

Project title: Carrots - Independent assessment of agronomy trials and carrot breakage assessments

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[The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.]

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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Headlines

- There are many commercially suitable varieties resistant to breakage during handling
- The seed rate trial demonstrated that a yield plateau is reached as drill density increases but this will be different depending on local conditions

Background

The Carrot Demonstration Day, organised by BCGA in October is an annual event which is usually attended by over 200 visitors, exhibitors and seedsman - just about the whole UK carrot industry. The event is an ideal opportunity for growers to bring themselves up to speed with the latest developments and to see research in practice such as the seed density trial. Knowledge transferred to growers is also delivered through online formats and through BCGA committee and membership communications.

In 2021 there were 78 variety plots from 7 different seed companies, a selection of which (approx. 40 varieties) were tested for breakage characteristics. An additional trial investigated the effect of seed rate on yield.

Methods

The seed density trial and breakage samples taken from the BCGA demo plots were hosted by Rodger Hobson near West Knapton, North Yorkshire.

Carrot breakage methods

A selection of 40 varieties were screened to see how prone to breakage they were.

The screening was conducted the day after harvest and is only an indication of variety breakage performance. Carrots are individually dropped from a fixed point to give a one metre drop and any breakages counted and recorded.

This work was also carried out in 2019 and 2020 bringing the total number of varieties tested to 77.

Seed rate trial methods

In order to demonstrate the effect of seed rates on yield a randomised complete block trial of 9 seed rates, 3 replicates was drilled and taken to yield.

Yield fractions and un-marketable product was recorded.

Table 1. Seed rate trial drilling rates

Seed rate /ac	Seed rate /ha
350,000	870,000
450,000	1,110,000
550,000	1,360,000
650,000	1,610,000
750,000	1,850,000
850,000	2,100,000
950,000	2,350,000
1,050,000	2,590,000
1,150,000	2,840,000

Results

Carrot breakage results

As only a small sample of each variety was tested it is only possible to loosely group the varieties.

The following performed as well as or better than Nairobi in the breakage test. They are split into 3 sub-groups depending on how many years of data each variety has and within each subgroup ranked from least breakage to most breakage. Confidence in the data increases with the number of years of data where the variety performs as well as or better than Nairobi. Full data are available in the Appendix.

Table 2. Carrot percentage breakages – 2019 and 2021 results

		2019	2020	2021	mean
variety	company	% breakage	% breakage	% breakage	% breakage
Nerac	Elsoms	0.0	0.0	0.0	0.0
Caribou	Seminis	0.0	0.0	2.0	0.7
Octavo	Hazera	1.0	2.0	2.0	1.7
Elegance	BASF	4.0	0.0	2.0	2.0
Volcano	Hazera	2.0	2.0	2.0	2.0
Nairobi	Elsoms	4.0	4.0	0.0	2.7
Eskimo	Hazera	2.0	6.0	0.0	2.7
Nipomo	Elsoms	6.0	0.0	2.0	2.7
Nazareth	Elsoms	6.0	0.0	4.0	3.3
Melodio	Hazera	3.0	4.0	4.0	3.7
Olimpo	Hazera	0.0	6.0	6.0	4.0
Speedo	Hazera	4.0	6.0	2.0	4.0
SVDN 5865	Seminis	4.0	6.0	2.0	4.0
CA 6572 F1	Agriseeds	0.0	2.0		1.0
Berdina	Agriseeds	0.0	2.2		1.1
Nun 13095	BASF	4.0	0.0		2.0
VAC111	Hazera	2.0	2.0		2.0
SVDN7396	Seminis		2.0	4.0	3.0
VH133	Hazera		4.0	4.0	4.0
Fidra RZ	Rijk Zwn	2.0	6.0		4.0
Nun 13096	BASF	2.0	6.0		4.0
Brilliance	BASF			0.0	0.0
Ellis RZ	Rijk Zwaan			0.0	0.0
MVC586	Hazera			0.0	0.0
Stromboli	Clause	0.0			0.0
Allyance	BASF			2.0	2.0
CR1706	Seminis			2.0	2.0
Hestan RZ	Rijk Zwaan			2.0	2.0
Nagoya	Bejo/Elsoms			2.0	2.0
NUN 13102	BASF			2.0	2.0
SVDN8104	Seminis			2.0	2.0

Carrot seed rate results

The seed rate trial was drilled on 21st April 2021 in good conditions, in sandy clay loam and established well.

Chart 1. Carrot seed rate – mean of establishment per drill rate v final percentage of establishment

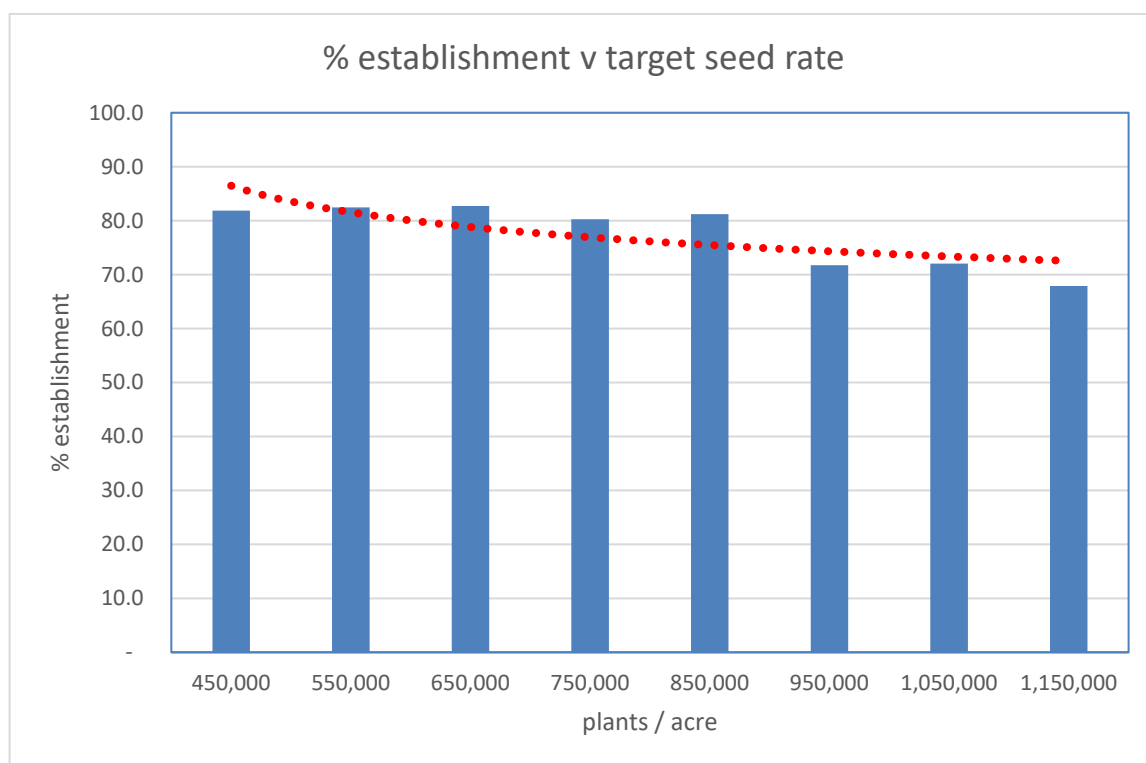


Table 3. Carrot seed rate – meaned harvest data

Drilled pop'n	Harvest Pop'n	Harvest Pop'n	Harvest Pop'n	marketable	Nett yield	undersized	other defects
plants/ac	plants/m2	plants/ha	plants/ac	%	t/ha	%	%
350,000	105.5	1,055,000	427,126	81.0	79.4	4.2	14.7
450,000	91.0	910,000	368,421	82.6	74.5	5.1	12.3
550,000	112.0	1,120,000	453,441	85.1	86.0	6.6	8.3
650,000	132.8	1,328,333	537,787	87.6	85.3	7.9	4.5
750,000	148.7	1,486,667	601,889	86.0	82.0	7.7	6.3
850,000	170.5	1,705,000	690,283	80.5	87.2	12.5	7.0
950,000	168.3	1,683,333	681,511	84.3	80.0	11.2	4.6
1,050,000	186.8	1,868,333	756,410	81.4	80.5	15.0	3.6
1,150,000	192.8	1,928,333	780,702	80.7	77.8	15.1	4.2

Chart 2. Carrot seed rate – yields (t/ha) of plot harvested populations (plants/m²)

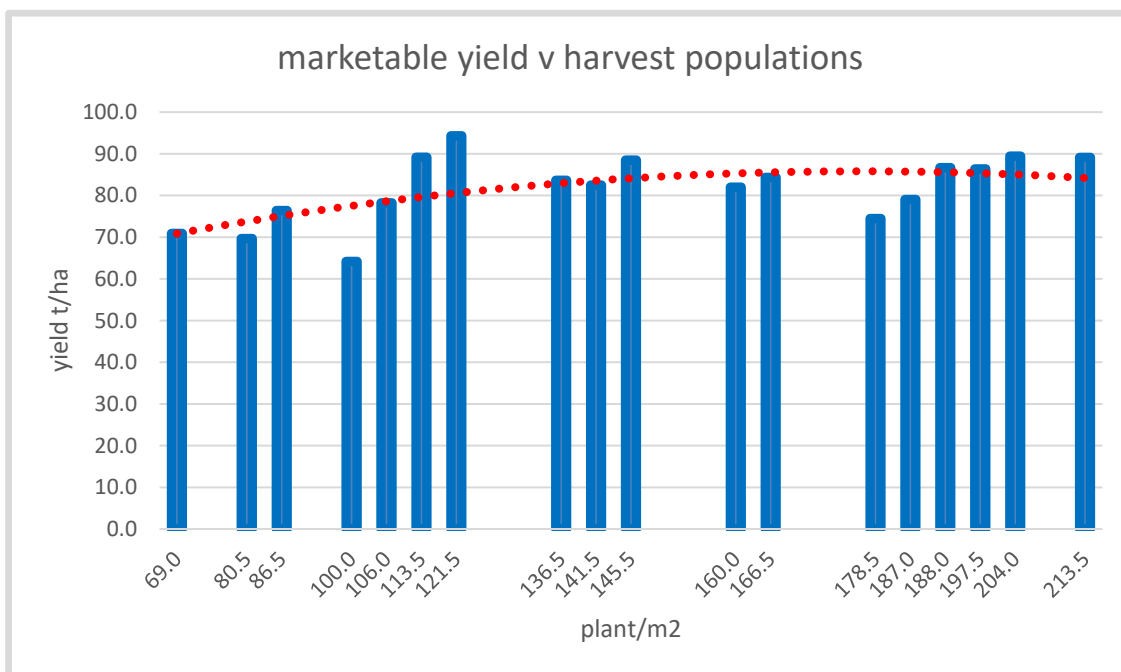


Chart 3. Carrot seed rate – yields (t/ha) of plot harvested populations (plants/m²)

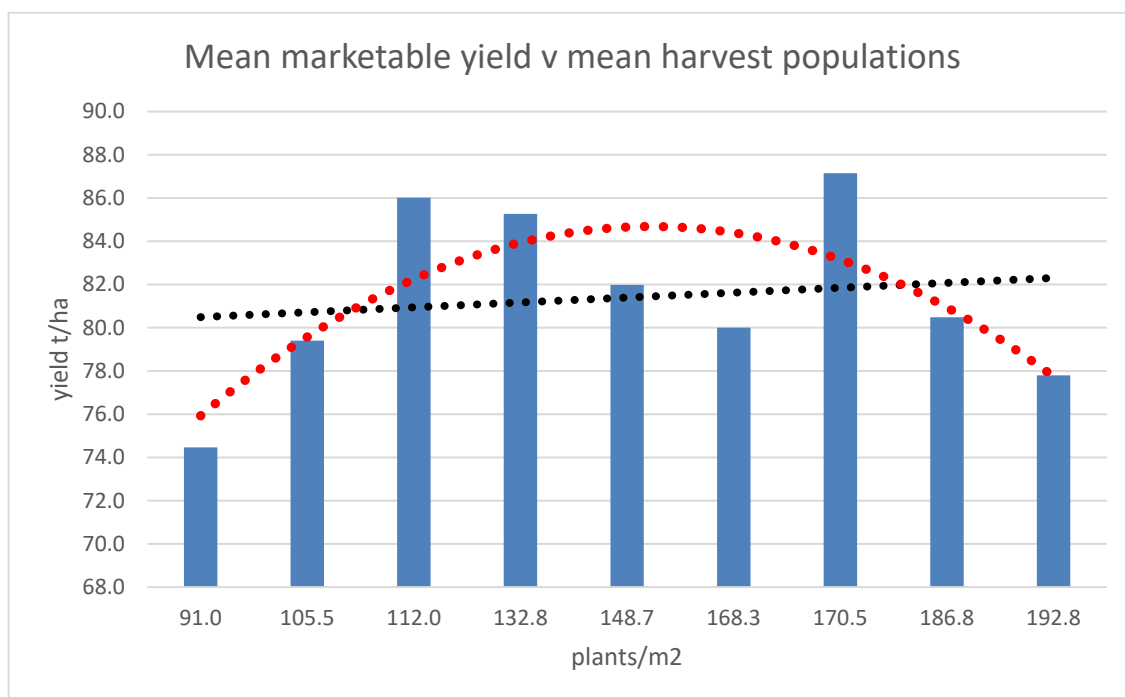


Chart 4. Carrot seed rate – percentage of defects at plot harvested populations (plants/m²)

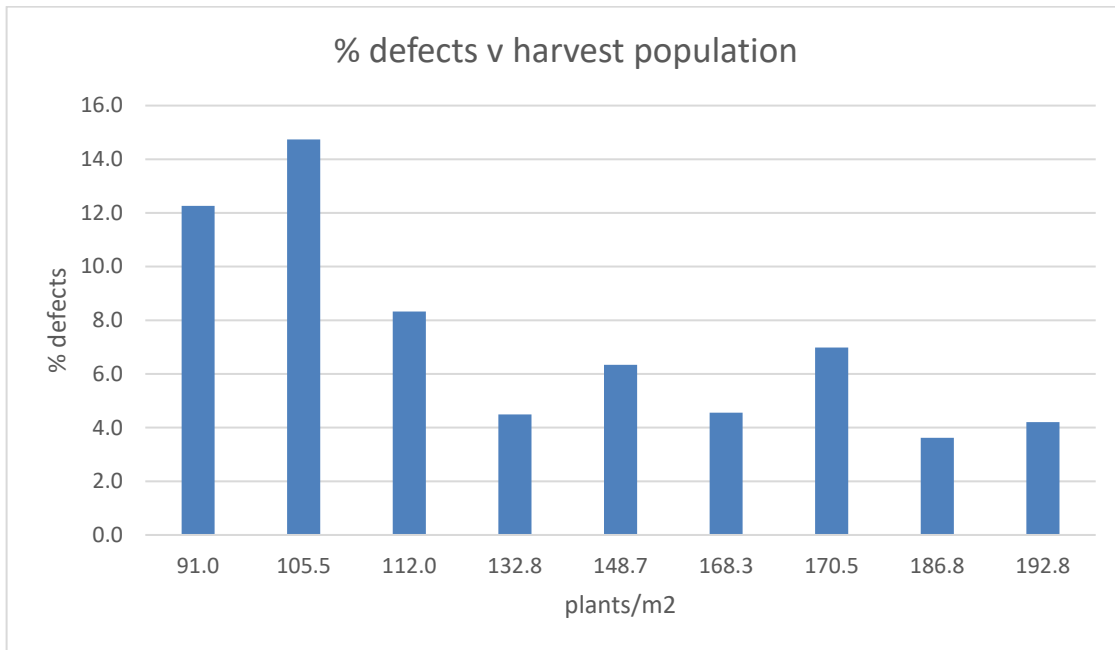
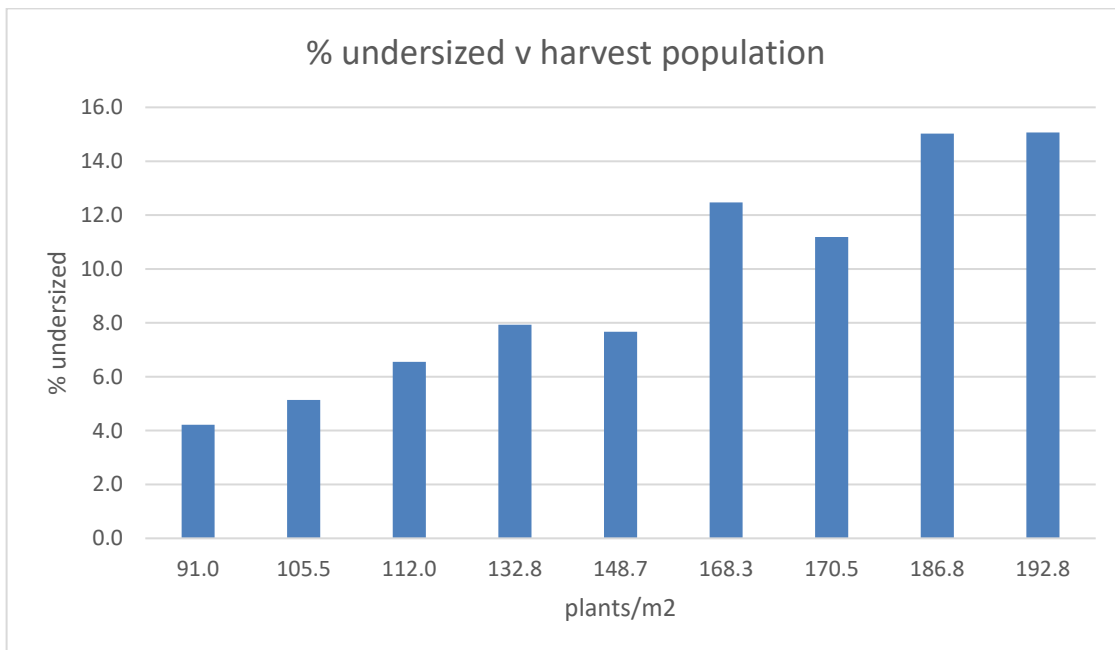


Chart 5. Carrot seed rate – percentage of undersized at plot harvested populations (plants/m²)



Discussion

Carrot breakage

For many years Nairobi has dominated the area grown in part due to its reputation that it is very strong. Newer varieties have struggled to gain market share even where they have greater uniformity and other desirable characteristics.

The results have shown that there are a good selection of varieties that display similar or better strength than Nairobi. While the samples were relatively small varieties have consistently shown good strength across 3 years and the plan is to expand on this work in 2022.

Carrot seed rate

Growers face many challenges and establishing the crop is not always simple to achieve. Even with germination data for the seed lot it is then reliant on local knowledge to have a best estimate of projected establishment and plant densities when selecting drilling rates.

Crop establishment can be tricky and small plot establishment accentuates these issues. The 350,000 plants/acre establishment data has not been plotted in chart 1 as it had an establishment rate of 122% - probably due to singulation issues.

In order, to get the higher density populations tractor speed was near crawling pace which wouldn't be a good option with a commercial drill but should be born in mind if you are thinking of switching to a higher density.

This is only a single trial's worth of data, from a single site and a single soil type, with a single variety and thus can only be used to demonstrate proof of principal. No reliable statistical analysis was possible on such a small data set and to have done so would have given a false confidence in any quoted 'ideal' population to drill.

Chart 2 shows the marketable yield for individual and grouped (means of similar harvest population) plot data. Whereas chart 3 shows the means of the drilled rates.

The curve line added to chart 2 is the better indication of how the yield benefit of higher rates starts to plateau around 145-170 plants per m² and eventually dip down as the number of undersized carrots increases. While yield increases the split between grading fractions changes towards smaller fractions. Chart 4 shows the percentage defects and importantly chart 5 shows the percentage undersized which has a step change over a certain population, but then hits a plateau as establishment will also most likely plateau.

The general trend towards higher yield, up to a plateau, from higher drill rates would need to be optimised on a farm by farm, soil by soil, field by field, season by season basis – hence most growers are likely to use a ‘standard’ drill rate recommended for a variety by the seed company with the addition of local knowledge from the farmer and local agronomist. There is probably scope to optimise yields, especially for new varieties, by some local experimentation and pushing of the envelope. This would need to be balanced locally with any contractual grade size requirements.

Forecasting tools to better predict crop establishment would allow growers more confidence to fine tune drilling rates.

Financial Benefits

- More varieties that are less prone to breakage, at harvest, are available to select from
- Higher drill rates should give bigger yields but bespoke on farm work would be needed to define optimal drill rates

Action Points

- Consider the additional variety choices if harvest breakage is an issue
- Seek variety data performance at different seed rates

Technology Transfer

- AHDB/BCGA virtual event (approx. 40 attendees)
- Presentation of results to BCGA committee
- Circulation of presentation to BCGA membership
- Trial coverage in The Vegetable Farmer

Appendix

Carrot breakage data (1 of 2)

		2019	2020	2021	mean
variety	company	% breakage	% breakage	% breakage	% breakage
Brilliance	BASF			0.0	0.0
Ellis RZ	Rijk Zwaan			0.0	0.0
MVC586	Hazera			0.0	0.0
Nerac	Elsoms	0.0	0.0	0.0	0.0
Stromboli	Clause	0.0			0.0
CA 6572 F1	Agriseeds	0.0	2.0		1.0
Berdina	Agriseeds	0.0	2.2		1.1
Caribou	Seminis	0.0	0.0	2.0	0.7
Octavo	Hazera	1.0	2.0	2.0	1.7
Allyance	BASF			2.0	2.0
CR1706	Seminis			2.0	2.0
Elegance	BASF	4.0	0.0	2.0	2.0
Hestan RZ	Rijk Zwaan			2.0	2.0
Nagoya	Bejo/Elsoms			2.0	2.0
NUN 13102	BASF			2.0	2.0
Nun 13095	BASF	4.0	0.0		2.0
SVDN8104	Seminis			2.0	2.0
VAC111	Hazera	2.0	2.0		2.0
Volcano	Hazera	2.0	2.0	2.0	2.0
Eskimo	Hazera	2.0	6.0	0.0	2.7
Nairobi	Elsoms	4.0	4.0	0.0	2.7
Nipomo	Elsoms	6.0	0.0	2.0	2.7
SVDN7396	Seminis		2.0	4.0	3.0
Nazareth	Elsoms	6.0	0.0	4.0	3.3
Melodio	Hazera	3.0	4.0	4.0	3.7
VH133	Hazera		4.0	4.0	4.0
Fidra RZ	Rijk Zwn	2.0	6.0		4.0
Nun 13096	BASF	2.0	6.0		4.0
Olimpo	Hazera	0.0	6.0	6.0	4.0
Speedo	Hazera	4.0	6.0	2.0	4.0
SVDN 5865	Seminis	4.0	6.0	2.0	4.0

Carrot breakage data (2 of 2)

		2019	2020	2021	mean
variety	company	% breakage	% breakage	% breakage	% breakage
Sirkana	BASF		4.4		4.4
Norwich	Elsoms	8.0	2.0		5.0
Romance	BASF	6.0	4.0		5.0
Naval	Elsoms	6.0	2.0	8.0	5.3
YMER RZ	Rijk Zwaan	16.0	0.0	0.0	5.3
Calindor	Agriseeds			6.0	6.0
Florance	BASF			6.0	6.0
Laguna	BASF			6.0	6.0
Miami	Elsoms	10.0	2.0		6.0
Natuna	Elsoms	10.0	2.0		6.0
NUN 89853	BASF			6.0	6.0
Laguna	BASF	6.0			6.0
Norfolk	Elsoms	10.0	4.0		7.0
Polydor	Clause	0.0	10.0	8.0	6.0
Carruba	Seminis	10.0	6.0		8.0
Nagasaki	Bejo/Elsoms			8.0	8.0
Nominator	Elsoms	8.0	8.0		8.0
Nun 13098	BASF	2.0	14.0		8.0
Sirikana	BASF			8.0	8.0
VAC136	Hazera			8.0	8.0
CA 98-681 (Calantis)	Agriseeds	6.0		10.0	8.0
VAC67	Hazera	8.0			8.0
Cestas F1	Agriseeds	8.0			8.0
CLX 31566 Calista	Clause	8.0			8.0
Jerada RZ	Rijk Zwn	8.0			8.0
Kaptop	Agriseeds		8.0		8.0
Carrillon	Agriseeds	10.0	8.0		9.0
SV1140DN	Seminis	12.0	6.0		9.0
Subito	Hazera	10.0	10.0		10.0
Malbec	Seminis			12.0	12.0
Metro	Agriseeds		12.0		12.0
Match	Clause	12.0			12.0
Mercurio	Clause	12.0			12.0
Caravel	Agriseeds	18.0	8.0		13.0
Maestro	Hazera	18.0	8.0		13.0
Belveta	Seminis	20.0	8.0		14.0
CA 444 F1	Agriseeds	14.0			14.0
CA-12329 F1	Agriseeds		16.0		16.0
CAR02251	Sakata	22.0	12.0		17.0
Bengala	Agriseeds	16.0	18.0		17.0
Caracal	Agriseeds			18.0	18.0
Dailyance	BASF	18.0			18.0
Mokum	Bejo/Elsoms			18.0	18.0
Viva	Agriseeds	26.0	12.0		19.0
Calibra	Agriseeds	24.0	16.3		20.2
Cariana	Agriseeds			32.0	32.0