THE EFFECTS OF CERTAIN MEDIA ON THE GROWTH AND PRODUCTION OF GREENHOUSE TOMATOES

By

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CHAPTER I

INTRODUCTION

The production and use of greenhouse grown tomatoes Lycopersicon esculentum, (Mill.) has increased rapidly in recent years and this trend is expected to continue.

Satisfactory yield depends upon the production of good plants with consistently high-quality fruit. Some factors that adversely affect greenhouse tomatoes and which limit production and quality of fruit are soil quality, nutrient imbalance and soil-borne diseases.

A cultural system that would provide ways to minimize soil-borne diseases such as fusarium, verticillium and nematodes could be the use of a prepared medium.

The standard "peat-lite" medium which is currently used for many kinds of greenhouse crops is primarily a combination of peat and vermiculite. This is being used in ring and trough culture in a few greenhouse operations for tomatoes.

The objectives of this study were to evaluate the effects of certain media on the growth and production of greenhouse tomatoes and to determine the different media that might be satisfactory for crop production and growth.

Factors considered in evaluating these objectives were: (1) fruit quality; (2) effects of media on growth; (3) effect of media on yield and grade of fruit.

CHAPTER II

REVIEW OF LITERATURE

Research in the use of "peat-lite" media in the production of a number of greenhouse crops has been conducted and reported (29). This provided detailed information on greenhouse tomato production and included a cultural system that would allow for more effective prevention of problems which are more common to soil culture.

Holmes (10) studying the persistence of tomato mosaic virus, found that heating the soil beds did not completely eliminate virus. Jensen (12) reported that sterilization of soil with steam does not always seem to free soil of virus below 18 inches, so this method cannot insure exclusion of tobacco mosaic virus. The soil temperature was not reported in these two reports.

Boyle and Bergman (2) found that in dried mosaic-infected tomato leaves, when heated at 248°F for 30 minutes, the virus retains its infectiousness.

Diener (8) observed that sanitation and use of resistant varieties were the two main means of control of tobacco mosaic virus in greenhouse tomatoes.

In 1968, Walter (26) developed a multiple disease resistant indeterminate tomato, including tobacco mosaic, at the Florida Gulf Coast Experiment Station.

Jensen (11) reported that many greenhouse tomato growers in New

Jersey are presently using cultural systems known as ring and trough culture. The medium used is a mixture containing 50% peat moss and 50% vermiculite. Yields of marketable tomatoes have been in excess of 100 tons per acre, utilizing these systems.

Sheldrake and Dallyn (21) reported that the use of "peat-lite" mix for commercial tomato production minimized disease problems that were soil borne.

Scott and Bearce (20) encountered consistent nutrient level problems when they grew tomatoes in chips of hardwood bark and in hardwood sawdust obtained from mixed species of trees. The material had been composting for 12 months.

In 1970, Wright (31) reported that pine bark residue as a soil amendment was compared to commercial peat moss and hardwood sawdust in a three-year trial with hybrid tea roses. They were grown in mixtures of organic materials and soil (the organic materials constituting 50 and 75% of the mixture). During the three years, the treatment containing pine bark resulted in higher yields than did the treatments containing peat moss and sawdust.

Dallyn, Sheldrake and Snagster (7) reported in 1970 that various combinations of artificial media (or soil substitutes) used in ring and trough culture were adequate for tomato production and in some cases produced higher yielding plants at the same plant spacing than did soil.

Hardie (9) reported that the use of a "peat-lite" mix encounters higher fertilizer levels due to more confined root system because no leaching is performed in trough culture.

Taylor and Flannery (24), working with plants grown in trough

culture in "peat-lite" mixes at soil test levels 2-3 times greater than those considered optimum for mineral soils will frequently show deficiency symptoms.

CHAPTER III

METHODS AND MATERIALS

The objectives of the following experiments were to evaluate the effects of certain media in the growth and production of greenhouse tomatoes.

The studies reported herein were conducted in the Oklahoma State University Department of Horticulture greenhouse from December 1, 1969 to June 30, 1970 and from July 24, 1970 to January 30, 1971.

Greenhouse Facilities

A 30 ft. by 100 ft, 5 ounce clear Filon fiberglass covered greenhouse, constructed with metal frames and glass sides was heated with steam and gas hot air heater. A combination of overhead convection tubes and cooling pads were used to cool the greenhouse. The greenhouse was equipped with a 200 gallon fertilizer tank with an impeller pump and electric motor system.

Culture Media

Eight combinations of media were used in this preliminary test. Medium components are given in Table 1. Materials used in the various media and the sources are given below:

1. Pine bark - Greenleaf Nursery in Park Hill, Oklahoma
2. Peanut shells - Agronomy Experimental Station, Stillwater
3. Cardboard - Stillwater
4. Pecan shells - Horticulture Experimental Station,

TABLE I

MEDIA USED IN EXPERIMENT I

Quantity in Bushels

	Mix I	Mix II	Mix III	Mix IV	Mix V	Mix VI	Mix VII	Mix VIII**
Peanut Shells	1	1/2	1/2	1/2	1/2		3/4	
Peat Moss	1/2	1/2	1/2		1/2	1/2		1/2
Vermiculite	1/2	1/2	1/2		1/2	1/2		
Pecan Shells		1/2			1/4	1/2		
Pine Bark*				1/4			1/2	
Soil				1/2			1/4	1/2
Cottonseed Hulls				1/4	1/2	1/2	1/2	
Perlite								1/2

* Weathered for two years
** Check Treatment

Stillwater, Oklahoma
5. Sawdust - Pawnee, Oklahoma
6. Soil - Horticulture Experimental Station

Peanut shells, pecan shells and soil were steam sterilized at 200 degrees F for one hour. The cardboard material was shredded by the use of a hammer mill. The perlite, peat moss and vermiculite were purchased from a commercial supplier.

Ring Culture Preparation

Definition of ring culture by Sheldrake (21) "is a system of growing tomatoes in which the tomato plant is set into a round (8 to 10 inch diameter) "ring" of plastic fiber. The "ring" has no top or bottom."

For a more precise description the term cylinder should be substituted for the term ring. In view of the widespread use of the term "ring", even though incorrect, it will be used in this thesis.

Asphalt building paper (30 pound grade) was used in preparing the rings. Cylinders 12 inches high and 10 inches in diameter were formed and the edges were stapled together using $1\frac{1}{2}$ inch by $\frac{1}{4}$ inch wood strips.

Trough Culture Preparation

The test area for experiment (3) for trough culture was prepared by leveling the ground surface. Troughs were 26 inches wide by 6 inches deep and prepared by using 1 inch by 6 inch lumber. The lumber was butted together with nails. In maintaining parallel sides, 1 x 4 inch stakes 14 inches long were used and spaced 4 ft. apart. The mixture of each medium is given in Table II.

TABLE II

COMPOSITION OF MEDIA USED IN EXPERIMENT III

Treatment	Materials (Bushels)
I	1/2 peat moss 1/2 vermiculite 1 sawdust (new) 1 peanut shells
II	1 peat moss 1 vermiculite 1 cardboard (shredded)
III	1 peat moss 1 vermiculite

Fertilization

A small concrete mixer was used to combine the media and fertilizers for each test. The fertilizer (10-20-10) was in a granular form and had to be dissolved in water and added gradually as a liquid during the mixing process for more uniform distribution. Fertilizer formula recommended by Sheldrake and Dallyn (21) for "peat-lite" mix was used in all media at the time of mixing. Before plots were planted, each medium was analyzed to determine the nutrient level of nitrogen, phosphorus, potassium and pH. The only adjustments were the addition of dolimitic limestone at the rate of $\frac{1}{2}$ pound per ring in media six, seven and eight and thoroughly mixed. This decreased the acidity from a pH of 5.8 to a pH of 6.6.

Water soluble fertilizer materials were applied through the watering system. The materials and the quantities per 100 gallons of water are as follows:

1. 20-20-20 at 3 pounds;
2. Potassium nitrate (13-0-44) at 3 pounds;
3. Calcium nitrate (15.5-0-0) at 3 pounds;
4. Monocalcium phosphate (0-45-0) at 3 pounds;
5. Iron Chelate (14.2% Fe) 8 ounces;
6. Manganese Chelate (19% MN) 8 ounces;
7. Peter's minor elements at 20 grams.

Application of calcium nitrate, potassium nitrate and monocalcium phosphate were used in place of 20-20-20 during the fall crop. These rates were applied separately at 3 pounds per 100 gallons of water.

The first application was made immediately after the plants were set. Water and fertilizer were applied by means of plastic rings[1] which were placed on the medium around each plant.

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[1] Chapin Water-Loops, Chapin Watermatics, Inc. 368 N. Colorado Avenue, Watertown, New York 13601.

The water and nutrients applied through plastic rings were regulated in flow at 40 pounds pressure to insure even distribution. The application was controlled by a shut-off valve at each row.

All media were tested weekly utilizing the Simplex Soil Kit[2] and Beckman Zeromatic SS-3 pH Meter[3].

Pruning and Training

The tomato plants were pruned twice a week to single stems by the removal of side shoots. Plastic twine was used to support the plants. The top of the trellis support was 7½ feet from the ground. The plants were topped as they developed to the trellis. This was 50 days before the second crop was to be planted.

Cultural methods were the same for all experiments.

Pollination

Pollination, utilizing a mechanical vibrator, was done each day, between 12 noon and 2:30 p.m. when sunlight was adequate. Temperatures were maintained at 80 to 85° F during the daytime and 62° F at night. If cloudy weather persisted for as much as two days, the temperature in the greenhouse was allowed to increase to 80° F one hour preceeding pollination. Following pollination the temperature was lowered to 65° F for the day and 55° F at night in order to conserve carbohydrates.

Disease Control

Gray mold, Botrytis cinerea and leaf mold, Cladosporium fulvum

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[2]The Edwards Laboratory, 202 Milon Avenue, P.O. Box 318, Norwalk, Ohio.

[3]Beckman Instruments Inc., Scientific and Process Instruments, 2500 Harbor Boulevard, Fullerton, California.

infections appeared during periods of high humidity. Plants were protected with a fungicide mixture containing 1/2 pound terraclor and 1/2 pound captan per gallon of water and was applied at the rate of 1/2 pint per plant. Applications were made as a media drench. Three were made to each treatment during a period of four weeks. Botran was also used at the rate of 6 ounces per 25 gallons of water. It was applied as a spray on the foliage once per week for three weeks until the infection was under control.

Cultivar Tropic

The cultivar Tropic was used in all treatments. This cultivar was developed by Walter (26) who prepared the following description indicating resistance to the following diseases and disorders: (1) Verticillium wilt (Verticillium albo-atrum); (2) Fusarium wilt (Race 1 of Fusarium oxysporium f. lycopersici); (3) Gray leafspot (Stemphylium solani); (4) Graywall (Blochy ripening); (5) Tobacco mosaic virus (resistant to stain 1 and slightly tolerant to 4 other strains).

Harvesting of Fruit

At harvest, data were collected on fruit number, weight, quantity by U.S. grade standards for all test plots. Harvesting was done twice weekly to assure a maximum percentage of fruit in the pink-red to firm-red stage of maturity.

Experiment I

The experimental test area for Experiment I was prepared by

sloping the ground surface slightly to one end of the row. A ridge of soil was made, one on each side of the row, leaving a furrow in the middle. The ground surface was covered with four mil white plastic and the rings placed on the ridges. The white plastic covered the bed and overlapped in the aisle. This gave added light reflection and also acted as a sanitation measure. The rings were placed on a slight slope to allow the excess water or nutrients to drain.

Eight media were used in the preliminary test to determine their effect on tomato plants grown in ring culture.

Seeds were planted December 1, and plants transplanted December 15 into three inch pots in a soil mix containing 1/3 each of sterilized soil, peat moss and perlite. The plants were placed in rings January 24. Seven plants constituted a plot and were placed in a row allowing four square feet of space per plant. Two replications were used.

Experiment II

Two media, 1 and 2 selected from experiment 1, were used in experiment 2 to determine their effect on tomato plants grown in ring culture. Experiment 2 was different from experiment 1 in that three replications were used instead of two.

Seeds were sown July 24, and seedlings transplanted into three inch pots in a soil mix containing 1/3 each of sterilized soil, peat moss and perlite mix August 1. The plants were placed in rings September 1.

Greenhouse soil was steam sterilized during the summer months. Sawdust was incorporated in the soil to tie up available nitrates. Prior to planting, the soil was leached with water.

Experiment III

The principal difference between experiment 2 and 3 was that the plants were grown in trough culture, rather than ring culture. Three different medium trials were conducted in three separate troughs. Fourteen plants constituted a treatment allowing four square feet of space per plant.

Seeds were sown July 24, and seedlings transplanted into three inch pots in a soil mix containing 1/3 each of sterilized soil, peat moss and perlite mix August 1. The plants were transplanted in troughs September 1.

CHAPTER IV

EXPERIMENTAL RESULTS

Experiment I

Throughout the experiment nitrogen deficiency was a problem in media three, four and seven. This was attributed to the presence of peanut shells and pine bark. Additional nitrogen was supplied in the form of $CaNO_3$. This also caused an increase in the pH. The quantity of potassium supplied to the medium was increased as sunlight decreased. Symptoms indicating serious iron and manganese deficiency were apparent in all media. Applications of iron and manganese chelate appeared to correct these problems. Symptoms of iron deficiency were evident in plants in all media by the time the fourth and fifth clusters of flowers had developed. Three applications of iron chelate were made to treatment 1 during the growth period, at the rate of 8 ounces per 100 gallons of water.

The effect on quality and total yield is given in Table III and the statistical analysis of the various data using Duncan's New Multiple Range is shown in Table IV.

Acidity of the medium became a problem in treatments 6, 7 and 8 which contained cottonseed hulls. Blossom end rot developed and a foliar spray containing 20 grams calcium chloride per gallon of water was applied to the foliage for control. Three applications of calcium chloride were made to the foliage during a period of three weeks.

TABLE III

THE EFFECT OF EIGHT MEDIA ON THE NUMBER, WEIGHT, GRADE AND AVERAGE WEIGHT OF TROPIC TOMATO FRUITS OF PLANTS GROWN IN RING CULTURE[1]

Treatment and Replication	Number and Weight By Grade						Total Number	Total Weight	Pounds/ Plant	% of # 1	% of # 2	Avg. Fruit Wt. in Ounces
	# 1		# 2		Culls							
	No.	Wt.	No.	Wt.	No.	Wt.						
I												
Rep I	250	89.5	69	15.1	21	5.7	340	110.3	15.7			
Rep II	240	82.4	62	16.8	23	6.1	325	105.3	15.0			
Total	490	171.9	131	31.9	44	11.8	665	215.6		79.9	14.8	5.2
II												
Rep I	249	84.3	41	13.7	25	6.1	325	104.1	15.3			
Rep II	268	82.9	67	14.6	21	4.9	256	102.4	14.6			
Total	517	167.2	118	28.3	46	11.0	681	206.5		81.1	13.7	4.8
III												
Rep I	262	70.1	60	15.2	28	6.6	350	91.9	13.1			
Rep II	239	72.9	45	16.2	26	7.1	310	96.2	13.7			
Total	501	143.0	105	31.7	54	13.7	660	188.1		76.0	16.7	4.6
IV												
Rep I	219	72.5	74	16.1	27	5.9	320	94.5	13.5			
Rep II	238	67.5	67	17.6	24	6.1	329	91.2	13.0			
Total	457	140.0	141	33.7	51	12.0	649	185.7		75.4	18.1	4.6
V												
Rep I	263	79.0	58	13.4	25	6.2	346	98.6	14.1			
Rep II	248	78.8	64	12.9	28	6.2	340	97.9	14.0			
Total	511	157.8	122	26.3	53	12.4	686	196.5		80.3	13.4	4.6
VI												
Rep I	252	71.0	78	18.6	30	6.8	360	96.4	13.8			
Rep II	211	66.9	77	20.2	27	7.8	315	94.9	13.6			
Total	463	137.9	155	38.8	57	14.6	675	191.3		72.1	20.3	4.5
VII												
Rep I	202	73.0	55	13.1	29	7.1	296	93.2	13.3			
Rep II	230	76.4	50	12.2	29	7.0	309	95.6	13.7			
Total	432	149.4	105	25.3	68	14.1	605	188.8		79.1	13.4	5.0
VIII - Check												
Rep I	247	77.2	49	14.9	19	5.3	315	97.4	13.9			
Rep II	232	72.6	49	15.2	22	5.9	303	93.7	13.4			
Total	479	149.8	98	30.1	41	11.2	618	191.1		78.4	15.8	4.9

[1] Spring Crop Harvest Period April 14-June 30, 1969
Weight in Pounds of Tomatoes

7 Plants Per Replication

TABLE IV

ANALYSIS OF YIELD DATA FROM TOMATOES GROWN IN EIGHT MEDIA IN RING CULTURE

Fruit Grade In Pounds	Total Pounds (2 Replication)							
	Treatments							
	1	2	8*	5	7	3	4	6
#1's	85.95	83.6	78.9	74.9	74.7	71.5	70.0	68.9
	6	4	1	3	5	2	8	7
#2's	19.4	16.85	15.95	15.70	15.05	14.15	13.15	12.65
	6	7	3	8	4	1	5	2
Culls	7.3	7.05	6.85	6.2	6.0	5.9	5.6	5.5
Total/Treatment	1	2	8	6	5	7	3	4
	107.8	103.25	98.25	95.65	95.55	94.40	94.05	92.85

*Check treatment

Any two means not underscored by the same line are significantly different at .05 level.

Any two means underscored by the same line are not significantly different at .05 level.

This was more prevalent in the afore mentioned media than in the others. Calcium was also supplied to the media in the form of $CaNO_3$ at the rate of 3 pounds per 100 gallons of water. This increased the pH from 5.8 to 6.0 and also supplied nitrogen that was needed.

Tomato mosaic virus was the most serious disease problem in the greenhouse. Very little could be done to keep the virus from spreading after infection occurred.

Gray mold, Botytis cinerea and leaf mold, Cladosporium fulvum, infection occurred during periods of high humidity. Tomato stems of two plants infected with gray mold resulted in a decline of growth and yield.

Experiment II

In Treatments 1 and 2, chelated iron and manganese were added to the medium at the rate of one level teaspoon full of each, per bushel of medium during the mixing. Chelated iron and manganese at the rate of 8 ounces of each, per 100 gallons of water, were also added as the fourth flower cluster developed. No apparent deficiency symptoms of these elements appeared in the test plants. After the fifth cluster was set, fertilizer application of 20-20-20 was discontinued. Total soluble salts had accumulated to a level that caused consistent wilting of the plants during the heat of the day. Leaf analysis indicated an excess of nitrates. Data on the variation between replications and media with regard to grade, yield and number of fruit grown are given in Table V. Statistical analyses of data, using Duncan's New Multiple Range, are shown in Table VI.

The plants set in rings made excellent growth and a good set of fruit was secured. A high level of nitrogen in the soil plots was

TABLE V

VARIATION BETWEEN REPLICATIONS AND MEDIA WITH REGARD TO THE NUMBER, WEIGHT, GRADE AND AVERAGE WEIGHT OF TROPIC FRUITS OF PLANTS GROWN IN RING CULTURE[1]

Treatments and Replications	Number and Weight By Grade						Total Number	Total Weight	Avg. Fruit Wt./Plant		% of # 1	% of # 2	Avg. Fruit Wt. /ounce
	# 1		# 2		Culls								
	No.	Wt.	No.	Wt.	No.	Wt.							
I													
Rep 1	215	88.0	35	13.6	3	1.00	250	102.6	14.4		87.5	11.5	6.5
Rep 11	165	70.2	25	8.7	1	.4	190	79.3	11.2				
Rep 111	192	78.0	28	8.9	1	.4	220	87.8	12.3				
Total	572	236.2	88	31.2	5	1.8	660	269.7	12.8	Avg.			
II													
Rep 1	240	76.2	28	7.9	2	1.00	232	85.1	12.2		89.3	9.6	5.8
Rep 11	178	66.4	32	10.1	1	.9	210	77.5	11.1				
Rep 111	225	81.1	25	6.0	1	.4	250	88.0	12.4				
Total	607	223.7	85	24.0	5	1.13	692	250.6	11.9	Avg.			
III													
Rep 1	95	48.5	65	19.4	25	6.7	185	74.6	10.7		63.7	26.4	6.4
Rep 11	125	56.0	49	17.9	30	7.4	204	81.3	11.6				
Rep 111	98	41.2	55	23.2	25	8.1	178	72.5	10.4				
Total	318	145.7	169	60.5	80	22.2	567	228.4	10.9	Avg.			

[1]Fall Crop Harvest Period November 12, 1970 - January 24, 1971
Weight in Pounds of Tomatoes
7 Plants Per Replication.

TABLE VI

ANALYSIS OF YIELD DATA FROM TOMATOES GROWN IN THREE MEDIA IN RING CULTURE. AVERAGE PRODUCTION PER SEVEN PLANT REPLICATION

Fruit Grade In Pounds			
	Treatments		
	2	1	3
#1's	74.56	78.73	48.56
	3	2	1
#2's	20.16	10.40	8.00
	1	2	3
Culls	1.66	1.66	26.6

Any two means not underscored by the same line are significantly different at 0.5 level.

Any two means underscored by the same line are not significantly different at 0.5 level.

caused by previous treatments. This resulted in excessive plant growth and a large number of the fruits were fasciated and cracked. The soil treatment 3 resulted in larger numbers of fruit which were graded as 2's and culls than did treatment 1 or 2, shown in Table V. Sawdust had been added and leaching attempted prior to planting. Sugar was also applied to the soil at one tablespoon per plant and watered in the soil to decrease available nitrogen.

The soil mix, treatment 8 used in Experiment I produced satisfactory yields and high quality fruit. Soil was not used in rings in Experiment 2 because it requires steam sterilization, and handling was more of a problem than with the lighter weight media.

Experiment III

The mix containing sawdust, treatment 1, resulted in death of the plants due to heat build-up in the medium. Within a few days following setting, the plants wilted and died. They were replaced within a week after the medium had been watered and aerated. This caused a delay of one week between plants in treatment 1, as compared to 2 and 3. Data on number, weight, grade and average weight of fruits in trough culture are given in Table VII.

Of the three media used in trough culture, treatment 1 (containing the sawdust) and treatment 2 (containing cardboard mix) were the most difficult in which to control the level of available nitrogen. Applications of additional nitrogen were supplied in the form of $CaNO_3$ at the rate of 3 pounds per 100 gallons of water. Five applications were made during growth of the plants. The first application of $CaNO_3$ was applied during the second week of planting, followed by four additional applications.

TABLE VII

THE EFFECT OF THREE MEDIA ON THE NUMBER, WEIGHT, GRADE AND AVERAGE WEIGHT OF TROPIC TOMATO FRUITS OF PLANTS GROWN IN TROUGH CULTURE[1]

Treatment	Number and Weight By Grade											
	# 1		# 2		Culls		Total Number	Total Wt. Lbs.	Pounds/ Plant	% of # 1	% of # 2	Average Fruit Wt. in Ounces
	No.	Wt.	No.	Wt.	No.	Wt.						
1	370	131.6	55	12.4	32	7.1	457	151.0	10.8	87.1	8.2	5.3
2	477	153.0	35	11.5	29	6.9	541	171.4	12.2	89.2	6.7	5.1
3	450	164.3	60	12.9	20	4.0	530	181.2	12.9	90.6	7.1	5.5

[1] Fall Crop Harvest Period November 15 - January 29, 1970 - 71
Weight in Pounds of Tomatoes.

14 Plants Per Treatment.

Treatment 3 (containing peat and vermiculite) had nutrient problems.

A characteristic of the cultivar Tropic is the tendency to produce short internodes and relatively close spacing of the flower clusters. With a good set of fruit on the early cluster, there was little fruit development on the sixth and seventh cluster of some plants. The retarded fruit did develop normally after fruit from the lower clusters were harvested and the plants had been topped to prevent further vegetative growth. This condition occurred only in Treatment 3 of Experiment 3 of the fall crop in peat and vermiculite mix. The retarded fruit may have been caused by lack of nutrients during development, and insufficient carbohydrates to produce the committed crop and set more fruit.

CHAPTER V

SUMMARY AND CONCLUSIONS

Satisfactory yields of greenhouse tomatoes depends upon the production of good plants with consistently high-quality fruit. Some factors that adversely affect greenhouse tomatoes and which limit production and quality of fruit are soil nutrient imbalance and soil-borne diseases.

The objectives of this study were to evaluate the effects of certain media on the growth and production of greenhouse tomatoes and to determine the different media that might be satisfactory for production and growth.

Factors considered in evaluating these objectives were: (1) fruit quality; (2) effects of media on growth; (3) effect of media on yield and grade of fruit.

Eight media were used in the preliminary test, experiment 1, and are identified as to medium components in Table I. The treatments were replicated twice and all plants grown in ring culture. Data on effect on quality and total yield are given in Table III.

Treatments 1 and 2 from experiment 1 were selected to be used in the fall crop test. Selection of media was based on growth and vigor of the plant, yield and nutrient management. In ring culture the treatments were replicated three times. Data on variation between replications and media with regard to the number, weight, grade and average

weight are given in Table V.

Experiment 3 utilized trough culture and contained three media. The mixture of each medium is given in Table II. Data on production and grade are reported in Table VII.

Maintaining fertilizer and moisture in ring culture was a critical operation, more so than in trough or soil. This was due to the total growth volume of each plant, limited primarily to a ring twelve inches high by ten inches in diameter. In order to increase yields in ring culture, it was necessary to fertilize twice as often in rings than in the growing media in troughs. High temperatures in the media consequently resulted in difficulty in retaining sufficient moisture to prevent wilting, especially with media containing coarse materials such as pecan shells. In the ring culture sun rays were absorbed into the sides of the ring of asphalt paper, resulting in warmer media temperature. Using thermometers in all different media, the temperature exceeded 90° F in rings compared to 76° F in soil. This added warmth around the plant roots may have caused a media root relationship for plant and development of more marketable fruit.

Fertilizer and ingredient rates as recommended by Sheldrake and Dallyn (21) for "peat-lite" mix was used in all media during mixing. Additional chelated iron and manganese were added to the mix at the rate of one level teaspoon full per bushel of medium in Experiments 2 and 3. Nitrogen deficiency was a problem in media containing peanut shells and pine bark thus additional nitrogen was applied in the form of $CaNO_3$. Iron and manganese deficiency symptoms of plants became evident in all treatments. Applications of iron and manganese chelate corrected these problems. Difficulty in keeping the pH at a satisfactory level in media containing cottonseed hulls may have caused

the development of blossom end rot on fruits of these media to a greater extent than in other media. Peanut shells appeared to provide better aeration than did other media.

Due to excess nitrogen in the soil, prior to this experiment, tomato plants grown in soil developed a large percentage of deformed fruit and more vigorous plants. Sawdust was added and leaching attempted prior to planting. Sugar was applied to the soil to decrease the available nitrogen, but deformed fruit continued to develop.

This research has shown that greenhouse tomatoes can be grown in various media and are satisfactory for tomato production if proper nutrient levels are maintained and disease problems are controlled. A major factor in the selection of the medium is economic, not only cost of the materials, but also the availability, handling and maintenance during growth.

Currently most growers are using soil for tomato plant production.

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VITA 2

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Thesis: THE EFFECTS OF CERTAIN MEDIA ON THE GROWTH AND PRODUCTION OF GREENHOUSE TOMATOES

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