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Research Continues for Improved Carrot Varieties

A. A. Duncan Leaves For Minnesota Position

Dr. Andrew A. Duncan has accepted the position of Head of the Department of Horticultural Science at the University of Minnesota's St. Paul campus, beginning in early April. Dr. Duncan has guided OSU's off-campus educational programs in vegetable crops production for the past 12 years and has been a frequent contributor to *Oregon Vegetable Digest.* He has worked on improving growers' irrigation practices through proper timing and application of adequate amounts of water. Several of the production problems of fresh market vegetable growers throughout the state have been solved through his efforts.

Recently Dr. Duncan has been interested in introduction of optimized cropping systems in which high density plantings are used. The aim is to eliminate moisture, nutritional, weed, insect, and disease stress for highest yields and quality. Through his efforts, two multi-row bean harvesters were tested at Corvallis during 1969.

In This Issue . . .

A. A. Duncan Leaves OSU 1
Carrot Research Continues 1
Oregon 58 Bush Bean Released 3
Onion Spacing Results Summarized 4
Control of Onion Pink Root Studied 5

Carrot varieties and breeding lines were studied again at the vegetable research farm, Corvallis, in 1969, in a search for carrots with better color, shape, resistance to cracking, and overall processing quality. Plantings were made in early June, rather than late April or May, in order to at least partially avoid heavy infection by the motley dwarf virus. The plants also were dusted at approximate 10-day intervals with diazinon to reduce spread of the virus. These efforts appear justified, since infection with motley dwarf is known to predispose carrots to rotting, and we have experienced extremely heavy losses of promising lines of carrot roots stored through the winter for seed production the following summer.

In October we asked seedsmen and representatives of processing companies to observe roots of most of the carrot lines. The most promising lines, as well as the check varieties, are listed in Table 1. The raw product ratings were based primarily on root shape, smoothness, and internal color, and on possible use as whole, sliced, diced, or all-purpose carrots. Differences of opinion exist about the "use" categories, but it is believed that fairly good guidelines can be established for the plant breeder from such information.

Two new carrots from Michigan—Michigan 2 and Spartan Sweet—were given good raw product ratings; some of the Oregon 4362 sub-lines also ranked high for root characteristics. The Michigan 2 line had excellent length, slimness, and rather good color. Spartan Sweet was somewhat more variable for shape and was not as uniform, slim, and cylindrical as Michigan 2.

The Oregon 4362 line originated several years ago as a selection from Campbell Soup Company material.

(*Continued next page*)

Carrot Varieties . . .

The MF (male fertile) 4362 sub-lines have all been developed from the original selection. Because of the heterozygosity present in the selection it has been necessary to inbreed many sub-lines, only a few of which are of distinct promise. The MS (male sterile) 4362 lines have been developed by continued backcrossing of MF 4362 to male sterile carrots received several years ago from Dr. Peterson and Dr. Gabelman.

Table 1. Raw product ratings for carrot lines or varieties (Corvallis, 1969)

Line or variety	Number individuals rating line of best promise for purpose indicated[1]				
	Whole	*Sliced*	*Diced*	*All-purpose*	*Total*
Michigan 2	4	7	0	0	11
Spartan Sweet	2	6	1	0	9
Royal Chant.	0	0	0	0	0
Nantes	0	0	0	0	0
Autumn King	0	0	0	0	0
Ore. MS 19-8, 4362	1	4	0	2	7
Ore. MF 20-3, 4362	0	3	0	2	5
Ore. MF 26-2, 4362	3	4	6	5	18
Ore. MF 55, 125, 4362	6	2	1	5	14
Ore. MF 69, 176, 4362	2	7	0	0	9

[1] Ratings, by 12 individuals in the seed trade and processing industry, were obtained on appearance of raw carrot roots. Lines are identified only by number at time of rating.

It is noted in Table 1 that the Oregon lines were rated for a possible wider range of usage than the slim "market type" Michigan lines. In general, the 4362 line is medium long, with excellent raw carrot color and a moderate to slight taper.

Data on processing quality, cracking, virus resistance, germination, seedling vigor, and seed stalks are shown in Table 2. A Food Science and Technology panel rated the Michigan lines distinctly high, and certain of the Oregon lines were given good ratings. The data verify earlier observations that appearance of raw carrots—especially for color—may or may not be accompanied by parallel ratings of the processed product. Within the Oregon 4362 sub-lines, for example, the 26-2 line has rated highest of all carrots for raw product appearance the past two years, but ratings when processed have not been distinctly high. The male sterile 4362 MS 19-8 has rated consistently high as a processed carrot. The 20-3 sub-line of 4362 processed well, appears to have more tolerance to motley dwarf, and has better germination and seedling vigor than other sub-lines.

Many inbred lines of 4362 have been abandoned because of their tendency to develop seed stalks the first year. The lines shown in Table 2 had few seed stalks in 1968 and 1969. Other lines have been abandoned because of low germination and seedling vigor. Some of these weaknesses are to be expected because of inbreeding.

Relatively poor storage ability of high-color, promising selections of carrots has long been known. One means of bypassing this trouble is seed-to-seed production, although this method may also bypass inspection of individual roots for selection purposes and "drift" to poorer quality as a consequence. We are currently increasing the 4362 sub-lines by planting seed in gallon cans in the greenhouse. They reach fingerling size by March 1, when they are placed in cold storage, in the cans, until early May and then planted for seed increase under large cages in the field. We secured a rather good increase of 4362-26-2 in this manner in the summer of 1969; we have a large number of seedlings of 4362-20-3 for such increase in 1970. We also obtained an increase of MS 4362-19-8 in 1969. These materials are being made available to carrot breeders for testing and breeding work. Crack resistance of several of the Oregon lines is above average, as noted in Table 2. None have the high level of virus tolerance of Autumn King. The two Michigan lines have little or no tolerance to motley dwarf.

It will be of interest to use the Oregon lines in F_1 hybrid combinations with other breeding lines. We also plan to inter-hybridize, on a mass basis, the male fertile 4362 lines. This may restore vigor and provide a 4362 of more potential value than any one of the sub-lines.

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Table 2. Behavior of certain carrot lines and varieties (Corvallis, 1969)

Line or variety	Processing quality[1]		Percent roots cracked[2]	Virus resistance[3]	Germination	Seedling vigor	Seed stalks
	Canned	Frozen					
Michigan 2	7.3	7.1	9	3	8	9	None
Spartan Sweet	7.3	6.9	7	3	8	8	None
Royal Chant.	5.2	5.6	9	7	8	9	Few
Nantes	5.2	5.4	27	5	8	8	Few
Autumn King	....	....	5	9	7	7	Few
Ore. MS 19-8, 4362	7.3	6.4	4	6	8	8	Few
Ore. MF 20-3, 4362	6.3	6.0	4	7	8	8	Few
Ore. MF 26-2, 4362	5.4	5.3	3	6	6	7	Few
Ore. MF 55, 125, 4362	6.0	6.6	3	6	7	7	Few
Ore. MF 69, 176, 4362	6.3	6.4	3	5	7	6	Few

[1] Superior 9, 8, 7; Acceptable 6, 5, 4; Unacceptable 3, 2, 1; average rating of 7 panelists.
[2] Field readings November 14 on 50 roots in each of two or three plots.
[3] Scale 1 to 9, with 9 highly resistant and 1 very susceptible.

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Oregon 58 Bush Green Pod Bean Officially Released

The Oregon Agricultural Experiment Station has authorized release of Oregon 58 bush green pod bean. Seedsmen will be increasing the stock seed this summer and several Willamette Valley processors will have acreages planted for processing.

It is not deemed necessary to repeat the rather detailed report made on the Oregon 58 line in the July 1968 issue of *Oregon Vegetable Digest* (Vol. XVII, No. 3). Pilot trials of the bean in 1969 generally confirmed the earlier observations on quality, sieve size, growth habit, maturity, mechanical harvestability, and yield characteristics.

We should note that common mosaic resistant sublines (58-R) were isolated, increased, and have been made available to seedsmen for appreciable increase in 1970. The major 1970 increase, however, will be made from 58-S stock seed; the 58-S is variable for resistance. Oregon 58-R is resistant to the type strain of common mosaic (BV-1) as well as to the New York 15 (BV-1A) strain.

We have made many crosses of Oregon 58 with other breeding lines—especially with slim podded types. Several selections from progeny of Oregon 58 x Oregon 190, and (58 x 190) x 58 show promise and will be included in our test plots in 1970. Major emphasis is on combination of 58 habit with the slim pod of 190.

We gratefully acknowledge the cooperation of Dr. L. L. Dean, Idaho Agricultural Experiment Station, in testing various sub-lines of Oregon 58 for resistance to strains of common mosaic virus. We are indebted to field men, growers, processing firms, seedsmen, and their personnel for their kind cooperation in testing Oregon 58 and other breeding lines of beans.

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Onion Spacing Results Summarized

Spacing trials with Oregon Yellow Globe Danvers onions were conducted during the past three years at Lake Labish. Plots were located in commercial fields and were fertilized, sprayed, and irrigated the same as the rest of the field. Pelleted seed was planted using a one-row Stanhay precision drill. A diazinon-formaldehyde drench was applied in the furrow with the seed for the control of onion maggot and smut. All trials were replicated four times on three farms.

Table 1. Effects of spacing on yields and sizes of onions

Spacing	Yield	Size: Jumbo (over 3 inches)	Size: Medium (2-3 inches)
	Cwt/A	%	%
3 x 3 (9 sq. in.)	812	15%	81%
6½ x 3 (19½ sq. in.)	665	49%	50%
6½ x 2 (13 sq. in.)	721	37%	62%
13 x 1½ (19½ sq. in.)	647	47%	51%
Grower planting (check)	705	22%	74%

Table 1 shows the results of the 1968 and 1969 plots averaged together. These include the trials on the Harvey Lea, Nathan Kurth, and Jim Rickard farms.

Spacing influenced the yield and bulb size. The 3 x 3 inch spacing resulted in the highest yield (812 cwt.) but produced the largest percentage of small onions. Larger onion bulbs (3 inches) generally bring a higher price, but reduced plant population and yield are associated with larger onions. Present planting methods result in random plant spacing within the row and mixed bulb sizes. Precision seeding and optimum plant spacing results in higher yields and a more valuable range of bulb sizes.

Although the 3 x 3 spacing produced the highest yields, the difficulties of planting, weeding, and cultivating make it less desirable than a wider row width.

Most promising was the 6½ x 2 inch spacing. The yield was not as high as the 3 x 3 spacing, but the percentage of jumbos was 37 and the yield was higher than all other treatments except the 3 x 3. The 6½-inch row allows enough space to permit some necessary risk-reducing cultural practices. Bulb size is determined mainly by variety, plant density, and plant arrangement. Nine square inches per plant produced the highest yields and could be achieved by 3 x 3 or 6 x 1½ inch spacings.

The commercial fields in which the plots were located yielded slightly less than the 6½ x 2 inch spacing and produced only 22% jumbos. The smaller size is attributed to the random in-row seeding method used by the growers.

It appears that 6½ x 2 inches was the optimum spacing in these experiments. Although it did not account for the highest yield, this spacing suggests a suitable compromise between size, range, and yield.

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Vegetable Notes . . .

Denna in Colorado found that varieties of Brussels sprouts, broccoli, and cauliflower possess highly significant differences in regard to stomatal transpiration, cuticular transpiration, and quantity of wax per unit area of leaf surface. Rubbing away the waxy bloom increased the cuticular transpiration rate. There was little correlation between the quantity of wax and water loss per unit area of leaf surface during either the daytime or nighttime experiments. It appears inadvisable to attempt to breed for drought resistance in *Brassica oleracea* by selecting for the presence of a heavy waxy bloom or high levels of wax per unit area of leaf surface (*J. Amer. Soc. Hort. Soc.*, 95:30-32, 1970).

Effect of soil water stress on bush beans at three stages of growth was evaluated in Canada by Dubetz and Mahalle. Reductions in yield resulting from high stress (8 bars) as compared to low stress (0.6 bar) were as follows: preflowering—53%, flowering—71%, and postflowering—35%. Plants were grown in metal containers outdoors (*J. Amer. Soc. Hort. Sci.*, 94: 479-481, 1969).

Control of Onion Pink Root Studied

Soil fumigation for control of pink root disease of onion, *Pyrenochaeta terrestris,* has been under investigation in Malheur County for several years. Early tests were designed to identify effective materials and to eliminate ineffective ones. In recent years, the tests have been devoted largely to rates and methods of application of the fumigants.

In 1969, the effectiveness of fall fumigation using Vorlex, Telone, and Terrocide-30 was investigated in replicated plots at two locations—the Wada farm three miles northwest of Ontario and the Teramura farm two miles west of Cairo Junction. All materials were applied broadcast, Vorlex at 15 gallons per acre and Telone at 40 gpa. At one location, Terrocide-30 was applied at 10, 20, and 30 gpa. Relative disease severity was rated visually at harvest time, using the following scale:

1 = No root diseased
2 = 1 to 25% of the roots with pink color
3 = 26 to 50% of the roots with pink color
4 = 51 to 75% of the roots with pink color
5 = 76 to 100% of the roots with pink color

Disease indexes are the averages of the ratings of 10 plants from each of four locations in each individual plot. Harvest evaluations were made by obtaining the bulb weights in four grade categories.

At the Teramura plots, both Telone and Vorlex caused significant reduction in pink root severity and both increased the yields of jumbo onions (Table 1).

Table 1. Effect of broadcast fumigation on yield of Yellow Sweet Spanish onions (Teramura farm, 1969)

Treatment	Disease rating 8/14	Yield (Tons per acre) No. 1 jumbo	No. 1 medium	No. 2 jumbo	No. 2 medium	Culls
Check	3.17	7.6	2.1	9.7	2.4	5.8
Vorlex (15 gpa)	2.45	10.1	2.6	12.8	2.9	3.9
Telone (40 gpa)	2.25	9.8	2.8	13.7	3.1	2.3
LDS 5%	.28	3.5	1.8	2.5	2.4	2.1
1%	.42			3.8		

No significant increase in medium onions was obtained. At the Wada plots, there were no medium onions in either treated or untreated plots. Both Vorlex and Telone significantly increased yields of jumbo onions and caused significant reductions in pink root severity (Table 2). An increase of 4.7 tons of No. 1 jumbo onions at

Table 2. Effect of broadcast fumigation on yield of Yellow Sweet Spanish onions (Wada farm, 1969)

Treatment	Disease rating 8/14	Yield (Tons per acre) No. 1 jumbo	No. 2 jumbo	Culls
Check	2.90	11.9	8.8	5.5
Vorlex (15 gpa)	2.10	16.7	10.7	2.8
Telone (40 gpa)	1.97	14.7	10.4	4.1
LSD 5%	.51	2.4	2.6	2.1
1%	.77	3.7		

$4.00 per hundredweight was worth some $280 per acre to the grower after deducting the cost of materials and application. At the Wada plots, Terrocide-30 at 30 gpa significantly reduced the severity of pink root disease; at 20 and 30 gpa, it markedly increased the yield of No. 1 jumbos, although the increases were not statistically significant (Table 3).

Table 3. Effect of broadcast fumigation on yield of Yellow Sweet Spanish onions (Wada farm, 1969)

Treatment	Disease rating 8/14	Yield (Tons per acre) No. 1 jumbo	No. 2 jumbo	Culls
Check	2.90	10.5	8.8	5.7
Terrocide-30 (10 gpa)	2.85	11.5	8.2	5.2
Terrocide-30 (20 gpa)	2.65	13.7	9.2	5.1
Terrocide-30 (30 gpa)	2.35	13.7	9.1	6.4
LSD 5%	.41	3.5	4.2	2.2

Soil fumigation, either broadcast or band application, is becoming a standard practice in fields where onion pink root is severe.

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