Proceedings
of the
ONTARIO
BABY CARROT
SYMPOSIUM

February 6, 1975
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CHAIRMAN'S COMMENTS
Ed Tomecek

The Ontario Baby Carrot Symposium had two major objectives. Firstly, it enabled researchers in Ontario and Quebec to exchange information between themselves and to share their information with members of the Food Processing Industry and with growers concerning baby carrot production. Secondly, the symposium pointed out the potential of such production for Ontario. Potential markets were explored by members of the Ontario Food Council, and the requirements of buyers were detailed by Mr. Art Johnson of the Cara operations and again by the members of the Food Council. It is hoped that this symposium will further the cause of establishment of baby carrot production in Ontario to satisfy the needs of the Canadian consumer for processed and fresh market baby carrot products.

One concrete outcome of the symposium was the formation of the Ontario Baby Carrot Committee which is a Sub-Committee of the Ontario Vegetable Research Committee. The Ontario Baby Carrot Committee is composed of researchers of the Ontario Ministry of Agriculture and Food stationed at Ridgetown, Simcoe and Bradford, as well as researchers from Agriculture Canada stationed at Harrow and Ottawa. Extension Horticulturists and a member of the Ontario Food Council of the Ontario Ministry of Agriculture and Food, a representative of the processing companies and growers round out the membership of the Committee. In the future, a Crop Protection member and an Agricultural Economist will be included to fill out the membership of this Committee.

The Ontario Baby Carrot Committee number 1 priority will be to develop baby carrot production in Ontario through the initiation and coordination of research and through the initiation and support of various projects.

I would like to thank all the participants of the symposium for their excellent presentations and their contributions to these proceedings and finally acknowledgement is due to Miss Shirley Gyori who has typed and compiled these proceedings.
"In the eyes of the Ontario Food Council, a million dollars worth of imported product replaced with domestic production is worth just as much as a million dollars worth of extra exports." Sometimes I get a lot of flack in Ottawa on this statement but I still maintain very strongly that such is the case. If we could take a product that is presently imported and produce it at home that is just as good as developing a brand new export market. In fact, in many cases it should be easier to achieve when you consider how vulnerable exports are to all kinds of barriers, tariff and non-tariff put on by the importing countries.

That is exactly where we stand today with baby carrots. In 1973 imports reached one and a half million dollars. To the end of October 1974 we had already imported 1.1 million dollars.

To my mind, (and I admit I am not a researcher), we can certainly grow carrots in Ontario so why shouldn't we be able to grow baby carrots. Not only can we product carrots, half the time we over produce them, and the industry comes to the Ontario Food Council and asks for a plentiful foods program to bail them out. Let's work on the value-added concept and produce a product which has a ready-made market with double or triple the per-unit value of ordinary carrots.

Let's take a look at imports in more detail. In 1973, Canada imported $876,000.00 worth of canned baby carrots from the United Kingdom, $353,000.00 from the Netherlands and $269,000.00 from Belgium, a total of 1.5 million dollars. The growth was as follows: 1973, 1.5 million dollars; 1972, 1.2 million dollars; 1971, $836,000.00; 1970, $577,000.00; 1969, $476,000.00; and 1968, $432,000.00, in other words, a reliable market with a nice steady growth curve.

Let's break down the market into its 3 component parts and talk about the three separate markets in some more detail.

FRESH

Last fall, Hardee Farms ran a test market on fresh baby carrots in 12 ounce packages. Sales reached about 1,000 units per week. The retail price was 39¢ per 12 ounce package. You can compare that with 3 pounds for 49¢ for ordinary carrots. These came from LeClair in Quebec and Hardee are convinced that the market is here to stay and will grow in the years to come. The reason of course, is convenience. The apartment dweller wants to take
2 or 3 carrots and place them beside a meat entree which he or she has heated for the evening meal. People eat with their eyes and this product has eye appeal.

Dominion Stores also marketed a product called Gourmet Baby Carrots in one pound tray pack, poly over-wrap, for 59C per pound. These are described on the package as cleaned, washed, baby carrots. Actually, they are simply small grade-outs from ordinary carrots which are then put through a potato peeler to shave them down to a uniform small size. These in fact, out-sold fresh unwashed baby carrots from Florida in 12 ounce bags. In other words, the lesson to be learned is; if you are going to go for convenience, you better go all the way. Wash and sort them out to a uniform size, and the price doesn't matter.

The Caps Act, (Canada Agriculture Products Standards Act), has now gazetted a new regulation covering baby carrots. They can be designated as baby, mini, finger or cocktail, all four names are acceptable. The dimensions are; a maximum diameter of 3/4 of an inch at the crown and a maximum length of 3-1/2 inches. We don't know what the potential for sales are since we have just scratched the surface. Test markets to date indicate that baby carrots will sell and will sell at a premium.

CANNED

The two most prominent brands found in most supermarkets, are Smedley's and Robertson's, both from the United Kingdom. On a shopping expedition, we found ten different brands from the United Kingdom, Holland, Belgium and the U.S.A. Prices were all over the map and ranged from about 24C to 68C per 10 ounce can. Dominion Stores in Ontario alone, sold 17,000 cases in 1974.

Current prices for baby carrots are $6.50 per 24 x 10 ounce case and apparently that price has increased substantially in conditions in the United Kingdom, has caused Smedley and Robertson to substantially increase their prices.

It will take considerable time and effort to establish a brand image to break into this market. No doubt, some Ontario company will do this, but it will not happen over-night. This is not a ready-made market since the imported brands probably carry some snob appeal among certain customers.

INSTITUTIONAL

This is the ready-market, providing we can match the quality of the Belgium standard and compete in price. This market is there for the asking. Current price is $15.00 per case, 6 x 10 ounce. The Cara Organization alone uses 6,000 cases per year and project
10,000 cases in 3 years time.

We checked a few of the major hotels; The Royal York uses 1,000 cases, the Inn on the Park 520, and The Four Seasons Sheraton 800.

Most users mention the brand name Alfred Robin, purchased through J. Alfred Quimet Incorporated in Montreal. Price is $15.00 per case, 6 x 100 ounce or $2.50 per 100 ounce tin.

We asked some of the users and they were happy to spell out the specifications for their requirements:

(A) 415 to 470 actual count per can,
(B) Uniform size,
(C) Good colour, (A fresh appearance),
(D) Excellent taste (on the sweet side),
(E) Guaranteed Uniform quality.

Let's face it, the baby carrot is directly associated with a gourmet meal. Check the menus in some of your fancier eating establishments, if they specify carrots, diced or sliced carrots are served with the cheapest meals, individual baby carrots carry the gourmet connotation and are served with the high priced meal. If you are going to pay $6.00 or $8.00 for the meat entree, an additional 15c or 30c for the vegetable serving really doesn't matter.

It is amazing the length that a restaurant will go to to serve an appealing vegetable and let's face it, we are talking mainly about eye appeal. Some restaurants will actually shave down an ordinary carrot by hand and end up with a product that has the eye appeal and shape of a baby carrot. Think of the waste and the labour involved. Surely this job can be done more economically by a processor.

Think of the prepared meals you have eaten. The airlines serve baby carrots, eye appeal is very important to them. We were recently contacted by Magic-Minute Meals in Cambridge, they actually want a baby carrot quartered lengthwise. These people are always looking for a gimmic, something that will make their product look different from the competition.

What will it take to get commercial production of baby carrots in Ontario? Some of the basic research work has been done. It is now a matter of bringing the producer, the processor, and the customer together to end up with a viable commercial venture. And this is where the Food Council can perform a role. I would challenge one of the processors here to try baby carrots on a commercial scale, because if you are successful, the market is ready-made.
For many years, carrots have been processed, either canned, diced or used in soups. The canned whole baby carrot is relatively new, and owes part of its increase in popularity to the development of methods of cleaning the roots which do not damage the skin. It is really of no great concern if the skins are slightly damaged on carrots which will eventually be diced. It is important on carrots which are canned whole.

Growing carrots specifically for processing has increased in the U.K. very steadily in the last 15 years. Total carrot production there has fluctuated between 32000 acres and 40000 acres. Approximately 36% are now grown specifically for processing and this includes around 20% for canning whole. Therefore the U.K. produces annually about 7000 - 8000 acres of baby carrots, plus the small sized roots which are graded out of some of the remaining production.

Development of this enterprise from a preliminary research study in the late 1950's to a successful commercial venture has been an exciting program to have been associated with, and a real triumph for the total systems approach to research and development. If individual researchers had isolated themselves to work on separate factors within the overall project, with no reference to their fellow workers, it is doubtful if the progress would have been made in the way it has in England in the last 15 years. If we are serious in Ontario in wanting to promote this crop, then let us learn from the English example and insist that the specialists all get together as a coordinated team to include engineers, entomologists, nutrition chemists, production workers etc. and don't let us forget an economist.

BACKGROUND RESEARCH IN U.K.

In the late 1950's a team headed by Dr. J.K.A. Bleasdale at the National Vegetable Research Station at Wellesbourne near Stratford-on-Avon in England, was examining what happens when plant populations of various vegetables are increased considerably beyond what we used to consider normal. This work was based on better utilisation of growing conditions, maximum uptake of nutrients and water, maximum use of sunlight etc., by having more plants on the land. But it is not simply a matter of more plants per acre, especially with crops grown for processing which demands not only high yields of good quality, but also a very uniformly sized product. So the concept of plant arrangement goes hand-in-hand with plant spacing.
With seeded crops growing close together in widely spaced rows like the traditional way of growing onions, many of the individual plants are crowded out and produce only small plants, whereas others dominate and grow to a large size. The overall population, therefore, tends to be extremely variable in size. This is undesirable with a crop like carrots grown for canning whole. The first requirements therefore is to devise some method of producing a high proportion of the population in the desirable size range.

The work in England progressed from a first step of high populations through examination of plant arrangements on the ground, to assessment of seeding rates to achieve the ideal plant populations, seeding dates in relation to lifting dates in order to maintain a continuous program of harvesting in the late summer and fall. All this was done in coordination with work on the nutrient requirements of a crop grown under these new and intensive conditions, herbicides for weed control to enable the crop to be fully mechanised, and insect control.

There is no point here in discussing the recommendations for the U.K. as regards crop nutrition, herbicides and insecticides, because of the different growing conditions and also the statutory aspects of pesticide applications.

It is interesting to note that in the U.K. the production of baby carrots for canning whole is now centred on sandy soils rather than on peat fens which are analogous to our muckland areas. These peat soils in the U.K. still produce carrots, but mainly larger roots for fresh market. On sandy soils, the texture of the sub soil has been found to have a profound influence on its suitability for growing baby carrots. Land with coarse sand or gravel sub soil may be marginal in dry seasons without irrigation. English recommendations regarding irrigation are that on such soils as these which dry out, 1 inch of water can be applied after the four true leaf stage. Irrigation is not recommended before that stage.

Presence of stones and rocks in the soil will complicate seeding and harvesting of the small roots and such land should be avoided.

The present **English** recommendation for soil types is:
"Ideal soils are deep, well drained, stone free sands and peats with a minimum available water holding capacity of 14 in. per foot depth, over moisture bearing sub soils, which are free from perennial weeds."
The governing factor in deciding on a seeding plan is harvesting equipment. There is no doubt that the ideal arrangement from the physiological point of view of the carrot plant itself is the solid bed of closely spaced plants with the roots arranged evenly "on the square". A two-row potato harvester (Amac) fitted with two shares or with a single 48" share could lift a 42 in. bed of 12 rows 3½ in. apart. In England, such a system is difficult to operate because of the huge volume of soil to be moved at harvesting. It is now recommended only for good carrot soil, i.e. fine sand under dry conditions so that the sand flows freely from the roots. In addition to harvesting problems, it has been found that often the carrots in the centre rows of full beds have been too small. Growing conditions in Ontario are very different from those in England and it may be that if the necessary equipment can be found to harvest such beds, that this system would be workable here.

The English workers soon realised that some compromise was necessary, between what was ideal physiologically, and what was possible mechanically. The next stage of development therefore was to examine planting arrangements which could be lifted with either top-pulling harvesters or with single row potato harvesters. This led to the MINI-BED or Ribbon system. A satisfactory mini-bed system has been obtained using Stanhay precision seeder equipment. Each mini-bed consists of nine rows, seeded by three Stanhay units, each unit fitted with an attachment capable of placing 3 rows 1 in. apart, and allowing 2 in. between units, giving an overall width of the mini-bed of 10 in. from outside row to outside row. This 10 in. mini-bed can be efficiently lifted with a WHITSED type of harvester fitted with a squeezing share. Two of the mini-beds will fit into a 60 in. module, allowing 20 in. for tractor wheelings. Seeding rates can be reduced in the centre rows of the mini-bed to compensate for the fact that roots from the centre rows are usually slightly smaller. The exact seeding rate needs to be worked out for Ontario conditions.

Trials in England have examined various commercial types of seeders and it is generally concluded that the Stanhay is really the only one available which is capable of meeting these requirements of high density and precision.

Top lifting harvesters for root crops have never been common in England. This is probably because one crop which lends itself to such equipment, i.e. radishes, are traditionally marketed in England with tops on. Top lifting harvesters are seldom used for canning carrots, but they would certainly be adaptable for mini-beds. Such machines have definite advantages in being much lighter and can be fully mounted on a tractor. They also leave tops, stones and soil behind in the field.
The most usual type of harvester is the WHITSED elevator digger, originally designed for single rows of potatoes but modified with closer webs on the elevators to prevent loss of the small carrots. These are priced in England at the equivalent of about $3500 - $4000. The trailed types of double row harvester are very difficult to work under wet soil conditions and wheelings have to be quite wide. This is one reason for the move towards self-propelled models. Some growers in England have built their own self-propelled Amac two row harvesters, and these can be used on full beds or on mini-beds. Their cost is about ten times that for a Whitsed.

The usual method of removal of tops before lifting the root is with a forage harvester which precedes the root harvester and blows the debris on to the strip of land already cleared. Small rotary mowers are also used fitted to the harvester but the success of either method of topping depends on the uniformity of the seedbed, and the height at which the crown of the carrots stands above the soil surface. For this reason, it is absolutely vital to have good land preparation before seeding, and the need for a perfectly level seedbed should be obvious.

VARIETIES

In England only stocks of the CHANTENAY type are used for canning whole. These are conical and stump-rooted in shape, generally with good core and flesh colour, and moderate skin texture. However, now that cylindrical carrots have become dominant for fresh market use, there is interest in taking longer carrots than the Chantenay, e.g. NANTES and AMSTERDAM FORCING types, for canning whole as finger carrots. Obviously variety trials must be done in Ontario to assess processors' and consumers' requirements.

PLANT POPULATION

Considerable research has been done in England on this and in summary the following densities appear satisfactory with Chantenay.

<table>
<thead>
<tr>
<th>Shoulder plants per sq.ft. of total field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small roots, canning whole 3/4 - 14</td>
</tr>
<tr>
<td>Medium size, canning whole 1 - 1</td>
</tr>
<tr>
<td>Large, for dicing etc. 1-3/4 +</td>
</tr>
</tbody>
</table>

Some of the best growers on sandy soils are now achieving 70% grade-out in the small size.

Arrangement of this population of 35 plants per sq. ft. of field has already been discussed and the factor which governs a growers decision is largely the equipment used for harvesting.
SEED RATES

The English researchers have produced a formula to calculate seed rates to produce the required population.

\[
\text{Seed (lb/acre)} = \frac{272 \times \text{No. of plants/sq. ft. of field}}{\text{No. of seeds per oz. x Lab. germination x Field Factor}}
\]

Seed count and lab. germination can usually be obtained from the seedsman. Samples of Chantenay vary from 15000 to 36000 seeds per ounce and obviously it is vitally important to know the exact count. Using graded seed, especially with precision seeders, for instance the size grade 1.50 - 1.75 mm of Chantenay contains 20,000 per ounce. Variation in seed size and germination can alter the effective seeding rate by as much as 100%.

The lab. germination % will obviously not be the same as the percentage which ultimately germinates in the soil, and the real germination depends on various field conditions. Experiments at various places in England have indicated that the lab. germination % should be multiplied by a certain field factor, to compensate for this, as follows:

- Cold Soil, poor conditions: 0.5 Field Factor
- Average: 0.6
- Good: 0.7
- Ideal: 0.8

WEED CONTROL

With a crop growing at very high densities and in closely spaced rows, it is virtually impossible to do any inter-row cultivation for weed control. Therefore, growers must rely very heavily on chemical herbicides. Various weed control recommendations have resulted from work in England, but they cannot be directly applied here because of registration differences. One technique which is extremely valuable for this high density crop is the "stale seedbed" system. The seedbed is prepared about 10 days ahead of the anticipated seeding date, and a flush of weeds is allowed to develop, An application of paraquat (Gramoxone) is made to kill these weeds and seeding can be done immediately afterwards.

DATES OF SEEDING

Several trials have been undertaken in England to enable a programmed continuous harvesting schedule to be achieved. Maximum yields and high percentages of canning size have been achieved 16 to 20 weeks from seeding, depending on the time of year. Such a schedule needs working out for Ontario also.
YIELDS

The Ministry of Agriculture (England) Booklet on Carrots for Processing, quotes the following expected yields per acre.

Small carrots (3/4 - 1½ in. diam.) grown at 35 plants/sq. ft. of field -

<table>
<thead>
<tr>
<th>*Tons/acre</th>
<th>High</th>
<th>Average</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>14</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Peat (muck)</td>
<td>15</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

*Long tons (2240 lbs)

Total yields have been recorded as high as 27 tons/acre with 70% in the small grade, i.e. 19 tons small size.

This crop is also being tried as a follow-on catch crop following early potatoes. In this case, it is not seeded until July and yields only about 6 tons/acre.

Contract prices for 1974 in England were around £16 a ton (= $36 per Canadian Ton), delivered at the processing plant, for the 3/4 - 1½ in. size grade.

The canning trade for baby carrots in England really developed in the late 1960's when the fresh carrot trade was depressed because of over production. But as in most recent years, fresh market prices have far exceeded that of the more difficult canning grade, canning prices will surely increase markedly.

CAVITY SPOT

Probably the most serious disorder of canning carrots in England is Cavity Spot. Now that steam peeling has generally replaced carborundum peeling for these small carrots, there is a tendency for skin disorders to become more important. Cavity Spot is not noticed until the roots are cleaned and obviously presents a real problem for the canning trade. The cause is not known and at present it is not possible to recommend cures. This condition occurs also in Ontario and obviously needs attention before the production of baby carrots can be really successful here.

USEFUL LITERATURE

Published by the Ministry of Agriculture, Fisheries & Food (Publications) Tolcarne Drive, Pinner, Middlesex, England.

1) Short Term Leaflet No. 27: "The Bed System of Carrot Growing".
2) Horticultural Enterprises Booklet 4: "Carrots for Processing".

Published by the National Institute of Agricultural Botany, Huntingdon Rd., Cambridge, England.

3) N.I.A.B. Growers Leaflet No. 4: "Varieties of Maincrop Carrots".
I was supposed to speak to you about research on Baby Carrots at the Muck Research Station in the Solland Marsh.

However, before I do this, I would like to point our that recently grade regulations have been gazetted for Baby Carrots. The grade regulations are valid for the whole of Canada.

Baby Carrots can be named as follows:

Baby, Finger, Baby Finger, Cocktail, and Mini.

Maximum diameter = 3/4"
Maximum length = 3/4"

They should be clean and less than 1/2" sunburn allowed.

There is no regulation on colour.

These regulations are for Baby Carrots for the fresh market only. You may have seen them in the shops last summer. They were sold for 390 for 12 ounces in a polyethylene bag. Recently I found the same carrots in the local store imported from Florida at the same price 390 for 12 ounces.

Before I go on to the research which was done at the Muck Research Station, I would like to just talk a little bit about some research which was done in New Zealand.


The effect of plant density on yield of small (13-18 mm diameter, 7.5 - 11.5 cm long) finger carrots was studied in two experiments, one using cv. Manchester Table, the other using cvs. Little Finger, Tiny Tot, Index, and Manchester Table. With sowings at density ranging from 533 to 2500 seeds per square metre, yield increased with increasing density. The highest yields were obtained at the highest density used and ranged from 51.5 tonnes/ha for cv. Manchester Table to 90.6 tonnes/ha for cv. Index. At each density, yields of finger carrots classes as small reached a maximum for about 1 week. This maximum yield was reached earlier at low than at high densities. When plants were spaced close to equidistant, between and within rows, a yield lower than might have been expected in relation to density was obtained in all cultivars except Little Finger.

In New Zealand, small Finger carrots and carrots slightly smaller down to 10 mm diameter and 5 cm long are being grown on a small scale to be frozen whole.
The significance of this research work is that the highest yields of small finger carrots were obtained at the highest densities used. Even higher yields could result at still higher densities. The researcher said in his paper that further studies are necessary to determine a density which could achieve the maximum possible yield of small finger carrots.

So, looking at this research work, it appears that at 50 seeds/sq. foot, the yields were somewhere around 8 tons/acre. At 100 seeds/sq. foot, the yields were around 13 tons to the acre. At 150 seeds/sq. foot, yields were 17 tons/acre and 250 seeds per sq. foot, yields were still going up and reached more than 22 tons/acre.

In Holland, many acres of carrots are grown of which a substantial acreage goes for baby carrots.

One of the major cultivars grown for baby carrots in Holland is called Sweetheart. The seed is sold for about $12.00 per pound.

Baby Carrots are grown on very light soils, some of these soils are very nearly pure sand. The seed rate is around 17 lbs. to the acre. Rows are sometimes 7 to 18" apart and very often the beds are sown broadcast.

Dutch researchers also claim that the higher the seed rate, the smaller the diameter and the shorter the carrot. Harvesting is done with a two-row bulb lifter which is made by different Manufacturers; some of the larger farmers are using the Excelsior - Hermes high capacity mechanical carrot harvesters.

The Excelsior machine is made by the Agricultural and Horticultural Manufacturers, Excelsior N.V. Havenweg, 15-17, Bovenkarspel, Holland.

An identical machine is made by the Hermes Agricultural Machine Manufacturers, S. De Vries N.V. Leeuwarden, Holland.

The latest quotation I have was of January 18, 1973 when the machine price was 47,000 guilders F.O.B. Rotterdame, which would be about $19,000.00.

This standard machine is also suitable for harvesting carrots, onions and tulip bulbs. Potatoes, an extra harvesting section would be needed which would cost another $1,800.00. For onions, extra belts with smaller distance between the bars is needed which would cost an extra $2,600.00.

BABY CARROT RESEARCH - Muck Research Station

Investigations with baby carrots were begun in 1972 at the Muck Research Station by the late Conny Filman. For several years, Mr. Filman had been working on various plant populations. The purpose of these experiments was to determine whether increased yields could be obtained by increasing the population sq. foot rather than by increasing the stand/foot of row. At first, cultivars Scarlet Nantes and HiPack Elite were used for this purpose. On the basis of
4 years' work, it appeared that the expected carrot plant population is very difficult to obtain and the degree of variation depended upon the season. However, it was found that the nearer the plants are evenly spaced at about 12 sq. inches per plant such as a 4" x 3" spacing, the increased yield obtained were consistently significant over the standard 16" row spacing. The spacings that were used were 2", 4", 8" and the standard 16" spacing. The seed was sown in rows 2" apart. Treatment plots were randomized and replicated 4 times.

In 1972, a baby carrot project was designed to assess cultivars and the optimum plant population for the production of suitable size carrots for canning whole. Seven cultivars were sown at 3 plant populations; $\frac{1}{4}$ sq. inches/plant, 2 sq. inches/plant, and $\frac{1}{2}$ sq. inches/ plant. The seed was sown in rows 2" apart. Treatment plots were randomized and replicated 4 times.

I have tabulated the results of the 1972 research work as follows:

1) The highest yield was obtained with the cultivar Nantes at $33\frac{1}{2}$ tons/acre with 42 plants/sq. foot. However, the average diameter of the carrots harvested was .7" and the length was 4.75". These sizes are rather larger than what is desired for baby carrots.

2) The next best cultivar was Mini Pak, with 31 tons/acre at a plant density of 36 plants/sq. foot. Here again, the diameter was .7" and the length 4.75".

3) Each cultivar seems to have a optimum plant density requirement to obtain maximum yield.

4) The optimum plant population on the average would appear to be about 35 plants/sq. foot with 2" row spacings.

The 1973 experiment was also designed to assess carrot cultivars for canning whole. Ten cultivars were planted on June 1st, 1973 at an average plant density of 72 plants/sq. foot or about 2" square per plant. The carrots were harvested on Aug. 20th or in about 80 days. The seeding rate was 120 seeds/sq. foot. Germination on the average was 80%. Field hazard was taken at 20%. Total loss expected was 40%.

The cultivar Bunny Bite was not harvested due to being severely attacked by a disorder called rusty root.

Amsterdam Forcing was the highest yielding cultivar with 50.2 tons/acre. The carrots were about 7/8" diameter and 3.9" long. There was no difference in yield between cultivars Chantenay 6028, Round Plant, Little Finger, and Mini Pak.

The average length of all 9 cultivars varied from 2.95" (Mini Pak) to 3.90" (Amsterdam Forcing).

The average diameter varied from .50" (Little Finger) to 1.08" (Chantenay Royal).

The most uniform cultivar was Little Finger.

The smoothest cultivars were Tip Top #9, Little Finger, Chantenay Royal, and Amsterdam Forcing. Nugget, a globe shaped cultivar, with an average diameter of 1.20" produced the lowest yield (26.6 tons/acre). This cultivar was very uniform but not smooth.
This experiment showed again that Baby Carrots can be grown on the type of organic soils in the Holland Marsh area which is a peat soil successfully and producing economic yields in about 80 days.

It was felt then that more coordination with processors is required to obtain information on quality after canning. Colour and flavour after canning of these cultivars required further investigation.

The 1974 research work on baby carrots at the Muck Research Station was designed to study production on solid beds. Ten cultivars were seeded on June 4th in rows 3" apart with a wide shoe Planet Junior seeder to simulate broadcast seeding. Seeding rate was adjusted to obtain a desired plant population of 72 plants/sq. foot. However the actual plant density obtained was 50 plants/sq. foot due to various reasons.

The carrots were harvested Aug. 20-30th, or about 80 days. The roots were graded into two sizes: a) Baby size: 4-3/4" diameter, 14 to 3" long and
b) Finger size: 3/4" - 7/8" diameter, 3 - 5" long.

Cultivar Little Finger received the highest score for uniformity, short tops, crowns, shape etc. This cultivar produced 20 tons/acre baby sized carrots.

Next in line were: Amsterdam Minicore (16 tons/acre), Amsterdam Foram (15 tons/acre), and Coreless Amsterdam (15 tons/acre). Amsterdam Minicore received top marks for colour. This cultivar produced an additional 10 tons/acre of Finger sized fruit.

Roots were lye peeled and processed into tins and glass jars by the Horticultural Products Laboratory, Vineland Station. Unfortunately, the only method of peeling available at the Laboratory was by lye peeling. This is not the best method of removing the skin as it tends to 'pit' the carrots and produce an unsightly end product.

Processor and consumer comments were: Best colour in order of preference: Amsterdam Minicore, Coreless Amsterdam, Amsterdam Foram, and Little Finger.

Best uniformity of size and shape in order of preference: Little Finger, Amsterdam Foram, Amsterdam Minicore, and Amsterdam Coreless.

An observation trial of 8 cultivars was seeded in a similar manner as the replicated trial above. The most promising selections in this trial were: Sweetheart (23.5 tons per acre), Nanta (17 tons/acre), Amsterdam (18 tons /acre), and Masterdam Minicore (20 tons/acre).

The complete report of these trials enclosed - Appendix 'A'.

For clarification, the seed sources (column 1 in the tables) are as follows:

3-Beemsterboer, 7-Ferry Morse, 8-Harris, 14-Nunhems, 10-Keystone, 18-Rogers Brothers, 19-Royal Sluis, 21- Sluis en Groot, 22-Thoday & Son.
In conclusion, I would like to say that Ontario should be growing all of its requirements for Baby carrots whether it be for the catering trade, processing trade, for freezing, fresh market etc., etc. There are many soils which are very well suited to the production of baby carrots. In particular, I am thinking of the well-drained sandy loams and high moisture capacity organic sands. I don't believe that the organic soils which are not well decomposed, such as the peat soils in the Bradford area or the rooty mucks in the Cookstown and Grand Bend Marshes would be well suited for the production of baby carrots. However we shall continue to research plant populations and cultivars as well as studies on regulators, storage quality, dessicants etc.

The facilities of the Muck Research Station are always available for anyone who wishes to cooperate with us on studies with baby carrots.
BABY FINGER CARROT TRIAL
Muck Research Station 1974

BABY CARROTS

Much interest continues to be shown by processors in baby carrots. Grower interest in this crop is increasing. For this crop to be commercially feasible requires improved harvesting equipment capable of harvesting solid bed planted crops. This experiment was designed to study baby carrots sown in solid beds. Ten cultivars were seeded on June 4 in rows 3 inches apart with a wide shoe Planet Jr. seeder to simulate "broadcast" seeding. Seeding rate was adjusted to obtain a desired plant population of 72 plants per square foot. The actual plant density obtained was 50 plants per square foot.

Roots were harvested August 20-30. Carrots were graded into two sizes:
A - "baby" size: 1/2 - 3/4 inch diameter, 1 1/2 - 3 inches long and B - "finger" size: 3/4 - 7/8 inch diameter, 3 - 5 inches long. cv Little Finger received the highest score for uniformity, short tops, crowns, shape etc. It produced 20 T/A "baby" size carrots. Next in line were: Amsterdam Minicore (16 T/A); Amsterdam Foram (15 T/A) and Coreless Amsterdam (15 T/A). Amsterdam Minicore received top marks for color. This cultivar produced an additional 10 T/A of "finger" sized roots.

Roots were lye peeled and processed into tins and glass jars by the Horticultural Products Laboratory, Vineland Station. Processor and consumer comments were: Best color in order of preference: Amsterdam Minicore, Coreless Amsterdam, Amsterdam Foram and Little Finger. Best uniformity of size and shape in order of preference: Little Finger, Amsterdam Foram, Amsterdam Minicore and Amsterdam Coreless.

An observation trial with eight cultivars were seeded in a similar manner as the replicated trial above. The most promising selections in this trial were: Sweetheart (23.5 T/A), Manta (17 T/A), Amsterdamse (18 T/A) and Amsterdam Minicore (20 T/A).
### BABY CARROT REPLICATED TRIAL - 1974

<table>
<thead>
<tr>
<th>Variety</th>
<th>Source Total Yld.</th>
<th>Baby Size Max. 3”x3/4</th>
<th>Finger Size Max. 5”x7/8</th>
<th>Uniform Smooth</th>
<th>Shape</th>
<th>R. Root Resistance</th>
<th>Wt. Tons/Acre</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunny Bite</td>
<td>7.0</td>
<td>0</td>
<td>0</td>
<td>4- 3+</td>
<td>F</td>
<td>3+ 3</td>
<td></td>
<td>Full of Rusty root, not harvested</td>
</tr>
<tr>
<td>Mini Pak</td>
<td>8.13</td>
<td>11</td>
<td>0</td>
<td>4- 3+</td>
<td>F</td>
<td>3+ 7</td>
<td></td>
<td>Not bad, tends to grow heavy, immature at harvest</td>
</tr>
<tr>
<td>Coreless 'Adam</td>
<td>20 22</td>
<td>15</td>
<td>0</td>
<td>4- 3+</td>
<td>F</td>
<td>3+ 7</td>
<td></td>
<td>good length, very good colour and size</td>
</tr>
<tr>
<td>Nugget</td>
<td>10 13</td>
<td>11</td>
<td>0</td>
<td>3+ 3</td>
<td>R</td>
<td>3</td>
<td></td>
<td>Round type, nice, slightly green shoulders</td>
</tr>
<tr>
<td>Chantenay Royal</td>
<td>22 13</td>
<td>8</td>
<td>0</td>
<td>3+ 4-</td>
<td>W</td>
<td>4 14</td>
<td></td>
<td>Wedge type, poor color</td>
</tr>
<tr>
<td>New Special</td>
<td>22 13</td>
<td>8</td>
<td>0</td>
<td>3+ 3</td>
<td>W</td>
<td>3+</td>
<td></td>
<td>Small wedge, broad shoulders, plump, poor colour</td>
</tr>
<tr>
<td>Little Finger</td>
<td>21 27</td>
<td>20</td>
<td>0</td>
<td>4 4</td>
<td>F</td>
<td>4+ 6</td>
<td></td>
<td>Excellent in size &amp; shape, very good colour</td>
</tr>
<tr>
<td>Round Planet</td>
<td>21 23</td>
<td>20</td>
<td>0</td>
<td>4- 4</td>
<td>R</td>
<td>4-</td>
<td></td>
<td>Round shape, green shoulders</td>
</tr>
<tr>
<td>'Adam Foram</td>
<td>19 21</td>
<td>15</td>
<td>0</td>
<td>4 4</td>
<td>F</td>
<td>4 5</td>
<td></td>
<td>Very good colour and size</td>
</tr>
<tr>
<td>'Adam Minicore</td>
<td>19 27</td>
<td>16</td>
<td>10</td>
<td>4 4</td>
<td>LC</td>
<td>4 5</td>
<td></td>
<td>Excellent colour, very good size, also adaptable for finger carrots</td>
</tr>
</tbody>
</table>

**NOTES:**
- **Best:** Little Finger (20 tons); 'Adam Minicore (16 tons); tops in color, **also** 10 tons of finger carrots; 'Adam Foram (15 tons), very good size; 'Adam Coreless (15 tons)
- **Shape:** F = Finger  C = Cylinder  W = Wedge  R = Round  LC = Long Cylinder
- **Seeded:** June 4
- **Objective:** 72 plants/square foot
- **Rows:** 3' apart

Due to burning off, only 50 plants/sq. foot

Grower and processor interest in this crop is increasing. The Roots were lye peeled and processed into tins and glass jars by the Horticultural L Products Lab, Vineland Station. Processor and Consumer comments were: A'dam Minicore, Coreless 'Adam, 'Adam Foram, Little Finger (Best Color); Little Finger, 'Adam Foram, 'Adam Minicore, 'Adam Coreless (Best Uniformity)
### BABY FINGER NON-REPLICATED TRIAL - 1974

<table>
<thead>
<tr>
<th>Variety</th>
<th>Source</th>
<th>Total Wt. Tons/Acre</th>
<th>Net Grade-out Tons/Acre</th>
<th>Reason for Grade-out</th>
<th>Wt. of 20 Carrots (oz)</th>
<th>Uniform</th>
<th>Smooth</th>
<th>Shape</th>
<th>Length (inches)</th>
<th>Width (inches)</th>
<th>R. Root Resistance</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nanta</td>
<td>3</td>
<td>31</td>
<td>17</td>
<td>Oversize &amp; cracked</td>
<td>11.3</td>
<td>3+</td>
<td>3+</td>
<td>W</td>
<td>2&quot;</td>
<td>3/4- 3+</td>
<td>1 1/2</td>
<td>Not bad, no greening when small. Many oversize, otherwise a nice carrot</td>
</tr>
<tr>
<td>Sweetheart</td>
<td>3</td>
<td>31</td>
<td>24</td>
<td>Oversize</td>
<td>7.5</td>
<td>-4-</td>
<td>3+</td>
<td>C</td>
<td>2 1/2</td>
<td>3/4 4-</td>
<td></td>
<td>Very nice shape, fairly smooth, less green than Nanta</td>
</tr>
<tr>
<td>Oranza</td>
<td>3</td>
<td>23</td>
<td>13</td>
<td>Oversize</td>
<td>13.5</td>
<td>3</td>
<td>3</td>
<td>Sl.W</td>
<td>2-3</td>
<td>4-1 4-</td>
<td></td>
<td>Uneven size, tends to be rough, poor core color</td>
</tr>
<tr>
<td>Amsterdam</td>
<td>14</td>
<td>29</td>
<td>18</td>
<td>Oversize &amp; split</td>
<td>13.0</td>
<td>-3+</td>
<td>3+</td>
<td>C</td>
<td>2 1/2</td>
<td>3/4- 1-</td>
<td></td>
<td>Nice size, good color, greening a little</td>
</tr>
<tr>
<td>Nantes Slendor</td>
<td>18</td>
<td>27</td>
<td>12</td>
<td>Oversize &amp; split</td>
<td>13.5</td>
<td>-3+</td>
<td>3</td>
<td>H.C</td>
<td>2 1/2</td>
<td>4-1 3+</td>
<td></td>
<td>Heavy cylinder to wedge type, too heavy for finger carrots, nice &amp; short</td>
</tr>
<tr>
<td>Nantes Porto</td>
<td>18</td>
<td>20</td>
<td>16</td>
<td>Oversize &amp; small</td>
<td>13.5</td>
<td>3</td>
<td>3+</td>
<td>W</td>
<td>2</td>
<td>3/4- 4-</td>
<td>15</td>
<td>Turning into cylinder, nice size, no greening, good shape not smooth</td>
</tr>
<tr>
<td>A'dam Minicore</td>
<td>18</td>
<td>26</td>
<td>20</td>
<td>Oversize &amp; small</td>
<td>11.0</td>
<td>4-</td>
<td>4-</td>
<td>C</td>
<td>24</td>
<td>3/1 4-</td>
<td></td>
<td>Nice size, good color, only fair core</td>
</tr>
<tr>
<td>Baby #6028</td>
<td>18</td>
<td>18</td>
<td>26</td>
<td>Oversize</td>
<td>14.0</td>
<td>3+</td>
<td>3+</td>
<td>W</td>
<td>2</td>
<td>3/4- 4-</td>
<td>15</td>
<td>Grows too heavy for finger, might be O.K. for baby when harvested earlier, poor core</td>
</tr>
</tbody>
</table>

**NOTE:** Best: Sweetheart, Nanta, A'dam and A'dam Minicore

**Shape:**
- W = Wedge
- C = Cylinder
- HC = High Cylinder
- Sl.W = Slight Wedge
This past summer, Joe Muehner, Ed Tomecek and myself had a baby carrot trial in the Thedford Marsh. We tried to relate commercial conditions to the growing of baby carrots in southwestern Ontario. By using conventional equipment, our goal was to obtain a suitable commodity out of the field.

This co-operative effort, also, involved Charlie Srokosz in the Grand Bend Marsh as well as Ray Creech of the Thedford Growers Co-operative.

The planting occupied half an acre and consisted of three beds across the plot and down the total length of the field. Three baby carrot type varieties were available -- Baby Finger, Sweetheart and Bunny Bite. Different seeding rates were used on each variety. The trial was seeded on May 18th and soil conditions were hardly ideal with the previous week being quite wet. A planet junior seeder was used with a four inch shoe in order to make some attempt of broadcasting the seed within the row. Four rows were seeded on a forty-eight inch bed. Three different populations per variety were obtained by using different seeding rates. The intention of the trial was more demonstrative than anything else. A plant count per square foot was not taken however. Baby Finger was seeded using #4, 5 and 6, holes #5, 6 and 7 for Sweetheart and holes #6, 7 and 8 for Bunny Bite. The reason for the different hole sizes was the obvious difference in the size of the seed.

No data was taken during the growing season.

The whole trial was harvested on August 5th. Yield data was taken only on the highest plant population sections of each variety. At lower seeding rates, the plant population was not high enough to give a grower reasonable yields and returns.

The tops were removed with a Brady 722 forage harvester and then the roots were lifted with a potato digger. The original intent was to use a harvester developed on the marsh for the harvest of pickling onions. However, the muck contained a fair amount of wood and the digger would have had to be set at four inch in the soil. This might have damaged the harvester so it was used only to windrow the carrots after they had been lifted by the potato digger. As mentioned, the harvester can harvest a solid bed of silver skin onions and is very similar to a potato digger. The carrots, wood and everything else was lifted, carried up and dropped off the machine onto the ground into a windrow. The harvester might be set to dig four to five inches into the ground.
Yield data was taken and it must be emphasized that there is some lack of reliability because replicates were not taken. Yield data includes only marketable carrots. The carrots were not precisely measured however they were in the range of 3½" long and 3/4" in diameter. Carrots which were cracked, mishapen and obviously oversized were discarded.

Recorded yields were Baby Finger 3.8 tons per acre; Sweetheart 11.1 tons per acre and Bunny Bite 7.4 tons per acre. Baby Finger was probably the most desirable in terms of shape and conformation despite the low yield.

The biggest thing learned from this trial was some of the problems that can be encountered in a conventional commercial operation.

Some of the problems encountered were that Bunny Bite became oversized; Sweetheart became too long and Baby Finger was seeded at too low a plant density to have a reasonable yield. Also the timing of harvest is very critical. For example, the length of time these carrots were in the ground was only 79 days and these plots were at least a week past the optimum harvest date. The objective was to have the trial ready for harvest between pea and corn packs so that a processor might be able to have facilities to process the carrots.

More data is required to derive the best planting dates for a scheduled harvest. Since the growing season is about 70 days, baby carrots could be used as a second crop, perhaps following peas depending on soil moisture. An obvious problem with this would be emerging carrots in June and July that will suffer greatly or will most likely suffer greatly from burn off.

Another serious problem which was encountered after the baby carrots were lifted by the potato digger was the rapid loss of water from the carrots. The carrots were left in the field exposed to the sun on a hot sunny August day for about two to four hours. The carrots became shrivelled and unacceptable.

Furthermore, the field and planting bed must be perfectly level because without a level field the tops cannot be uniformly removed. Any carrots with a portion of green stem remaining are unacceptable to the processor.

Finally, soil type was a problem. The trials were located on muck which contained a large amount of wood. This wood interfered with the lifting and windrowing of the carrots as well as being mixed in the carrots in the bulk bins. Therefore, in future, well decomposed muck or sandy soil must be used.
In conclusion, despite all the problems, the potential exists for baby carrot production. Plans for next year are to use higher populations on a different soil type and a better timed and scheduled seeding to produce carrots when processing facilities are available.
BABY CARROT RESEARCH CONDUCTED BY
HARROW RESEARCH STATION
Wally Nuttall

Having acquired some information/recommendations on Baby Carrot varieties and seeding rates (in response to enquiries/interest from local industries), a modest start on research was made at the Leamington Marsh in 1972. Since no land was available for a spring crop, the first trial was seeded on August 2 after the set onions were harvested. We used three varieties: Amsterdam Coreless Forcing, Baby Fingers Nantes and Spartan Bonus and three rates of seeding, attempting to get 50, 80 and 110 per sq. ft., using a cone seeder. The resulting stands were approximately 50 to 60% of the seed planted.

It's all very well for us to talk about seeding rates of 50, 80 and 110 seeds/ft.\(^2\). From a grower's point of view, I would want to know what those rates mean in terms of pounds of seed per acre! To show that large variations do occur between varieties (in size and weight of seeds), the following serves to emphasize the point: with Amsterdam Coreless and little Finger, for the seeding rates of 50, 80 and 110 seeds/ft.\(^2\), this can be expressed in rates of 3.5, 5.5 and 8.0 lb/A respectively. For the same seeding rates for Mini Pak and Bunny Bite, the per acre quantities of seed were calculated to be 6.5, 11.0 and 15.0 pounds.

The plots 12½ feet long, consisted of 6-row beds, with 6 inches between rows and with each variety and each seeding rate replicated 4 times. In order to obtain comparable information relative to root development and uniformity, all plots were harvested on the same day (October 18) - 77 days after seeding.

Some general observations at harvest were:
1) tops were longer by 1 to 3 inches at the high density
2) seeding rates had no significant effect on root length.

In consultation with Industry, the three size grades selected were:
1) Baby Size: between \(\frac{1}{4}\)" and 7/8" maximum thickness (cross-section)
2) Small Size: under \(\frac{1}{4}\)"
3) Large Size: over 7/8"

It's a happy coincidence that these sizes approximate very closely the "official" Canada size announced today - 3/4" maximum cross-section, and 3¼" in length. (Industry looked at the large (7/8" plus) size as not being wasteful, but useful for either high quality dices or dices).
In all three varieties, the greatest yield was obtained from the highest density (Plot-to-acre conversions were based on the centre 10 feet and the 4 inside rows to eliminate border effect). Yields are summarized in Table 1.

Table 1: Yields from the 1972 fall crop of Baby Carrots

<table>
<thead>
<tr>
<th>VARIETY</th>
<th>SEED RATE (/ft.²)</th>
<th>Yield (T/Ac)</th>
<th>ROOTS</th>
<th>TOPS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BABY- SIZE</td>
<td>OVER- SIZE</td>
<td>(LENGTH IN INCHES)</td>
</tr>
<tr>
<td>Amsterdam Coreless:</td>
<td>110</td>
<td>13.2</td>
<td>4.4</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>9.8</td>
<td>5.9</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>5.2</td>
<td>5.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Baby Fingers Nantes:</td>
<td>110</td>
<td>9.6</td>
<td>2.2</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>6.2</td>
<td>3.1</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>6.1</td>
<td>2.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Spartan Bonus:</td>
<td>110</td>
<td>5.2</td>
<td>1.7</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>4.9</td>
<td>3.1</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>4.2</td>
<td>5.4</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Generally, yields were in excess of our expectations. (Industry had indicated that an acceptable yield would be from 4 to 6 tons per acre!). Our yields did excite industry and growers because some were more than double those anticipated. Another exciting factor not to be ignored was that baby carrots looked very promising as a fall crop, and, as a succession crop - this first trial having followed set onions.

Looking at specific varieties, Amsterdam Coreless had the edge in yield. While its tops were moderate in length, I don't know how important we should consider that factor. The coarseness of the tops may be of equal importance if the harvester is to "lift and top" in one operation. Perhaps a fine textured, short top would have an advantage if a modified radish harvester was used.

We considered Amsterdam Coreless to have roots that were slightly too long and slightly too pale in color. It was completely free of green shoulders at all rates of seeding, and therefore had no internal discoloration (green core). This variety might be best retained in future trials as a standard for non-greening.
Baby Finger Nantes produced an acceptable yield (relative to that expected), and its tops were shorter and finer textured than the two other varieties. Unfortunately, its roots were very, very rough, with deep lenticels. It was also subject to shoulder greening and green core.

Spartan Bonus had extremely long tops (20" to 22") which were very coarse textured. There was some shoulder-greening at all rates of seeding.

Because succession cropping appeared feasible in 1972, we tried carrots after carrots in 1973. The first-crop was seeded on May 18 and harvested July 18, requiring 61 days (16 days less than the 1972 fall crop.) Table 2 summarizes the results.

Table 2: Results of Baby Carrot Trials, Spring 1973

<table>
<thead>
<tr>
<th>VARIETY</th>
<th>SEED RATE (/ft.²)</th>
<th>YIELD (T/AC)</th>
<th>ROOTS (LENGTH IN INCHES)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BABY-SIZE</td>
<td>OVER-SIZE</td>
</tr>
<tr>
<td>Amsterdam</td>
<td>110</td>
<td>8.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Coreless</td>
<td>80</td>
<td>7.0</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>6.7</td>
<td>3.7</td>
</tr>
<tr>
<td>Mini Pak</td>
<td>110</td>
<td>5.9</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>5.8</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>4.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Bunny Bite</td>
<td>110</td>
<td>1.1</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>1.0</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Amsterdam Coreless gave the highest yield at the high seeding rate. Mini Pak, replacing Baby Finger Nantes, produced an acceptable yield at the high and middle seeding rates. While its roots were a nice length (average 2.8"), its tops were very long, and there was considerable shoulder greening. Bunny Bite gave a surprising and disappointing poor yield. It probably requires a longer growing period, being in the Chantenay class. It was also subject to shoulder greening.

Mr. G.M. Dmytrow compared steaming and hot water treatments for peeling these carrots prior to freezing. Ironically, our taste panel gave Bunny Bite the best score for color, texture and flavor when cooked after either the hot water or steam treatment for peeling. The variety undoubtedly merits further testing, and would likely perform differently if precision-seeded.
The second 1973 crop, seeded July 25, produced a near perfect stand. However, at about 2 weeks, a Pythium type damping-off (Later controlled by Ferbam), destroyed the stand beyond the point where reliable yield data could be obtained. There were sections of plots in every variety and rate of seeding which enabled us to predict a "reliable" harvest date (October 5) - 72 days after seeding.

It would appear, on the basis of the 1972 and 1973 fall-crop seeding dates, that if the crop can be seeded between July 25 and August 1, it should be successful.

Our 1974 spring crop was seeded on May 16 and harvested on July 25, requiring 10 days longer than in 1973. The best yields, as shown in Table 3, were obtained from the middle seeding rate (80 seeds/ft.²).

<table>
<thead>
<tr>
<th>VARIETY</th>
<th>SEED RATE (ft.²)</th>
<th>Yield (T/AC)</th>
<th>BABY-SIZE</th>
<th>OVER-SIZE</th>
<th>ROOTS (LENGTHS IN INCHES)</th>
<th>TOPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amsterdam Coreless</td>
<td>110</td>
<td>6.7</td>
<td>.03</td>
<td>4.1</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>8.9</td>
<td>.20</td>
<td>4.3</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>7.1</td>
<td>.40</td>
<td>4.2</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Mini Pak</td>
<td>110</td>
<td>7.5</td>
<td>.06</td>
<td>3.5</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>7.9</td>
<td>.60</td>
<td>3.4</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>7.3</td>
<td>.03</td>
<td>3.5</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Little Finger</td>
<td>110</td>
<td>2.8</td>
<td>.04</td>
<td>3.7</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>7.0</td>
<td>.50</td>
<td>3.6</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>4.7</td>
<td>.30</td>
<td>4.2</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

The tops of Amsterdam Coreless were "short" (average 13") as in the fall of 1972, but the roots were long (av. 4.1") as in the spring crop of 1973. There was a slight trace of shoulder greening but this did not extend into the core.

Tops of Mini Pak averaged only 18", 7" shorter than in 1973. This may reflect a strain difference, as there is more than one seed source and probably more than one primary seed producer.

Little Finger had much shorter and finer-textured tops than Bunny Bite, and merits further testing. There was noticeable shoulder and internal greening, particularly at the high density.
A fall crop was seeded (carrots following carrots) on August 2. We conquered drought and weed problems, ending up with a crop from which we anticipated reliable maturity dates and yields. However, on September 23, a severe ground frost badly "singed" the tops, particularly in the lower plant densities. On October 2, another strong frost froze the tops to the crown. At the time, the roots were approximately pencil thick or slightly greater. Nonetheless, the crop was a 'write-off'.

In summary, I'd suggest that our data show that production of Baby Carrots at the Leamington Marsh is feasible. The crop will help in diversification, since this is primarily an onion production area. There is evidence that Baby Carrots can be used in succession cropping. Using fast-growing varieties, the various combinations of carrots after set onions, carrots before or after spinach and before or after small beets, or carrots after carrots, all merit testing.

As mentioned earlier, this is a modest start that has set the stage for further investigations. Future research should possibly emphasize precision seeding, population densities, variety evaluations and succession cropping. Emphasis should also be retained on varieties that don't shoulder-green or on management that will prevent greening.

It will not be my privilege to continue with this research. However, I am very pleased to advise that Dr. Albert Liptay will assume responsibility for Baby Carrot research. Dr. Liptay has a program for Baby Carrot research lined up for 1975. I know that his work will contribute substantially to any proposed systems approach project with this new crop.
HISTORICS OF EVALUATION AT ST. JEAN, QUE.

Consumers' interest for mini-carrots has been increasing rapidly in the last few years in Canada. Everyone knows that the product is now available in fresh packed cello bags, in cans and in frozen packs. With the growing demand for this new delicacy came the need for research.

In 1971 a Marketing Service Government official of the Q.D.A. was discussing ways of diversifying the produce line of radish-carrot and lettuce with a young and progressive vegetable grower in the Sherrington area. Baby carrot was then mentioned as a vegetable already served on various airline flights and the idea kept moving along until it materialized in 1972. The new crop triggered various comments and reactions among growers, retailers, agricultural representatives, but most important of all did have the favor of the consumer.

At the same time, the Research Station decided to help by evaluating a few varieties in the greenhouse, and later bringing a more elaborate project in the field.

I - Greenhouse Screening (Winter 1972-73)

Four varieties, Amstel, Baby Finger, Bunny Bite and Early Scarlet Horn were studied in a randomized block experiment of 4 reps, using 8" x 10" plastic pails, each containing 15 lbs of virgin organic soil.

Three rates of seeding were used: 60-90-120 plants per sq. ft. Carrots were sown in 3 rows spaced 2" on March 13 and harvested June 5 (84 days).

Results were as follows:
- % Marketable roots were almost constant at R-60, R-90 but dropped rapidly at R-120;
- % Marketable yield was constant (56%) at R-60 and R-90 with Amstel and B.B. Finger but much lower (45%) at R-120.
- Early Scarlet Horn and Bunny Bite were rejected on grounds of undesirable characteristics (short "big crown" globe shape and low yield).

II - Preliminary Field Test 1973 (C.H.C. p. 39)

a) Variety Evaluation

The experiment was designed to assess a few American and European varieties for the purpose fresh cello-pack sales. Parameters of evaluation were: yield - conformity - size - color - general appearance.
- Size: diam. 1/2 - 3/4" (10-20 mm). Length max.: 3.5" (90 mm).
- 10 varieties were sown with the Planet Jr. at No 7 in 4 rows x 10 meters long spaced 8" (22 cm).
- Carrots were seeded: June 15 - harvested: August 21 (67 days).

Comments:
- Considerable damage was done by heavy rains at seeding time, erosion through the blocks and lack of herbicide coverage in preemergence.
- Due to above circumstances, yield was 50% lower than expected (average: 4.98 t/A No 1). Amstel, Minicor and Amsterdam Forcing gave the highest marketable yields.
- Most of roots classified as No 1 were in fact slightly longer than 90 mm.
- Despite many drawbacks, test showed that good profitable yield could be obtained with 70 days.

b) Experiment With the Æyjord cone Seeder

Using the Baby Finger variety, a field trial was set up during summer of '73 to evaluate yield and general appearance of mini carrots under 4 various seed densities: 20-30-40-50 seeds/L/ft. with a new experimental forage seeder equipped with an Æyjord cone.
- Date seeded: July 7 - Harvested: Sept. 11 (61 days)
- Plot: a continuous strip of 6 rows spaced 8", 20 feet long for each rate and repeated twice.

Comments:
- Seed rates of 20-30 and 40 seeds/lin. ft. gave an average yield of 12.6 t/A and 69.5% marketable. Seed rate 50 yielded 14.2 t/A at 72.4% marketable. At the higher density (4), the quality (length-diameter-and general appearance) was much superior.
- At this point it was generally accepted that the quality would be much improved by closer spacing or by some technique similar to bed seeding provided each plant could be given an equal area to develop and compete for light, water and nutrients.

A trip to Zellwood and Belle Glade (Fla.) in Nov. '73 showed us that American growers utilize to some extent the bed system for baby carrots. The fine texture of the soil allows an undercutter to be used to loosen the carrots prior to lifting. Tops are mowed with a rotary mower, and carrots then harvested with a radish harvester. Yields range from 3 to 4 t/A but the size seems larger than what we consider desirable.
Preliminary Trial on Baby Carrots
Ste-Clotilde, 1973

(Table 1)

<table>
<thead>
<tr>
<th>Variety</th>
<th>Source</th>
<th>Yield (t/ha)</th>
<th>Size</th>
<th>Damage to Test Weeds + Rain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Mkt</td>
<td>% Mkt</td>
</tr>
<tr>
<td>1- Amstel</td>
<td>Cl.</td>
<td>15.58</td>
<td>7.84</td>
<td>50.3</td>
</tr>
<tr>
<td>2- Amtou</td>
<td>Dan.</td>
<td>9.28</td>
<td>4.62</td>
<td>49.8</td>
</tr>
<tr>
<td>3- Feenina</td>
<td>Dan.</td>
<td>11.60</td>
<td>5.05</td>
<td>43.5</td>
</tr>
<tr>
<td>4- Minicor</td>
<td>Hol.</td>
<td>16.60</td>
<td>7.82</td>
<td>47.1</td>
</tr>
<tr>
<td>5- Ch. 6028</td>
<td>Hol.</td>
<td>15.71</td>
<td>0.60</td>
<td>3.8</td>
</tr>
<tr>
<td>6- A. ABK</td>
<td>Hol.</td>
<td>15.15</td>
<td>7.27</td>
<td>45.0</td>
</tr>
<tr>
<td>7- Finger</td>
<td>Hol.</td>
<td>12.80</td>
<td>6.37</td>
<td>49.7</td>
</tr>
<tr>
<td>8- L. Finger</td>
<td>U.K.</td>
<td>14.00</td>
<td>5.96</td>
<td>42.6</td>
</tr>
<tr>
<td>9- Baby Finger</td>
<td>Sto.</td>
<td>7.32</td>
<td>2.50</td>
<td>34.2</td>
</tr>
<tr>
<td>10- Bunny Bite</td>
<td>F.M.</td>
<td>1.81</td>
<td>25.4</td>
<td>1.81</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>12.6</td>
<td>4.98</td>
<td>39.1</td>
</tr>
</tbody>
</table>

Seeded: June 15 - Harvested: Aug. 21 (67 days)

Note: Rep I discarded @ 100% - Damage to others shown above.

Damage due to lack of herbicide coverage at seeding time and heavy rains in June.
III - Field Project 1974

a) Variety Evaluation (Cone Seeder)
    Using a modified version of the Øyjord cone, a special seeder was made at E.R.S. to seed 3 rows at 2" spacing; each 3 row strip was spaced 18" (45 cm).
    - The study included 7 varieties in a randomized block design x 4 Reps at 3 successive seedings: June 5, 18 and July 15.
    - Seed rate averaged 2.9 lb/A and allowed for 20 seeds/L.ft. or 120 seeds/ft.² counted and weighed for each cone.
    - Root count (population) was not done either at emergence or harvest. Height of foliage measured day before harvest.
    - Damage to Crop: A total of 10 inches of rain in July plus a hail storm on the 29th was responsible for high soil erosion, stem breakage, water choking and considerable yield reduction and poor quality.

Classification:

<table>
<thead>
<tr>
<th></th>
<th>Marketable No. 1: 10-20 mm</th>
<th>Undersize</th>
<th>Jumbos: 20 mm</th>
<th>Length (max)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10-20 mm</td>
<td>&lt; 10 mm</td>
<td>20 mm</td>
<td>90 mm</td>
</tr>
</tbody>
</table>

Results and Discussion

a) 1st harvest (77 days). No significant difference in marketable yields. The average yield by size was as follows:

| Total   | 10.14 t/A         | Jumbos: 2.65 t/A (23%) |
| Mkt No. 1 | 5.63 t/A (56%) | Culls: 2.16 t/A (21%) |

Jumbos class varied from 13% for L. Finger to 31% for Minicor. Most varieties offered a good appearance and normal size except Mini Pak (crown 20 mm and globe shaped).

b) 2nd harvest (71 days). Again no significant difference between varieties (except A.M.C.A.) owing to high variations between blocks. Average group yield by size was:

| Total   | 7.10 t/A         | Jumbos: 3.25 t/A (46%) |
| Mkt     | 2.95 t/A (42%)  | Culls: 0.90 t/A (12%) |

We note a 30% yield reduction due probably to very adverse climatic conditions. The marketable yield has dropped from 56 to 42% while jumbos have doubled.

Minicor has the highest total and marketable yield. Amsterdam A.B.K. proves to be too long and Mini Pak is again above acceptable size in crown diameter.
## PRODUCTION OF BABY CARROTS IN ORGANIC SOIL

Ste-Clotilde, 1974+

preliminary Test with Cone Seeder
(3 rows x 2 inches)

<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield (t/A)</th>
<th>Classification per size in %</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.1</td>
<td>No.2</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1- Amstel</td>
<td>12.32</td>
<td>5.83</td>
<td>3.86 a</td>
</tr>
<tr>
<td>2- A. Minicor</td>
<td>11.19</td>
<td>5.71</td>
<td>3.47 a</td>
</tr>
<tr>
<td>3- A.M.C.A.</td>
<td>10.78</td>
<td>6.16</td>
<td>2.16 a</td>
</tr>
<tr>
<td>4- A. A.B.K.</td>
<td>10.47</td>
<td>5.56</td>
<td>2.81 a</td>
</tr>
<tr>
<td>5- Mini Pak</td>
<td>9.65</td>
<td>5.79</td>
<td>1.68 a</td>
</tr>
<tr>
<td>6- Baby finger</td>
<td>8.66</td>
<td>5.14</td>
<td>1.42 a</td>
</tr>
<tr>
<td>7- Little Finger</td>
<td>7.91</td>
<td>5.20</td>
<td>1.05 a</td>
</tr>
<tr>
<td>Average</td>
<td>10.14</td>
<td>5.63</td>
<td>2.35 a</td>
</tr>
</tbody>
</table>

N.S.

Seeded: June 4
Harvested: Aug. 21 (77 days)
Source: cf Table 3
Cone Seeder: Cooperation of E.R.S., Ottawa, Ont.
b) **Density Planting (Planet Jr. Plate No. 9)**

Same varieties sown with the Planet Jr. at 6.5 lb/A. Seeder is equipped in front with a grooved wheel, spreading the seed in 5 rows spaced 1" - followed by a 6" wide press wheel. Each strip is spaced 18 inches.

**Results and Comments:**

Compared to the cone seeder, this method increased total and marketable yield by 10% while reducing the jumbo class by almost 50%. Average yields by size is:

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Mkt.</th>
<th>Jumbos</th>
<th>Culls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13.20</td>
<td>7.80 t/A (59%)</td>
<td>2.38 t/A (18%)</td>
<td>3.04 t/A (23%)</td>
</tr>
</tbody>
</table>

- **Minicor** has highest total and marketable yield.

- **Mini Pak** is not acceptable due to oversize crown.

**Plans to Improve Yield and Quality in 1975**

1) **Cone Seeder:** increase rate of seeding to 3.5 lb/A and reduce space between rows to 1.5 inches (4 cm) and between strips to 12 inches (30 cm).

2) **Planet Jr.:** repeat experiment with Plate hole No. 7 (6.9 lb/A), No. 8 (8.4 lb/A) in strips spaced 12 inches (30 cm).

3) **Bed Seeding:** assess value of 1 meter wide bed sown with Planet Jr.

5 rows x 25 mm, i.e., 40 rows at 1" spacing.
PRODUCTION OF BABY CARROTS IN ORGANIC SOIL
Ste-Clotilde, Que., 1974
Preliminary test with Cone Seeder

<table>
<thead>
<tr>
<th>variety</th>
<th>Source</th>
<th>Yield (t/A)</th>
<th>Classification</th>
<th>Size of Roots</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(3 rows x 2 inches)</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Mkt.</td>
<td>No.1</td>
</tr>
<tr>
<td>1- A. Minicor</td>
<td>R.S.</td>
<td>9.05</td>
<td>3.72a</td>
<td>4.36a</td>
</tr>
<tr>
<td>2- Amstel</td>
<td>Cl.</td>
<td>8.34</td>
<td>2.83ab</td>
<td>4.48a</td>
</tr>
<tr>
<td>3- A. A.B.K.</td>
<td>J.J.</td>
<td>8.15</td>
<td>3.39ab</td>
<td>3.88ab</td>
</tr>
<tr>
<td>4- Mini Pak</td>
<td>H.S.</td>
<td>6.70</td>
<td>2.63ab</td>
<td>2.95abc</td>
</tr>
<tr>
<td>5- A.M.C.A.</td>
<td>Cl.</td>
<td>6.21</td>
<td>1.65b</td>
<td>4.10a</td>
</tr>
<tr>
<td>6- L. Finger</td>
<td>S.G.</td>
<td>5.95</td>
<td>3.39ab</td>
<td>1.61bc</td>
</tr>
<tr>
<td>7- Baby Finger</td>
<td>Sto.</td>
<td>5.30</td>
<td>3.03ab</td>
<td>1.39c</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>7.10</td>
<td>2.95</td>
<td>3.25</td>
</tr>
</tbody>
</table>

Source: R.S. Royal Sluis
Cl. Clause (Fr.)
J.J. Jacob Jong
H.S. Harris Seed
Sl. Sluis & Groot
Sto. Stokes

Seeded: June 18
Harvested: Aug. 28 (71 days)
## PRODUCTION OF BABY CARROTS IN ORGANIC SOIL

**Ste-Clotilde, Que., 1974**

**Modified Planet Jr. (Plate No.9)**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield (t/a)</th>
<th>Classification</th>
<th>Root Dimension</th>
<th>Hgh. Leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.1 No.2 No.1</td>
<td>No.1 No.2</td>
<td>L. Diam.</td>
<td>(in)</td>
</tr>
<tr>
<td></td>
<td>Total Mkt. Jumbos Culls</td>
<td>Mkt. Jumbos Culls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1- A. Minicor</td>
<td>15.37 11.55 1.04 2.78</td>
<td>75 7 18</td>
<td>3.90 0.71</td>
<td>13.5</td>
</tr>
<tr>
<td>2- A.M.C.A.</td>
<td>15.14 8.97 2.21 3.96</td>
<td>59 15 26</td>
<td>3.66 0.68</td>
<td>14.5</td>
</tr>
<tr>
<td>3- Amstel</td>
<td>15.05 7.73 4.66 2.66</td>
<td>51 31 18</td>
<td>3.85 0.65</td>
<td>13.7</td>
</tr>
<tr>
<td>4- A. A.B.K.</td>
<td>13.60 5.99 4.08 3.53</td>
<td>44 30 26</td>
<td>3.82 0.66</td>
<td>13.0</td>
</tr>
<tr>
<td>5- Baby Finger</td>
<td>12.12 8.04 1.54 2.54</td>
<td>66 13 21</td>
<td>3.60 0.65</td>
<td>13.0</td>
</tr>
<tr>
<td>6- L. Finger</td>
<td>10.70 6.21 0.11 4.38</td>
<td>58 1 41</td>
<td>3.50 0.71</td>
<td>9.0</td>
</tr>
<tr>
<td>7- Mini Pak</td>
<td>10.61 6.13 3.04 1.44</td>
<td>58 29 13</td>
<td>3.42 0.84</td>
<td>18.5</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>13.22 7.80 2.38 3.04</td>
<td>59 18 23</td>
<td>3.68 0.70</td>
<td>13.6</td>
</tr>
</tbody>
</table>

Harvest of 1 Rep only ( 2 rows x 10 m long )

Seeded: June 4
Harvested: Aug. 21 (77 days)
Baby Carrot Production - Equipment

Over the past two years, Engineering Research Service, Agriculture Canada has been investigating methods of seeding and harvesting baby carrots. The specific product is a carrot with a maximum diameter of 3/4 in. (19.05 mm) and a maximum length of 3.5 in. (88.9 mm). The roots are grown from specific strains which produce a small root of good quality when mature. The types with a blunt end and a minimum amount of tapes are regarded as ideal. Tops range from 10 to 14 in. (254 to 355.6 mm), when mature.

The course of this study has led to investigations of production systems in Prince Edward Island, Quebec, Ontario and Manitoba and in Florida in the United States. A summary of systems seen and of investigations into improving or adapting these systems is given here.

Seeding

After initial investigations, it was found that North American systems involve row planting. This is usually due to the type of harvester used. This has lead to interest in increased yields through experimentation with row widths.

The most common seeder used for baby carrots is a Planet Jr. with a wide scatter shoe. This produces a seed row up to 2 in. (50.8 mm) wide. A 3 row shoe is available but poses covering problems in some soils.

In 1973, a two row experimental seeder was tested at Ste. Clothilde, Quebec. The seeder was capable of placing two bands of seed 2 in. (50.8 mm) apart. Results (5) were encouraging and a 3 row model was tested in 1974. The seeder was primarily for research purposes and allowed varying rates to be placed in rows 1 in. or 2 in. (25.4 mm or 50.8 mm) apart, within a band of which can be harvested by a row type harvester. A second seeder was developed to place 5 rows into a band 5 in. (127 mm) wide. Results from the use of this seeder are given elsewhere at this symposium (R. Bernier).

Precision drop seeders such as the Shankey models were not used in the investigations because of the high seeding rates required in a narrow band, nor was this type of seeder seen in use in any of the operations monitored. Coated seeds and accompanying seeders were not used or investigated for the same reason.

Bed seeding was investigated even though there were no harvesting systems available for bed harvesting. The experimental 5 in. band seeder is adaptable to a bed up to 60 in. (152.4 cm) wide. Germination proved to be satisfactory in muck soils. An investigation was made into using a commercial mulch covering which is sprayed over seeds scattered on the soil surface. On a coarse sand soil, the mulch covering showed some improvement in stand and investigation plots. Further investigation would be warranted if germination was a problem where carrots are grown in beds or mini beds on mineral soils.
Bed Forming

In course of the investigations, several bed forming seeders were seen ranging from a very sophisticated model with integral rotary cultivation and seeding components as seen in Florida to a simple sled type of former seen in Ontario. Little is known at the present time of the cultural advantages of these types of machines but they are worth investigating in some instances where their operation would improve the operation of harvester by providing an easier digging profile and an even surface for topping.

Harvesting

Several harvesting methods for baby carrots were seen in course of this investigation. A full description of each machine is not given here as the information is available elsewhere (4, 5, 6).

1. Tawco Radish Combine

The Tawco radish combine was seen in operation in Quebec and in Florida. The harvester worked well in Florida where baby carrots were grown on a fine muck soil. Tops were shortened with a forage harvester and the carrots were under cut with a full width undercutting blade prior to harvesting. Results were not good in Quebec where the carrots were grown on a muck soil containing wood pieces. These wood pieces were brought to the surface by any kind of undercutter or digging shoe to interfere with the lifting belts. Without undercutting field losses were high.

This system could be recommended for soil types which will allow undercutting. Topping quality was excellent and rows can be grown as close as 3 in. (228.6 mm) apart. Probable yields could reach 9 tons per acre with this system under ideal conditions.

2. FMC Carrot and Red Beet Combine

The FMC carrot and red beet combine was seen in operation with baby carrots in Quebec and in Florida. The combine must only be modified by installing elevator chains with smaller links. The system works well with the only disadvantage being that the harvester requires rows spaced 14 in. (355.6 mm) minimum apart. This reduces yield potential to 4 to 5 tons per acre. Topping is satisfactory. It is for this machine that research into seeding methods to increase yields is being done.

3. Campbell and Burns Development (2)

A most interesting harvester is under development in Prince Edward Island. The harvester is essentially a potato digger with five pitch chains. Rotary cutting blades are positioned at the front to cut the carrot crowns. This type of harvester shows a lot of promise where carrots will be used for processing. Yields were acceptable when using this machine but carrots were of the English type with diameters up to 1.25 in. (31.75 mm).

4. Excelsior Harvester - Holland (not seen)

Baby carrots are harvested in Holland and other parts of Europe using several models of Excelsior Harvesters. None of these harvesters have been located in North America. It can be assumed that these harvesters would be suitable for fine soils that separate on a vibrating screen.
5. **English Harvesters (none seen)**

In England, a larger type of "baby" carrot is grown. The maximum diameter is 1.25 in. (31.75 mm). To harvest these, a potato digger type of harvester is used with a slasher mounted ahead of the blade to remove the tops. The harvesters are usually made with a blade width of only 20 to 24 in. (508 to 609.5 mm).

6. **Radish Harvesters**

Several makes of radish harvesters were investigated and usually the manufacturers were confident that their machines would work in baby carrots. These machines really only differ from the Tawco in the topping mechanism and in fact, Tawco will supply the same type of topper. The toppers consist of discs or chain plates to force the radishes out of the pulling belts at an uniform distance and the tops are cut with a rotating knife blade under the positioners. This type was apparently tried in Florida without success.

7. **E.R.S. Belt Lifting Harvesters**

A belt type harvester is presently under development to harvest green onions, beets and carrots for fresh market sales with "tops on." An existing model using the same principle is in existence that is capable of harvesting rows spaced as close as 6 in. (152.4 mm). However, a topping mechanism does not exist for this machine and is not being exploited as simpler means using the pre-described harvesters look promising.

**Conclusion**

Baby carrots can be harvested with an FMC carrot combine in most soil conditions but yields may be low. Work is being done to improve yields. Tawco harvesters with roller bar toppers will work in fine soils with some increase in yield potential. Care must be taken with the Tawco machines as they easily become overloaded with a heavy yield of baby carrots. Bed type harvesters are no doubt the answer for harvesting baby carrots but little information is available as yet. Careful soil preparation will be a must as topping must be exact.

Propagation of baby carrots looks promising. Researchers are confident that yields can be increased and work is now being done to increase yields in field formats to suit existing equipment. More equipment will be available for testing in the coming year. It would be worthwhile for growers and processors to carefully explore the possibilities of baby carrot production now.
REFERENCES


2. Campbell & Burns Ltd. - Central Bedeque
   Prince Edward Island

   Report 7302-5, Engineering Research Service, Agriculture Canada, Ottawa K1A OC6


   Report 7302-7, Engineering Research Service, Agriculture Canada, Ottawa K1A OC6
TASTE PANEL EVALUATION OF RESEARCH SAMPLES, COMMERCIAL SAMPLES & BABY CARROT ENTREES
Joe Muchmer

(5-exceptionally good; 3-still acceptable; 1-undesirable)

<table>
<thead>
<tr>
<th>RATING</th>
<th>SOURCE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8</td>
<td>Le Sieur</td>
<td>Very tiny whole, sweet, true-baby pack</td>
</tr>
<tr>
<td>3.8</td>
<td>Robertson's Chantenay Red</td>
<td>&quot;Left-over-pack&quot;, but very acceptable for quality</td>
</tr>
<tr>
<td>3.8</td>
<td>Smedley's, small whole</td>
<td>Salty! Pale appearance, fairly good in all respects</td>
</tr>
<tr>
<td>3.4</td>
<td>Little Finger</td>
<td>Coarse texture, poor flavor, appearance O.K.</td>
</tr>
<tr>
<td>3.2</td>
<td>A' dam Minicor (Baby)</td>
<td>Fair</td>
</tr>
<tr>
<td>3.0</td>
<td>A' dam Foram</td>
<td>Fair, poor flavor</td>
</tr>
<tr>
<td>2.9</td>
<td>Minipak</td>
<td>Bitter, otherwise poor flavor also</td>
</tr>
<tr>
<td>2.5</td>
<td>Coreless A'dam</td>
<td>Bland, greenish appearance, poor internal</td>
</tr>
<tr>
<td>2.0</td>
<td>Nugget</td>
<td>Green Core, bitter, poor internal color</td>
</tr>
<tr>
<td>1.5</td>
<td>A' dam Minicor (Finger)</td>
<td>V. poor appearance, poor size, terrible taste</td>
</tr>
<tr>
<td>1.5</td>
<td>Round Planet</td>
<td>Green Core, slightly bitter</td>
</tr>
<tr>
<td>2.0</td>
<td>Chantenay Royal</td>
<td>Squash flavor, poor appearance</td>
</tr>
</tbody>
</table>

General Comments:

The lye-peeled samples were extremely poor due to knobbiness, pimples and lack of uniformity.

The steam-abrasive peel method appears most suited if "silverskin" could be avoided.

For future evaluations the major criteria should be: size, uniformity, eye appeal, color, small core, wholeness, flavor, sweetness.

Exact grading to specifications of particular pack is necessary. No single pack will suit all requirements!