.0	14.0	3.3	1.0	1.6
NEWARK	166	104.3###	0.4	3.0	4.4	1.4	0.0	1.2	2.8	0.2	0.0	86.6	7.0	7.0	13.0	3.1	2.0	1.2
ULYSES	142	112.4###	0.9	1.3	0.3	0.0	0.0	0.5	3.6	0.1	0.1	93.1	7.0	8.0	14.7	3.3	5.0	1.3
CA 1564	96	87.6	0.2	10.2	1.7	0.0	0.0	0.0	3.4	1.2	0.0	83.3	7.0	7.5	15.0	3.5	1.0	1.6
NIPOMO	146	113.5###	0.7	0.0	3.9	0.0	0.0	0.0	2.7	0.9	0.0	91.9	8.0	8.5	14.7	3.1	2.0	1.5
HARVEY	154	113.2###	0.2	3.0	4.9	0.0	0.0	0.4	6.9	2.4	0.2	82.2	7.5	8.0	16.0	3.4	7.0	1.6
OSIRIS	97	90.2	0.2	10.0	13.5	0.0	0.0	1.4	4.5	0.1	0.0	70.3	8.0	7.5	16.3	3.4	11.0	1.3
NEPAL	122	101.9###	0.1	3.9	1.6	0.3	0.0	0.0	3.4	2.4	0.0	88.1	7.0	7.5	15.9	3.3	0.0	1.5
TORRO	75	72.4	0.0	27.9	2.1	0.0	0.0	0.0	10.9	0.0	0.0	59.1	7.0	8.0	16.7	3.8	3.0	1.5
ESKIMO	77	82.4	0.1	12.0	3.4	0.0	0.0	0.0	3.0	0.0	0.0	81.5	8.0	6.0	16.3	3.5	0.0	1.9
55-67RZ	127	110.0###	0.1	7.1	1.5	0.0	0.0	0.0	5.2	0.6	0.0	85.5	8.0	8.0	14.3	3.4	2.0	1.6
means	129	102.3###	0.3	7.1	3.4	0.2	0.0	0.3	4.5	0.7	0.0	83.4	7.3	7.5	15.2	3.4	3.1	1.5

NIAB TRIAL FOR HDC - Harvest 3
Contract no.: FV 200b

table 1c

Site: Southrepps, Cromer, Norfolk

HARVESTED: [#####08-Mar-06](#)

Variety	Population m/2	Marketable yield (t/Ha)	% RECORDED AS (by wt)										Root quality					Quality
			Under-sized	oversized	broken	harvest cracks	misshapen	Growth split	Fanged	Rot	other defects	%mark	Shape uniformity (1-9)	Skin texture (1-9)	Mean root length (cm)	Mean root breadth (cm)	% Artificial breakage	BRIX
NAIROBI	213	141.5	1.0	2.0	0.5	0.0	0.0	0.0	1.4	0.4	0.0	94.7	6.0	6.0	13.7	3.3	2.0	1.3
NEWARK	167	116.7	1.1	3.2	3.2	0.0	0.0	0.4	3.9	0.8	0.4	86.9	6.5	7.0	13.6	3.2	7.0	1.0
ULYSES	163	121.5	0.4	0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.0	95.4	8.0	8.5	13.0	3.0	4.0	1.1
CA 1564	101	86.4	0.3	11.6	0.0	0.0	0.0	0.0	6.0	1.8	0.0	80.3	7.0	7.0	15.2	3.6	0.0	1.2
NIPOMO	153	110.9	1.0	0.0	0.6	0.0	0.0	0.0	4.3	1.5	0.0	92.4	8.0	8.0	14.7	3.0	1.0	1.4
HARVEY	141	95.6	0.7	2.8	3.0	0.0	0.0	0.0	7.5	3.5	0.5	82.0	7.5	7.5	15.9	3.3	19.0	1.0
OSIRIS	99	82.9	0.1	12.9	6.0	0.9	0.0	0.0	7.7	3.1	0.0	69.4	7.0	7.5	17.0	3.5	10.3	1.5
NEPAL	118	79.7	0.9	1.9	0.0	0.0	0.0	0.0	5.4	15.0	0.0	76.8	7.0	7.5	14.3	3.2	4.0	1.7
TORRO	74	82.0	0.0	22.7	0.0	0.0	0.0	0.0	10.6	0.0	0.0	66.7	8.0	8.0	16.3	3.8	7.0	1.6
ESKIMO	99	94.2	0.4	4.1	4.0	0.0	0.0	0.4	2.6	0.0	0.0	88.6	8.0	6.5	16.0	3.5	0.0	1.8
55-67RZ	118	103.4	1.4	6.1	1.9	0.0	0.0	0.1	3.8	0.5	0.0	86.2	7.5	7.5	15.7	3.5	0.0	1.2
means	132	101.3	0.7	6.1	1.7	0.1	0.0	0.1	5.2	2.4	0.1	83.6	7.3	7.4	15.0	3.3	4.9	1.3

Contract no.: FV 200b

Site: Southrepps, Cromer, Norfolk

HARVESTED: #####
3-Apr-06

Variety	Population m ²	Marketable yield (t/Ha)	% RECORDED AS (by wt)										Root quality					Quality
			Under-sized	oversized	broken	harvest cracks	misssh apen	Growth split	Fanged	Rot	other defects	%mark	Shape uniformity (1-9)	Skin texture (1-9)	Mean root length (cm)	Mean root breadth (cm)	% Artificial breakage	BRIX
NAIROBI	215	144.7	0.6	1.2	0.0	0.0	0.0	0.0	2.6	0.0	0.2	95.4	6.0	6.0	14.8	3.4	3.0	1.3
NEWARK	172	123.0	0.4	2.4	1.2	0.0	0.0	0.0	2.6	1.0	1.2	91.2	6.5	7.0	13.4	3.2	4.0	1.0
ULYSES	124	102.0	0.5	0.0	0.7	0.0	0.0	0.0	4.7	0.0	0.3	93.9	8.0	8.5	16.2	3.6	6.0	1.1
CA 1564	105	85.3	0.2	9.2	1.6	0.0	0.0	0.0	4.7	5.4	0.0	79.0	7.0	7.0	14.0	3.5	3.0	1.2
NIPOMO	114	88.6	0.6	1.6	1.3	0.0	0.0	0.0	4.1	2.7	0.0	89.8	8.0	8.0	16.0	3.5	2.0	1.1
HARVEY	130	96.9	0.0	0.0	2.0	0.0	0.0	0.0	2.9	5.4	0.4	89.3	7.5	7.5	15.5	3.3	5.0	0.9
OSIRIS	108	90.9	0.2	10.1	7.7	0.0	0.0	1.8	6.4	2.3	0.0	71.5	7.0	7.5	16.9	3.5	10.3	1.0
NEPAL	113	71.8	0.3	5.9	1.1	0.0	0.0	0.0	7.5	12.0	0.0	73.3	7.0	7.5	15.1	3.4	2.0	1.2
TORRO	68	58.0	0.0	35.1	1.7	0.0	0.0	0.0	6.6	2.7	0.0	54.0	8.0	8.0	17.4	4.3	4.0	1.5
ESKIMO	90	84.9	3.5	0.0	1.6	0.0	0.0	0.0	2.1	1.1	0.0	91.7	8.0	6.5	16.0	3.5	1.0	1.5
55-67RZ	127	98.9	0.8	5.9	0.6	0.0	0.0	0.0	7.1	3.0	0.0	82.7	7.5	7.5	14.2	3.4	2.0	1.1
means	124	95.0	0.6	6.5	1.8	0.0	0.0	0.2	4.7	3.2	0.2	82.9	7.3	7.4	15.4	3.5	3.8	1.2

NIAB TRIAL FOR HDC - Harvest 5

Contract no.: FV 200b

table 1e

Site: Southrepps, Cromer, Norfolk

HARVEST #####19
ED: -Apr-06

Variety	Population m/2	Marketable yield (t/Ha)	% RECORDED AS (by wt)										Root quality					Quality
			Under-sized	oversized	broken	harvest cracks	misshapen	Growth split	Fanged	Rot	other defects	%mark	Shape uniformity (1-9)	Skin texture (1-9)	Mean root length (cm)	Mean root breadth (cm)	% Artificial breakage	BRIX
NAIROBI	221	127.1	0.9	1.5	0.0	0.0	0.0	0.0	3.8	4.0	0.0	89.8	6.0	6.0	13.8	3.2	1.0	1.0
NEWARK	166	115.2	0.4	2.2	1.4	0.0	0.0	0.0	3.4	1.5	0.0	91.1	6.5	7.0	13.5	3.3	4.0	1.0
ULYSES	135	109.0	0.2	6.4	0.2	0.0	0.0	0.7	3.7	1.0	0.0	87.7	8.0	8.5	14.4	3.3	4.0	0.9
CA 1564	92	67.5	0.1	11.7	0.8	0.0	0.0	0.0	8.5	0.0	0.0	79.0	7.0	7.0	15.1	3.4	1.0	1.2
NIPOMO	128	89.0	0.5	0.0	2.1	0.0	0.0	0.0	3.2	7.2	0.0	87.0	8.0	8.0	15.6	3.4	6.0	1.2
HARVEY	122	88.9	0.1	3.6	0.4	0.0	0.0	1.8	7.3	2.8	0.0	84.0	7.5	7.5	14.7	3.4	1.0	1.0
OSIRIS	87	77.6	0.1	6.0	4.6	0.0	0.0	0.7	10.7	2.2	0.0	75.8	7.0	7.5	15.0	3.6	10.3	0.6
NEPAL	115	81.3	0.3	1.6	0.6	0.0	0.0	0.0	5.9	7.8	0.0	83.8	7.0	7.5	15.9	3.4	1.0	1.6
TORRO	91	81.8	0.3	19.8	0.0	0.0	0.0	2.3	11.6	2.3	0.0	63.7	8.0	8.0	16.7	4.0	1.0	1.3
ESKIMO	68	62.4	0.0	1.7	0.0	0.0	0.0	0.0	2.0	10.1	0.0	86.2	8.0	6.5	16.8	3.7	0.0	1.2
55-67RZ	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	14.7	3.4	0.0	1.1
means	122	90.0	0.3	5.5	1.0	0.0	0.0	0.6	6.0	3.9	0.0	82.8	7.3	7.4	15.1	3.4	2.7	1.1

Carrot Taste Test 5th January 2006**table 2a**

Samples ex Southrepps,
Norfolk

<i>sample</i>	<i>variety</i>	<i>pleasantness</i>	<i>strength</i>	<i>off taste</i>	<i>sweetness</i>	<i>texture</i>
1	NAIROBI	2.8	3.2	1.3	3.0	2.2
2	NEWARK	2.7	2.7	1.2	2.3	3.0
3	NIPOMO	2.4	2.5	1.8	2.5	2.3
4	ULYSES	2.3	2.3	1.5	2.2	2.2
5	HARVEY	2.8	2.8	1.0	2.3	2.8
6	OSIRIS	2.7	2.5	1.2	2.3	2.3
7	55-67RZ	2.8	3.2	1.7	2.5	2.5
8	ESKIMO	2.8	2.3	1.5	2.7	2.8
9	NEPAL	2.7	2.5	1.5	2.2	2.8
10	TORRO	2.7	2.3	1.2	2.0	3.2
11	CA 1564	2.8	3.3	1.2	2.2	3.0
	means	2.7	2.7	1.4	2.4	2.7

Carrot Taste Test 1st February 2006**table 2b**

Samples ex Southrepps,
Norfolk

<i>sample</i>	<i>variety</i>	<i>pleasantness</i>	<i>strength</i>	<i>off taste</i>	<i>sweetness</i>	<i>texture</i>
4	55-67RZ	3.0	3.7	1.3	2.7	2.7
11	CA 1564	3.0	3.0	1.2	2.8	2.8
5	ESKIMO	1.8	2.5	2.2	2.0	2.3
9	HARVEY	2.3	3.5	2.0	2.5	2.7
1	NAIROBI	2.2	2.8	1.8	2.2	2.7
2	NEPAL	3.3	2.8	1.0	2.7	2.5
6	NEWARK	2.5	2.5	1.7	2.5	2.3
10	NIPOMO	2.5	2.3	1.7	2.5	2.3
7	OSIRIS	3.2	3.0	1.0	2.2	3.0
8	TORRO	2.8	4.2	1.5	2.8	3.0
3	ULYSES	2.2	2.7	1.7	2.5	2.5
	means	2.6	3.0	1.5	2.5	2.6

Carrot Taste Test 9th March 2006

table 2c

**Samples ex Southrepps,
Norfolk**

<i>sample</i>	<i>variety</i>	<i>pleasantness</i>	<i>strength</i>	<i>off taste</i>	<i>sweetness</i>	<i>texture</i>
11	55-67RZ	2.5	2.0	1.7	2.0	2.7
9	CA 1564	2.0	2.7	2.0	2.3	2.8
3	ESKIMO	2.8	2.5	1.3	2.3	2.8
8	HARVEY	2.0	2.3	1.0	2.0	2.7
5	NAIROBI	2.8	2.8	1.7	2.8	2.5
1	NEPAL	2.8	3.2	1.8	2.3	3.5
10	NEWARK	2.3	1.8	1.3	1.7	2.7
7	NIPOMO	2.7	2.7	1.2	2.2	2.8
6	OSIRIS	2.3	2.0	3.0	2.2	2.2
2	TORRO	3.0	2.7	1.3	2.7	2.7
4	ULYSES	2.2	1.8	1.7	2.0	2.5
	means	2.5	2.4	1.6	2.2	2.7

table 2d

<i>pleasantness</i>	<i>strength</i>	<i>off taste</i>	<i>sweetness</i>	<i>texture</i>
3.0	2.8	1.7	2.5	3.0
3.0	2.8	1.8	3.0	3.2
2.5	3.0	1.8	2.3	3.3
1.5	2.5	2.3	1.8	3.0
2.5	2.5	1.5	2.7	3.0
3.3	3.0	1.7	3.0	2.7
3.5	3.0	1.3	3.2	3.2
2.7	2.5	1.8	2.7	3.3
2.5	2.2	2.0	2.0	3.0
2.8	3.0	1.7	2.3	4.0
2.5	2.3	1.7	2.3	2.7
2.7	2.7	1.8	2.5	3.1

Carrot Taste Test 20th April 2006

table 2e

**Samples ex Southrepps,
Norfolk**

<i>sample</i>	<i>variety</i>	<i>pleasantness</i>	<i>strength</i>	<i>off taste</i>	<i>sweetness</i>	<i>texture</i>
7	55-67RZ	2.3	3.5	1.8	2.2	3.2
8	CA 1564	3.3	3.3	1.3	2.8	3.0
10	ESKIMO	2.8	3.2	2.0	2.0	3.2
11	HARVEY	2.8	3.2	2.0	2.0	3.2
6	NAIROBI	2.7	2.5	1.3	2.0	2.8
9	NEPAL	2.3	2.5	2.3	2.2	3.0
4	NEWARK	2.7	2.0	1.7	2.2	3.0
5	NIPOMO	3.8	2.3	1.0	3.0	3.0
1	OSIRIS	2.2	2.3	2.0	1.5	4.2
3	TORRO	2.8	2.7	1.3	2.5	3.0
2	ULYSES	3.3	2.7	1.8	2.3	3.3
	means	2.8	2.7	1.7	2.2	3.2