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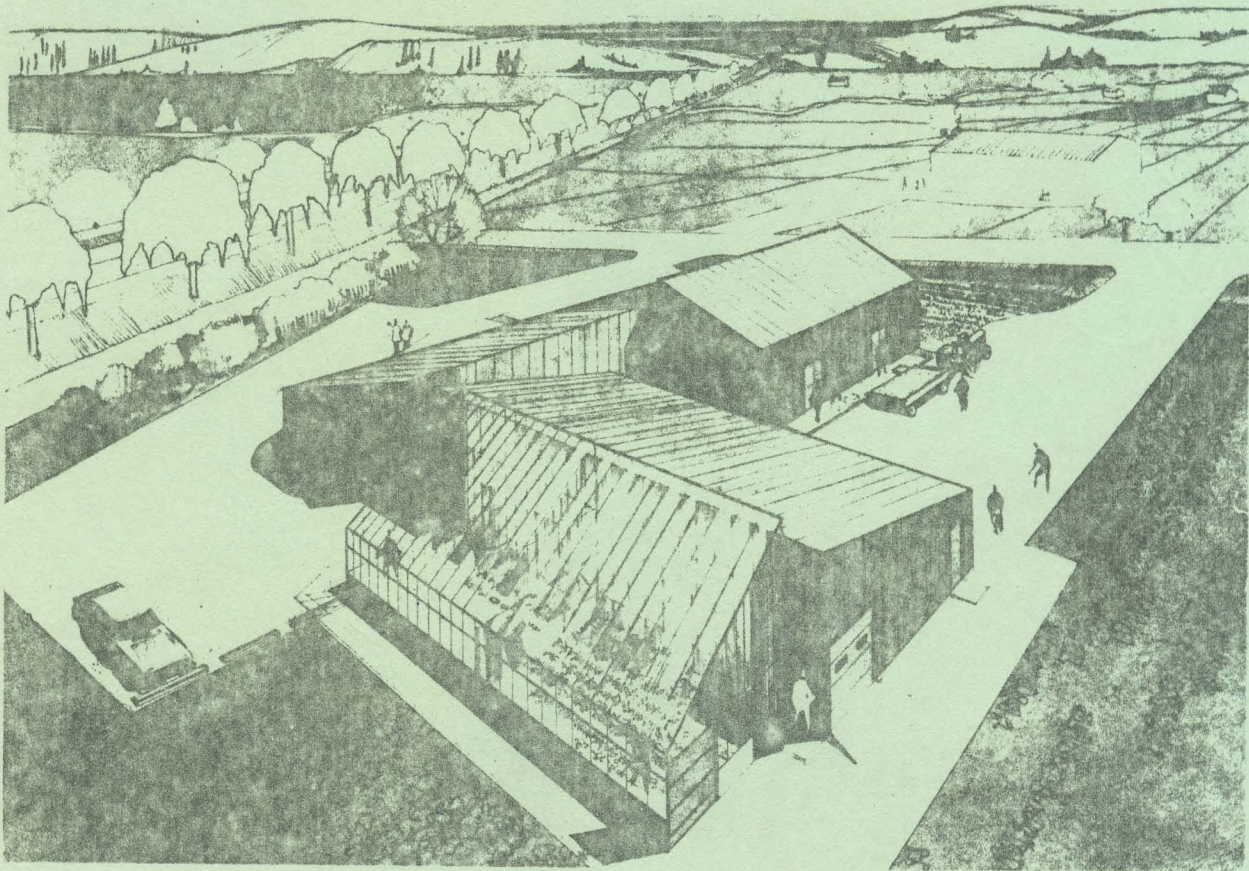
DECEMBER 1972

PROGRESS REPORT

MUCK RESEARCH STATION
R.R.-4 BRADFORD, ONTARIO
CANADA.

MUCK RESEARCH STATION
Horticultural Research Institute - Ontario
R.R. 4, KETTLEBY, ONT. LOG 1J0

VEGETABLE RESEARCH 1972



MUCK RESEARCH BUILDING, BRADFORD

PROGRESS REPORT

Muck Research Station,
R. R. 4, Bradford, Ont

1972

This report is a compilation of abstracts on research work conducted at the Muck Research Station R.R. 4, Bradford, Ontario, 1972. It is a progress report only and results are not necessarily final. If further information is required, please contact the author(s).

Results of certain projects that involve a storage period, have not been included. Many of the research projects are in co-operation with resource personnel from the University of Guelph, Guelph, Ont., Canada Department of Agriculture, Vineland Station, Horticultural Research Institute of Ontario, Vineland Station and with Extension Horticulturists of the Soils and Crop Branch.

ONTARIO MUCK CROPS COMMITTEE

Objective - To provide relevant information through research leading to recommendations on production and marketing of muck crops in Ontario. The committee should also act as a research advisory committee for the Bradford Muck Research Station.

<u>Crop Value -</u>	<u>Farm Value</u>	<u>Acres/1971</u>
Carrot	\$ 4,120,000	3760
Onion	3,128,000	4353
Lettuce	1,311,000	1492
Celery	499,000	451
Parsnip	253,000	326
	<u>\$ 9,311,000</u>	<u>10,382</u>

Committee Membership -

M. Valk (Chairman) OMAF, Newmarket	G.E. Franst, Statistics Branch
I.L. Nonnecke, Hort.Sci., O.A.C. Guelph	H.G. Henderson, Bradford, (Industry)
L.V. Edgington, Environ. Biol. O.A.C. Guelph	M. Orawski, Leamington, (grower)
A.B. Stevenson, C.D.A. Vineland	P.J. Smith, Newmarket, (grower)
C.C. Filman, OMAF, Bradford	C.H. Srokosz, Grand Bend (grower)
E.J. Chudleigh, Ont. Food Council	G. Groetelaars, Port Colborne (grower)

Problems that face the industry listed by priority for research programs - in addition to research already in progress, 1972.

Priority 1 - Control of rusty root and horizontal crack diseases of carrots.

Recommendation

- 1 - Conduct a diagnostic survey in Bradford Marshes to find the casual agent(s) of rusty root and horizontal cracking.
- 2 -- Investigate the effect of herbicides, insecticides and fungicides on growth and disease incidence.
- 3 - Study effect of soil fertility and ph, plant density, and stress in growth on these root diseases.
- 4 - Screen cultivars and inbred lines for resistance to root diseases.

Priority 2 - Moisture losses due to inadequate humidity control and diseases in storage contribute to the deterioration of carrot quality in the Bradford area.

Recommendation - A Storage Project Team of Engineering, Plant Pathology, Storage Researchers and Specialists should combine their efforts to solve these storage problems. Sprayer evaluation, disease and insect monitoring micro-climate studies in relation to micro-climate observations and disease forecasting, should be carried out to reduce the number and amount of fungicide and insecticide applications.

Storage Project Team -

K.A. Clarke	A.E. Maitland
M. Valk	K.L. Priest
R.B. Smith	

The effect of salt concentration on greenhouse tomato production in muck soil. Filman, C.C. and R.A. Cline. Vegetative growth at the expense of adequate fruit set is a major production problem in the Bradford muck soil areas. High total salt levels are used in an attempt to avoid this disorder. This project was initiated to determine (1) if the use of a high salt level is warranted and (2) the total salt level (mho's x 10^{-5}) best suited for tomato production in muck soil.

Plastic cylinders 10" in diameter, 16" deep and open at the bottom were placed in the greenhouse ground bed. Muck soil mixed with the following rates of 0-20-20 commercial fertilizer was placed in the plastic containers: 11.5, 23, 46, 92, and 184 pounds per 1000 sq. ft. A normal weekly feeding schedule was followed after the fruit had set on the first cluster. One check plot consisted of a plastic container of muck soil with no commercial fertilizer added. The other check plot was greenhouse soil without a plastic container. Treatments were randomized and replicated 7 times. Vendor and Michigan Ohio were transplanted into the containers on January 28, 1972.

Results obtained from one year's data were as follows:

- (1) Vegetative growth at the expense of fruit set was not a problem. The initial total salt readings of 133 (mho's x 10^{-5}) in the plastic sleeve and 90 (mho's x 10^{-5}) in the open greenhouse soil were high by standards set for mineral soils, but they did not appear to adversely affect vegetative growth.
- (2) Higher salt levels tended to reduce yields and this difference was significant at the highest salt level - above approximately 200 (mho's x 10^{-5}).
- (3) Increased total salt level did not produce any increase in early or total fruit number or fruit weight.
- (4) Michigan Ohio produced significantly more fruit and a higher yield (weight) than did Vendor.
- (5) Fruit number and weight of fruit was reduced by confining the root system in the plastic sleeve.
- (6) Plant weight (healthy plants only) taken at end of harvest period was reduced by confining the root system and by high total salts level. Muck Research Station, R.R.#4, Bradford, Ontario.

BIOLOGY and ecology of the onion maggot,
McEwen, F.L, Ritcey, Gwen, Harris, C.R. and Svec, H.
This project was initiated to investigate the feasibility of using a sterile male approach to control the onion maggot. During 1972 the following information was obtained.

1) The overwintering population of puparia in the soil ranged from less than 1 to 10 per square yard, with the average approximately 2.

2) Not all the puparia that overwintered hatched in 1972, indicating that some of these may survive 2 years in the soil as puparia.

3) There are 3 distinct generations of flies in the Holland Marsh area and the population of flies increased from the first to the third generation.

4) Intensive application of insecticides still permitted the large number of adult flies to survive.

5) The onion maggot does not travel a great distance--less than 100 feet in preliminary release experiments.

6) The onion maggot can be sterilized by irradiation with the cobalt source and appears to live a normal length of time after such treatment.

7) Sterilized flies will mate, but do not lay fertile eggs.

8) Preliminary tests indicate that sterilized males are as competitive as nonsterilized in mating with females.

9) Using laboratory techniques now developed, large numbers of onion maggot flies can be produced for release purposes.

(Department of Environmental Biology, University of Guelph; Agriculture Canada, London).

CONTROL of onion smut and onion maggot.

Edgington, L. V., McEwen, F.L., Goble, H.W. and Scorrar, P.D. This project was a continuation of work in progress for a number of years to determine the best chemical treatments for onion smut and for the onion maggot. Included in the test were the standard recommendation thiram, the fungicide Pro-Gro and some new compounds identified only by number. Insecticides tested included chlorfenvinphos, fensulfothion, fonofos, ethion and carbofuran. The test was conducted at the Bradford Research Station. Planting was done with a Stanhay seeder and 4 replicates of single row plots were involved for each comparison. The results indicated that Pro-Gro was superior to thiram for control of onion smut. It was also found that the experimental compound TF3170 was superior to TF3172 for onion smut control. Uniroyal 2006 and Uniroyal 2008 also gave good control. A high incidence of onion smut was present in the experimental plots. Approximately 80% of the plants were infected where fungicides were not used and this percentage was reduced to approximately 50% by the best fungicide treatments. It should be noted that the method of evaluating onion smut in these plots was a critical one and plants with any infection were rated positive. Many of the plants receiving positive ratings would however, produce satisfactory onions. The onion maggot incidence in untreated plots in this experiment was approximately 24%. The best control of the onion maggot was obtained with fonofos followed by AC92100, fensulfothion, and chlorfenvinphos. Plots receiving the standard treatment with ethion (35 lb/acre of 5% granular) had 13% maggot infestation and plots receiving treatment with carbofuran had 20% infestation.

The attempt to seed these plots using a precision seeder was not sufficiently satisfactory that comparisons can be made between treatments with respect to stand counts or yields. In the short plots involved in these tests seeding rates were uneven and emergence was erratic due to seeding differences and due to trampling of the plots during seeding. Comparisons made on the basis of percentage infestation (in the case of maggot attack) or per cent infection (onion smut) are considered valid. (Department of Environmental Biology, University of Guelph in co-operation with the Ontario Ministry of Agriculture and Food, Research Station, Bradford)

The response of onions grown in an organic soil to linuron residue.
 Filman, C.C. A toxic level of linuron to onions grown in an organic soil, has been suspected for several years.

To demonstrate the possible carry-over of linuron in the soil, 2, 4, 6 and 8 pounds of product were applied per acre to a block of carrots in 1970 and 1971. In 1971 and 1972, Autumn Spice onions were planted in these treatment blocks. The treatments were randomized and replicated four times.

Results obtained in 1971 are presented in the following:

Linuron (Product) (lb.)	Ave.Wt.(gms) of plants in 4' of row. June 30/71	% Tops down Aug 17/71	Ave.No. of bulbs in 20' of row	Ave.Wt. per plot (lb)
2	268	75	193	32
4	237	78	267	34
6	193	79	242	32
8	135	79	251	33
check	407	100	247	29
LSD @ 5%	112			NS

On June 28, there was some curling and twisting of onion plants when two pounds of product was applied in the previous year. Overall injury was slight. When 4 pounds of product was applied to carrots in 1970, injury to onion plants in 1971 was apparent. Onion growing points were brown and the tops were curled. Injury was just as severe when 6 pounds of product was used. Very serious injury occurred to onion plants when 8 pounds of product was applied in the previous year. Tips were badly burned. Plants were stunted and curled.

By mid-July, the onions in all treatment plots had almost completely recovered. Plants were green, erect and had almost caught up to the plants in the check plots. In the check or untreated plots, approximately 65% of the tops were down on July 30 and by August 17, tops were 100% down. Seventy-five to seventy-nine percent of tops were down in the treated plots by Aug. 17, indicating that plants had been checked in growth at an earlier date.

On June 30, the difference between the weight of plants in the check plot and the weight of plants from any one of the treated plots was statistically significant. The application of linuron at all rates to the previous main crop of carrots affected the growth of young onions. The stand of onions was not affected by the linuron treatments. The differences in yield between treatments, and between treatments and check were also not statistically significant.

Results obtained in 1972 indicated that linuron applied at 2, 4, 6 and 8 pounds of product in 1971 had no effect on onions. The reason for this difference is not known.

It is recommended that growers apply linuron to carrots in the previous year according to the recommendations, and provide ideal growing conditions for young onion plants in the following year. Muck Research Station, R.R.#4, Bradford, Ontario.

Onion Drying at the Bradford Marsh (1) E. W. Franklin (2) and E.C. Loughheed (2). Rapid drying (curing) of onions following harvest improves bulb colour and lessens the possibility of neck rots. A project has been initiated to compare different methods of drying onions. Early results indicated that onions with tops either attached or removed may be harvested directly from rows, in the field and satisfactorily dried with artificially heated forced air. Because good drying weather occurred, it was also possible to naturally dry onions in the field by windrowing them for 10 days, then placing them with tops either attached or removed into pallet bins which were provided with a polyethylene rain cap. The bins were stacked in the field for several weeks for further drying before storing. Because good drying weather is always uncertain, following windrow drying, comparable samples were dried artificially.

The good drying weather resulted in little or no neck rots in any sample. The artificially dried bulbs whether tops were attached or removed had the best bronze colour and were free from staining. The poorest appearing bulbs, also most difficult to clean, resulted when onions with tops attached were naturally dried in the field in pallet bins.

- (1) Muck Research Station, R.R.#4, Bradford, Ontario.
- (2) Horticultural Science Department, University of Guelph, Ontario.

Fungi associated with rusty root of carrots in Ontario. Sutton, J.C. Carrots were sampled in one field on each of 8 farms distributed widely in the Bradford and Keswick Marshes on June 16, July 14, and August 14, 1972. Fungus isolations were made from the roots of each sample.

From this study, it was concluded that soil fungi that invade carrot roots are not the primary cause of rusty root. Department of Environmental Biology, University of Guelph, Guelph, Ontario.

WEATHER and carrot disease studies at Bradford Marsh
Gillespie, T. J. (1), Sutton, J.C. (2), and Maitland, A.E. (3)
From late July to early October of 1972 the temperature, relative humidity and duration of leaf wetness were continuously monitored within plots of carrots. Weekly determinations of percent of carrot leaf area affected by blights (*Alternaria* or *cercospora*) were made after August 8. Some of the carrots were sprayed with fungicide on four occasions dictated by present or forecast weather conditions.

The carrot leaf blights behaved according to the following rules:

1. Wet leaves were needed for the disease to progress.
2. The disease multiplied like compound interest, with the interest rate dependant on the temperature during wet periods.
3. Two successive wet periods separated by an interval when leaves dried (so spores could fly to new leaves) but skies were cloudy and the humidity was high (so spores were not killed by dessication) were ten times as effective in advancing the disease as periods between which the sun shone.

According to these rules, for optimum disease control five fungicide sprays should have been applied during the 73 day period of the experiment and this would have allowed less than 2% of the leaf area to become infected by October 6 as compared to about 15% infection on unsprayed carrots. The four correctly timed sprays actually used were only slightly less effective, allowing 2 to 3% blighted leaf area to develop.

It is concluded that:

1. Correct timing of sprays for optimum carrot leaf blight control is possible using weather observations and forecasts.
2. During the 10 week test period most growers used roughly twice the fungicide really required for good disease control.
3. Owing to the "compound interest" nature of disease progress, the later season sprays are most important if healthy tops are to be maintained for mechanical harvesting.

- (1) Department of Land Resource Science, University of Guelph
- (2) Department of Environmental Biology, University of Guelph
- (3) Simcoe Horticultural Research Station

FUNGICIDE/Variety Trials - Carrots. Maitland, A.E., Valk, M., Filman, C. C. The fungicides Bravo, Benlate, Dithane M-45, Kocide, and maneb were compared against the carrot cultivars, Gold Pak, High Pak, Spartan Sweet, Spartan Bonus, Scarlet Nantes and Carousel for foliage blight control. Carrots were seeded on May 17 and were sprayed with a suspension of spores of *Alternaria dauci* on August 9. Four fungicide sprays were applied with a small plot sprayer developing about 45-50 psi and delivering the equivalent of about 50 g.p.a. Sprays were timed for the most effective protection on the basis of weather forecasts and thermohygrograph data.

Blight assessment was done on September 5 and 21 and on October 2 and 7, using the improved Horsfall and Barratt grading system for measuring plant disease. Blight control with Bravo and Benlate were as good as Dithane M-45 and maneb with Bravo being slightly better than the other treatments. Blight incidence in treated plots was very low, ranging from an average of 0.1 to 3.2%. In unsprayed plots, up to 23% blight was recorded.

There was noticeable varietal differences in blight susceptibility, Spartan Sweet being the most severely blighted in unsprayed plots. Spartan Bonus had more vigorous foliage than Spartan Sweet in unsprayed plots up to October 7. Kocide was very phytotoxic, resulting in severely burned foliage. Kocide injury was least on Scarlet Nantes, most severe on Spartan Sweet, and moderate on High Pak and Carousel on August 21. On September 21, degree of injury from Kocide could not be differentiated among varieties.

FUNGICIDES/Urea evaluation for carrot foliage blight control. Maitland, A.E., Valk, M., Filman, C. C. This project was undertaken to assess the effect of foliage sprays of urea, applied alone and in combination with fungicides, on foliage blight of carrots. The cultivar Spartan Sweet was seeded on May 17, using planet junior planters. On August 9, a spore suspension of *Alternaria dauci* was sprayed on the plots. Blight control treatments were applied as follows: July 19 and August 29, fungicides, urea and urea + fungicides combinations; August 14 and Sept. 19, fungicides alone. Fungicide sprays were timed for the most effective protection, on the basis of weather forecasts and on cumulative thermohygrograph data. A small plot sprayer developing about 45-50 p.s.i. and delivering the equivalent of about 50 gallons per acre was used. Treatments were replicated 4 times in a randomized complete block design.

Degree of blight control was based on disease assessment using the improved Horsfall and Barratt grading system for measuring plant diseases. Fifteen leaves randomly taken from the tops of 5 plants from each treatment were assessed for leaf blight on September 5 and 21, and on October 2 and 7. Although *Cercospora* blight from natural infection was present along with *Alternaria*, the two were not quantitatively separated in the assessment. Foliage condition on October 7 was comparable for urea/fungicide and non-urea/fungicide treated plots. The results of this experiment are summarized in Table 1.

Table 1 Percent Foliage Blight Infection for 4 Dates For Spartan Sweet Carrots-Muck Res. Station

Treatments	Percent Blight			
	Sept.15	Sept.21	Oct.2	Oct.7
Check	3.5a	16.6a	14.1a	10.4a
Urea 10 lb.	3.8a	8.2a,b	5.2b	7.2a
Zineb 3.0 lb. + Urea 10 lb.	3.9a	4.2a,b	0.8b	4.9a,b
Maneb 3.0 lb. + Urea 10 lb.	4.5a	1.4b	0.2b	0.7b
Bravo 1.5 lb. + Urea 10 lb.	1.9a	1.0b	0.1b	4.9b
Zineb 3.0 lb.	1.7a	0.4b	0.4b	1.0b
Maneb 3.0 lb.	0.5b	0.7b	0.1b	1.2b
Bravo 1.5 lb.	0.8b	0.1b	0.4b	0.6b

Note: Values that are significantly different for each assessment date are indicated by different letters.

WHOLE pak carrot variety and population study.
 Filman, C.C. and Lowndes, T.F. This project was designed to assess varieties and their optimum plant population for the production of suitable sized carrots for canning whole purposes. Seven varieties were sown at three plant populations: 1.5 sq. inches per plant, 2.0 sq. inches per plant and 2.5 sq. inches per plant. The seed was sown in rows 2" apart. Treatment plots were randomized and replicated 4 times. Results are presented in the following table.

Whole pak carrot variety and population study-1972

Variety	57 plants /sq.ft.		72 plants /sq.ft.		96 plants /sq.ft.		Av. Length (in.)	Av. Width (in.)
	*#1	*#2	*#1	*#2	*#1	*#2		
Baby Fingers	17	32	29	31	18	34	4.75	.75
Bunny Bite	7	32	10	37	5	54	2.75	.9
Mini Pak	26	27	31	36	28	49	4.75	.7
Nantes	27	23	26	32	33.5	42	4.75	.7
Sweetheart	16	33	13	39	19.5	53	3.5	.8
Amsterdam Forcing	21	28	27.5	45	27.0	50	3.75	.8
Spartan Bonus	23	33	17	48	22.5	52	4.52	.73

Baby Fingers, Bunny Bite and Mini Pak were selected by Bick's Pickles as having some of the desired characteristics for whole pak processing. Bunny Bite was particularly suitable as it was short and had excellent external and internal color. The texture was firm. The yield of Bunny Bite was low as it did not have the length of either varieties in the trial. It was also highly susceptible to the rusty root disorder. Baby Fingers and Mini Pak were very smooth and uniform in size and shape. Their color was too pale and they were too long for canning whole.

The optimum plant population would appear to be around 35 plants per square foot with two-inch row spacing.

A variety having the same color and texture as Bunny Bite, but producing a much higher yield is needed to make the production of whole pak carrots on the Holland Marsh a profitable enterprise.

*#1-Tons/A *#2-# plants per sq. ft. obtained.
 Muck Research Station, R. R. #4, Bradford, Ontario.

EFFECT OF PLANT POPULATION ON YIELD AND QUALITY
OF CARROTS. C. C. FILMAN

Modern production techniques have made it possible to grow carrots at greater densities than when hand labour and between row cultivation had to be employed. Research work in other areas has shown that a higher yield of more uniformly shaped carrots can be attained by increasing the plant population per square foot, rather than by increasing stand per foot of row. Studies have been conducted at the Muck Research Station, Bradford to determine whether similar results could be obtained on the organic soils in the Bradford area.

Two seeding rates were chosen to obtain an expected stand of 18 and 36 plants per square foot. Row spacings were 2", 4" 8" and the standard 16" spacing. The Scarlet Nantes variety was used in 1969 and 1970. Hipak Elite was planted in 1971 and 1972.

In 1969 the 4" x 3" spacing produced a yield that was significantly better than the least evenly spaced seed (16" x .8"). The roots were larger and more uniform. In 1970 somewhat similar results were obtained. The 2" x 2.4" spacing gave the highest yield of well formed carrots. The yield differences between 16" x .8" (standard) spacing and the closer row spacings with the same population per square foot were highly significant.

In 1971, results were again somewhat similar except that the difference in yield between the 2" and 4" row spacings at the same population were not significant. At the 8" row spacing and 6 to 11 square inches per plant, the yield was significantly lower than the 2 and 4 inch row spacings at 5 to 7 square inches per plant.

In 1972 the 12-14 square inches per plant spacings produced yields that were significant over all other spacings. A reduction in yield of Hipak Elite occurred at the 4 square inch per plant spacing that was highly significant when compared to the 12 square inch per plant spacings. In this instance a high population of 7 sq. in. per plant depressed yield in the poor growing season of 1972

On the basis of four years' work it would appear that the expected carrot plant population is difficult to obtain and the degree of variation will depend upon the season. The nearer the plants are evenly spaced at about 12 sq. inches per plant such as 4" x 3", the increased yields obtained have been consistently significant over the standard 16" row spacing. Muck Research Station, R. R. #4, Bradford, Ontario.

Breeding for resistance to rusty root and horizontal cracking of carrots. Baker, L.R.¹, C.C. Filman, and T. F. Lowndes A co-operative testing program of carrot and onion breeding lines, with Michigan State University, has been under way for about ten years at the Muck Research Station. Spartan Era, a storage-type cooking onion and Spartan Bonus, an excellent processing carrot were early introductions to Ontario growers through this program.

One hundred and twenty-nine experimental hybrids and inbred lines from Michigan State University were tested at the Muck Research Station in 1972. The hybrids were chosen because of rusty root resistance or susceptibility of that parent line last year in the rusty root plot. The breeding program has two objectives, firstly, does the resistance and susceptibility remain constant from year to year, and, secondly, what is the nature of the resistance (dominant or recessive).

All experimental hybrids and inbred lines were rated as to their susceptibility or resistance to rusty root and horizontal cracking, and were compared to ten varieties commonly grown on muck soils of Ontario.

A high percentage of Spartan lines were found to have resistance to rusty root and/or horizontal cracking. Data obtained to date would indicate that a hybrid carrot with high resistance to rusty root should be available shortly for the carrot growers. Meanwhile present Spartan hybrids seem to carry some level of resistance to rusty root. Gold Pak and Grenadier, under 1972 growing conditions, carried the same level of resistance. Hipak showed slight susceptibility to rusty root.

The horizontal cracking problem is thought to be a physiological problem and should be corrected easily by selection. Symptoms are more severe in the Bradford area than in the State of Michigan. Muck Research Station, R.R. #4, Bradford, 1972.

1 - Department of Horticulture,
Michigan State University
East Lansing Michigan, U.S.A.

LEACHED soil and rusty root of carrot. Filman, C. C. and S. G. Fushtey An organic soil highly infected with rusty root of carrot was placed in a greenhouse bench to a depth of 6 inches. Half of the soil was leached to lower the total salt level from 300 to that of tap water (30 mho's x 10^{-5}). Half of the leached and unleached soil received 5-10-15 fertilizer at the rate of 750 lbs. per acre. Old seed and new seed of the Scarlet Nantes variety was sown in each of the treatment blocks on June 16, 1972. Both seed samples were planted in the same soil in the field on May 20.

There was only slight evidence of rusty root symptoms (root browning, rat-tail, and stubby roots) throughout the greenhouse experiment. Roots tended to be short and had excessive healthy fibrous root growth. High air temperature throughout the growing period created an abnormal environment, for good carrot growth. Rusty root symptoms were extremely high in exactly the same soil outdoors.

Based on results from the indoor and outdoor experiments, it would appear that: 1) Abnormally high temperatures throughout the growing period in the greenhouse prevented the development of severe rusty root symptoms. Carrots from 1972 seed sown earlier in the same soil in the field developed severe rusty root symptoms. 2) Rusty root symptoms were more serious when 1970 Scarlet Nantes seed was used compared with 1972 Scarlet Nantes seed. 3) There was no apparent difference in yield or rusty root symptoms between leached and unleached or between fertilized and unfertilized indoor soil. Muck Research Station, R. R. #4, Bradford, Ontario.

LINURON and rusty root disorder of carrots.

Filman, C. C. Rusty root of carrot has been a production problem for the past 6 to 7 years. There is evidence that growth stresses such as moisture content, plant density and chemicals may have some connection. This project was started to determine whether or not the recently introduced chemical, linuron, could be a cause or one of the causes of rusty root.

Seed of Scarlet Nantes was sown on May 19. Linuron at the rate of 2, 4, and 8 pounds of product per acre was applied, as a pre-emergence application on May 26. The check plots were sprayed with a stoddard solvent type of oil when the seedlings were in the first true-leaf stage. Three inches of rain fell between May 29 and June 2.

Data obtained on August 29 indicated very slight symptoms of rusty root in all plots. On September 22, the number of roots showing rusty root symptoms ranged from 10 to 12 percent. The difference in the amount of rusty root symptoms due to treatments was not significant.

On the basis of this experiment linuron did not appear to have any connection with the development of rusty root symptoms. Muck Research Station, R. R. #4, Bradford, Ontario.

CARROT population and rusty root disorder.

Filman, C. C. This project was initiated to determine the effect of plant density on the severity of rusty root symptoms. Seeds were planted at 6, 15 and 30 per foot of row for Gold Pak and 8, 20 and 40 per foot of row for Scarlet Nantes. Spacing between rows was 17 inches. Seed was sown on May 24 and harvested on August 29 and Sept. 18.

At two harvest dates, data indicated for both varieties that: 1) As plant stand per foot of row was increased there was a significant increase in the severity of rusty root symptoms. 2) A greater number of Gold Pak roots exhibited symptoms of rusty root in the August 29 harvest than in the September 18 harvest. Thus, many of the affected roots were able to outgrow the symptoms. The Scarlet Nantes variety did not outgrow the symptoms. 3) At the standard rate of seeding (15 and 20 seeds per foot of row for Gold Pak and Scarlet Nantes respectively) symptoms of rusty root were too severe for economic production. 4) At half the recommended seed per foot of row the number of affected roots was reduced to approximately 10 per cent. This reduction was significant but still too high for carrot production.

Rusty root symptoms in carrots can be reduced by lowering the number of plants per foot of row. Further investigation is needed to increase yield to an acceptable level by reducing the row spacing as well. Muck Research Station, R. R. #4, Bradford, Ontario.

SOIL moisture content and its effect on rusty root of carrots. Filman, C. C. and E. T. Anderson. To determine the effect of soil moisture content on the development of rusty root, artificial water table levels were established in 4' x 3' x 2' plywood boxes. The boxes were placed in the field with the tops flush with the soil surface. Plastic film was used to line the boxes. A perforated one-inch plastic tube was placed in the bottom of each box for drainage to the outside. The sub soil (raw peat) was placed in the boxes. The top soil (8 to 10 inches deep) was used to fill the boxes.

The following treatments were used: a) Normal rainfall, drainage tap open. b) Soil in boxes saturated with water for 10 days before seeding. Normal rainfall thereafter. Drainage tap open. c) One inch of water added per week (rainfall plus irrigation). Drainage tap open. d) Water added to maintain a water table of 18" below soil surface. Drainage tap closed. e) Water added to maintain a water table of 15" below soil surface. Drainage tap closed.

New seed and old seed of Scarlet Nantes, Commander and Danvers Red Core were sown in each treatment box. Boxes were randomized and replicated three times. Results from two years' data were as follows: 1) All varieties were highly susceptible to rusty root in all treatment boxes, but the symptoms were not quite so severe when new seed of Scarlet Nantes was used. 2) Rusty root symptoms were approximately 20% lower in all treatment boxes in the late harvest than they were in the early harvest. Thus a certain percentage of roots were capable of outgrowing this disorder. 3) Rusty root symptoms were reduced somewhat when soil was flooded for 10 days before seeding. The reduction from 73 to 57 percent was not sufficient to be of value to the carrot grower. A significant increase in yield was obtained when one inch of water (rainfall plus irrigation) was added per week. When the water table was held at 15" below the soil surface a significant decrease in yield was obtained. Muck Research Station, R. R. #4, Bradford, Ontario.

EFFECT of rates and sources of nitrogen on horizontal cracking and rusty root of carrots.

Filman, C. C. To determine whether or not rates and sources of nitrogen have an effect on rusty root and horizontal cracking disorders of carrots, calcium nitrate was applied to the soil at the rate of 100 lb. N, 50 lb. N, and 25 lb. N per acre. Ammonium nitrate was applied at the rate of 100 lb. N and 50 lb. N per acre. The basic fertilizer used in the experiment was 0-20-20 at 500 lb. per acre. Treatments were randomized and replicated four times. The variety was Scarlet Nantes. At soil preparation time the pH of the soil varied from 5.8 to 6 and the calcium reading was adequate.

Rusty root and horizontal cracking symptoms were severe throughout the experiment. Differences in yield, rusty root and horizontal cracking due to rates and two sources of nitrogen were not significant. Muck Research Station, R.R.#4, Bradford, Ontario.

RESPONSE of carrots to overhead irrigation in chytrid-virus infested, rusty root muck soil at Bradford, Ontario 1972. Kemp, W.G., Filman, C.C. A field study was initiated to determine the influence of overhead irrigation in addition to 1972 seasonal rainfall on the incidence of a fungus-transmitted virus associated with a carrot root disease described as lateral root necrosis or rusty root. The effect of the irrigation treatments on yield and quality was also compared.

Overhead irrigation at 0.0, 0.25, 0.5 and 0.75 inches of water per acre had no significant effect on the total yield of Scarlet Nantes in 1972 harvested in late August and again in mid-October. The mean yield in each treatment was doubled (19.0 ton to 38.0 ton/acre) between the early and late harvest but the increase was not related to the additional irrigation. No difference in the severity of lateral root necrosis was observed between the irrigation treatments. Neither was the incidence of virus-chytrid infection in the various treatment plots different. Carrots harvested late from plots irrigated with 0.75 inches of water had less cavity spot than those from the other treatments. These irrigation rates did not affect the numbers of carrots that were over 4 inches, under 4 but over 2 inches, under 2 inches, split, rat-tailed or forked. The data suggest early harvesting to avoid excessive cavity spot increase is advisable even though total yield will be reduced.

Ten days after seeding and just after emergence both the virus and chytrid were detected in the carrot seedlings in all the irrigation treatment plots. After 3 weeks more than 75 percent of the seedlings assayed for virus were infected. Rusty root was not pronounced at this time although some mild discoloration was noted. (Research Station, Agriculture Canada, Vineland Station, Ontario and Muck Research Station, Bradford, Ontario.)

EFFECT of lime on growth and yield of carrots and onions. Filman, C. C. The application of lime is not recommended for organic soils that have a pH reading above 5. Many growers have applied gypsum or dolomitic limestone to soils above and below pH5 with no apparent differences in yield and quality of produce.

To demonstrate the effect of lime on growth and yield of onions and carrots, the following treatments were used in 1970: gypsum at 300 and 1,200 pounds per acre, and hydrated lime at 500 pounds per acre. Similar treatments were applied to the same plots in 1971. In 1972, rates were increased to 1,000, 2,000, and 4,000 pounds per acre of gypsum and 1,000 and 2,000 pounds per acre of hydrated lime.

The soil was a deep peat. The pH readings in the treatment plots ranged from 5.5 to 6.2. The commercial fertilizer applied for the first two years was 200 pounds of ammonium nitrate plus 300 pounds of muriate of potash per acre. In 1972, 5-10-15 was applied at the rate of 750 pounds/acre.

Results indicated that differences due to treatments in maturity and yield of onions and yield and quality of carrots were not significant. The application of lime did not have a significant effect on the incidence of rusty root of carrots. Horizontal cracking was very high in all treatment plots.

On the basis of this experiment the application of gypsum or hydrated lime is not warranted on an organic soil having a pH reading 5.5 or above. Muck Research Station, R. R. #4, Bradford, Ontario.

EFFECT of alar on growth and yield of carrots.
 Filman, C. C. This study was conducted on the late or main crop of Scarlet Nantes carrots. Seed was sown on May 29. Alar was sprayed on the foliage on July 20, 1972, when the roots were $\frac{1}{4}$ inch in diameter. All treatments were replicated four times. Data on the top growth, yield and rusty root disorders were recorded.

TREATMENT	AV. LENGTH		*YIELD		% Rusty	
	TOPS		MKTBLE.		Root	
	Aug. 7	Aug. 29	Aug. 29	Sep. 21	Aug. 29	Sep. 21
Check(water only)	16.6	19.0	951a	1420a	16	11
Alar 85 at 1 lb/acre	15.7	17.7	1001ab	1442a	9	12
Alar 85 at 2 lb/acre	14.5	17.5	1139bc	1527a	14	13
Alar 85 at 4 lb/acre	13.3	16.8	1228c	1611a	9	12

*Means followed by the same letter do not differ significantly at the 5% level in Duncan's test.

All alar treatments decreased top growth during the early stages of growth. At the final harvest date Sept. 21, there were no visual differences in top growth due to treatments. Data obtained at the early harvest date, August 29, indicated significant differences in yield of marketable carrots. The increase in yield obtained from the 2 pound rate was significant when compared to the check treatment. No further benefit was derived when the 4 pound rate was used. Yield differences due to treatment at the final harvest date (September 21) were not significant. There was however a trend to increased yields over the check plot as the rate was increased.

On the basis of this experiment alar applied at 2 pounds per acre could be an important production practice to obtain an earlier, higher yield of carrots for the bunching trade. Alar appeared to have no effect on the development of the rusty root symptoms. Muck Research Station, R. R.#4, Bradford, Ontario.