Results of Research at Vineland

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Three major areas of greenhouse vegetable research were continued in 1980. These were cultivar evaluations of tomatoes and seedless cucumbers, studies on soilless production techniques, and energy conservation. This paper will present the past year's results from these experiments and briefly outline the implication of the research. In addition, the cooperative project between the Ontario Greenhouse Vegetable Producers' Marketing Board (O.G.V.P.M.B.) and H.R.I.O. will be outlined.

ENERGY CONSERVATION

The solar greenhouse project continued during the 1979-80 heating season with somewhat discouraging results.

Table 1 - Natural gas and electric consumption of three test greenhouses (200m^2) with comparative energy costs. 1 September 1979 to 1 June 1980 (1 December 1979 - 15 January 1980 and 1 March 1980 - 31 March 1980 omitted).

	Natural Gas (GJ)	Electricity (GJ)	Costs (C$/m^2)
Control	291.8	20.2	5.09
Solar	277.6	26.2	5.19
SDP-16	301.6	16.9	5.17

Energy Consumption

Daily records of energy consumption indicated that during the period 1 September 1979 to 1 June 1980, natural gas usage was reduced 4.9% in the greenhouse with the solar supplement (Table 1). The unit glazed with SDP-16 used 3.4% more natural gas but 16.1% less electrical energy. Electrical consumption in the solar house was 29.8% higher than the control greenhouse. Consumption data do not include the time period 1 December 1979 to 15 January 1980 and 1 March 1980 to 31 March 1980 because monitoring devices were found to be faulty at that time. Assuming energy costs of $10.00/GJ for electricity and $2.80/GJ for natural gas, the unit energy costs for the control, solar and SDP-16 greenhouse were $5.09, $5.19 and $5.17/m^2 respectively.

Table 2 - Relative natural gas saving of an IR-heated house compared with the conventionally heated house for different periods

Period	Average Greenhouse Air Temperature (°C)		Average Minimum Temperature Outside (°C)	Relative Savings (%)
	IR	Conventional		
Nov. 7-12	10.4	10.4	1.7	40.0
Nov. 13-20	9.8	9.8	-1.4	40.7
Jan. 2-7	9.2	9.3	-6.7	33.0
Jan. 9-14	8.7	9.3	-7.7	36.6
Feb. 14-20	9.4	9.6	-7.1	36.3

Table 3 - Energy Conservation and Growing Media - Seedless Cucumbers

Medium	Air Blanket	Marketable Yield No. per Plant			Total Wt. (kg/m^2)	Av. Wt. (g/fruit)	Grade I (%)	Side Grades			
		31/3	29/5	17/7				E %	L %	M %	S %
Strawbales	-	14.3	32.0	46.4	40.0	586	96	14	47	30	9
	+	10.7	27.9	40.1	33.6	569	92	12	45	31	11
Soil	-	14.3	31.3	46.8	38.6	562	91	9	41	41	9
	+	10.4	25.9	37.1	30.1	552	88	12	41	36	11
Warmed Soil	-	12.8	30.7	42.3	33.9	545	94	10	35	39	16
	+	10.2	25.3	37.8	29.3	527	88	11	37	39	13
Oasis (Used)	-	12.6	25.1	35.2	29.5	570	97	10	33	38	19
	+	9.1	22.0	29.5	24.0	553	96	8	32	42	18
Bags (Peat/ Vermiculite)	-	12.9	25.9	36.2	29.4	553	95	8	38	36	18
	+	10.3	19.8	27.2	21.6	540	88	6	36	37	20
Oasis (New)	-	11.2	23.6	32.6	26.7	557	97	6	38	38	18
	+	8.8	21.4	30.3	23.2	522	97	3	25	44	28
Peat Bags	-	10.9	22.8	30.1	23.9	540	96	7	25	45	23
	+	9.9	21.8	29.9	23.6	536	91	9	34	40	17

Cultivar: Corona
Seeded: Dec. 14, 1979
Transplanted: Dec. 19, 1979
Planted on strawbales: Jan. 11, 1980
Spacing: 50 x 136 cm (0.68 m^2/pl)

Size Grades: E = Extra Large - 43 cm and up
L = Large - 38-43 cm
M = Medium - 33-38 cm
S = Small - 28-33 cm

Plants were raised in 12.5 cm plastic pots with soilless mix under artificial light (20 hr/day).

This experiment was conducted in two identical greenhouses, one of which was equipped with an "Air Blanket" as an energy conservation feature. The resulting saving in energy was approximately 30%. The Air Blanket reduced the light intensity in the greenhouse by approximately 18-20% and increased the relative humidity by about 5%.

In addition, light transmission readings were made for greenhouses glazed with SDP-16, Monsanto 602, and C.I.L. Durafilm 640. After two years of exposure the transmission of photosynthetically active radiation (PAR) was reduced an average of 5.3% in the polyethylene greenhouses, while the SDP-16 house had a reduction of 3.2% in PAR when compared to the first year. After two years PAR transmission was slightly higher through the Durafilm 640 than the Monsanto 602, but transmission of light over the total spectrum was equivalent.

The use of low intensity infrared (IR) heating provided significant energy savings in specific circumstances in commercial greenhouses. Savings of 33-41% were recorded in glass greenhouses in which carnations were grown. No significant differences in soil or air temperature were noted for the IR system versus the conventional heating systems. Both longitudinal and lateral temperature distribution are highly dependent on the layout of the IR system. The amount of energy saved was dependent on the outside weather conditions. (Table 2).

An IR system installed in a plastic greenhouse at the research station showed no significant energy savings. The permeability of polyethylene to IR radiation would suggest that this type of heating system would be less suitable for free-standing poly greenhouses.

An "Air Blanket" system was installed in a glass greenhouse at Vineland. The glass greenhouses are freestanding units with a ridge height of approximately five meters. Installing the airblanket at a maximum height of three meters from the ground resulted in a much reduced air volume in the greenhouse. Energy savings for the spring crop were approximately 35-40% when compared to an adjacent glass greenhouse without any energy conservation features. The double layer of polyethylene reduced light levels at the crop canopy by 15-18%. Dust particles and condensate collected on the upper surface of the blanket, resulting in reduced energy efficiency and light transmission. The system may be adaptable for crops only requiring low light and in large greenhouses where restricted air volume does not result in greatly increased relative humidity. Production of European cucumbers (Table 3) was reduced in the greenhouse with the air blanket.

II SOILLESS PRODUCTION SYSTEMS

Tomatoes were grown as a fall crop in soil, peat bags and on oasis, a porous inert material commonly used in floral arrangements. The use of oasis is roughly equivalent to the rock wool technique used in Europe. There was some difficulty with original root penetration into the media from transplants grown in peat pots, but once established, the plants grew with the typical development of plants in a hydroponic arrangement. Foliage tended to be reduced but fruit set was not hampered. The oasis requires regular watering to maintain proper moisture and nutrient levels. Yield (Table 4) was best in the soil but percent of first grade fruit was higher for the soilless systems. Equivalent results were achieved for European cucumbers in the fall (Table 5). A trial in the spring crop with seven different growing media for European cucumbers demonstrated the superiority of straw bales for an early planting (Table 3).

III CULTIVAR TRIALS

In a trial of red cultivars for fall production, Ontario Red 775 provided the highest total yield but percentage of first quality fruit was rather low, at 72% (Table 6).

All the cultivar trials were conducted at a minimum night temperature of 16.5°C and minimum day temperature of 20°C. Since the Ontario lines were bred for lower cropping temperatures, it is expected that yield advantages would have been more substantial at lower air temperatures. An observation trial of numbered lines from Ohio and Europe indicated that there is excellent potential for development of new high yielding cultivars (Table 7). The lines from Ohio possess tolerance to fusarium crown and foot rot and appear to have promising horticultural characteristics. It must be stressed that this was only one small trial, and large scale planting of these cultivars is **not** recommended until further tests have been conducted.

Table 5 - A Comparison of Growing Media for European Cucumbers, cv Corona

Medium	Marketable Yield (fr/pl) 30/9	31/10	19/11	Total Wt. kg/m^2
Soil	7.6	13.0	16.4	12.74
Peat Bags	6.6	10.5	13.0	10.92
Oasis	6.8	10.9	13.0	10.36

Table 6 - Greenhouse Tomato Cultivar Trial, Fall 1979

Cultivar	Supplier	Marketable Yield (kg/pl) Grade I	Total	Avg. Wt. of Fruit (g)	Grade I (%)
Onthybrid 775	H.E.S.	2.65	3.66	133	72
Jumbo	Bruinsma	2.55	3.35	162	76
Vendor	Stokes	2.74	3.22	129	85
G.S. 203	Goldsmith	1.98	3.00	161	66
G.S. 130	Goldsmith	2.27	2.88	180	79
Onthybrid 777	H.E.S.	2.35	2.84	119	83

Seeded: July 6
Transplanted: July 13
Planted: Aug. 13
Spacing: 80 x 45 cm
Harvest: Sept. 27 - Dec. 6

Table 4 - A Comparison of Growing Media for Greenhouse Tomatoes

Medium	Marketable Yield (kg/pl) Grade I	Total	Avg. Wt. of Fruit (g)	Grade I (%)
Soil	3.15	3.75	125	84
Oasis	2.82	3.05	134	92
Peat Bags	2.71	2.98	130	91

Seeded: July 6
Transplanted: July 13 (10 cm Jiffy pots)
Planted: Aug. 13
Spacing: 80 x 50 cm
Harvest Period: Sept. 27 - Dec. 6

IV O.G.V.P.M.B.

The Ontario Lottery commission has provided $140,000 over three years to fund greenhouse research. The O.G.V.P.M.B. has decided to channel the monies into a project carried out by research personnel at H.R.I.O. The project includes three basic areas. These are supplemental lighting for greenhouse vegetables, alternate food crops for greenhouse production, and use of low intensity infrared for greenhouse heating. All experiments will be conducted in commercial greenhouses.

The supplemental lighting studies will include extending a fall crop until January and lighting a spring crop from transplant production in

December until May. The objective is to establish potential for increased productivity using lights and for making domestic produce available year round. Three lighting regimes of ambient, 16 hr. and 20 hr., will be established for cucumbers and tomatoes. Response of cultivars and plant spacing will also be monitored.

Currently the greenhouse vegetable industry is based almost exclusively on tomatoes and cucumbers. If the number of food crops which can be grown can be expanded, it will broaden and strengthen the economic base of the industry. Management trials of peppers, eggplant, melons and zucchini have been carried out in the fall of 1980 and will be expanded in the spring of 1981. Determination of economic viability is the key issue in these trials.

As indicated, research of IR systems was initiated in 1979. These trials will be expanded under the O.G.V.P.M.B. project to include a cucumber grower in Essex county. The effects on a tall growing crop which develops an extensive canopy will be measured.

These data represent only the highlights of vegetable research at Vineland in the past year. If further information is required on any of the projects, this can be obtained by contacting the author at the Horticultural Research Institute of Ontario, Vineland Station.

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Table 7 - Cultivar Trial (Observation) of Greenhouse Tomatoes, Spring 1980

Cultivar	Supplier	Marketable Yield (kg/plant)	Avg. Wt. (gr/fr.)	Grade I (%)
79W177	Van Den Berg	7.1	155	85
B77.435	Van Den Berg	6.8	115	80
CR9	OSU	6.8	133	77
79W.175	Van Den Berg	6.7	151	77
CR3	OSU	6.6	148	76
CR6	OSU	6.4	151	77
Hg 77.459	Van Den Berg	6.2	136	70
CR7	OSU	6.0	115	77
CR4	OSU	6.0	109	83
CR1	OSU	5.8	124	82
Vendor	Stokes	5.4	126	75
MR 13	Stokes	4.3	134	77