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Suwannee Valley

Developing a Production System for Growing Organic Herbs Using Soilless Culture in a Greenhouse[1]

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Abstract

Greenhouse herb production has increased in Florida from near zero acres in 1990 to 19 acres in 2001 (Tyson, et al., 2001). In addition to increased demand for fresh cut herbs in the past ten years, the demand for organic herbs has also increased. Organic production has increased by about 20% annually for the past several years (Thompson, 2000). Combining Florida greenhouse hydroponic and organic production methods together would allow for the production of quality organic herbs due to the increased chance of controlling pests without chemicals in a controlled greenhouse environment. This study was conducted to evaluate organic nutrient sources and programs when using a soilless culture system in plastic pots. Production of basil, chives, cilantro, dill, spearmint, and oregano was evaluated using Fertrell (4-2-4: N-P_2O_5-K_2O), or Nature Safe (8-5-5: N-P_2O_5-K_2O) organic fertilizers applied to the top of the pots filled with a soilless media approved for certified organic production. These treatments were compared to the production of herbs using a standard conventional hydroponic nutrient solution. Each nutrient treatment was also evaluated with or without an additional organic fish fertilizer solution, Neptune's Harvest Fish Fertilizer (2-4-1: N-P_2O_5-K_2O). The conventional hydroponic nutrient solution produced significantly higher yield in all herbs tested, except spearmint where the yields were similar. The addition of Neptune's Harvest Fish Fertilizer had practically no effect on nearly all of the yield parameters of any of the six herbs evaluated in this test.

Introduction

Florida farmers are seeking information on the opportunities to grow and market profitable alternative or specialty crops on their farms. The Florida greenhouse vegetable industry has diversified in the past 10 years, increasing acreage of alternative crops to tomato and cucumber. These alternatives have included colored bell pepper,

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herbs, cut flowers, leafy vegetable crops, and strawberries. Herb acreage in Florida greenhouses has increased from near zero in 1990 to 19 acres in 2001 (Tyson et al., 2001). Many herb markets also seek organically grown herbs (Dunn, 1997). Fresh-cut herbs are becoming more important in the fresh produce market in the US (Greenleaf, 1999). Top fresh-cut herbs include basil, Arugula, cilantro, chives, marjoram, lemon grass, and tarragon (Greer, 2000; Greenleaf, 1999). More information on the production of fresh organic herbs is needed.

Demand for certified organic products continues to increase about 20% annually (Thompson, 2000). Organic field production of many crops in Florida can be very challenging, especially to supply the market for long periods during the year. Greenhouses provide many advantages to a grower to assist in reducing pest problems inherent to Florida organic production. This study was conducted to evaluate the possibility of combining production systems for growing organic herbs using soilless culture and pest management strategies in a greenhouse.

Materials and Methods

This trial was conducted in a double-layer polyethylene covered greenhouse with fan and pad ventilation. The greenhouse was located at the University of Florida North Florida Research and Education Center - Suwannee Valley near Live Oak, Florida. Transplants used in this trial were grown in a standard production system using Metro Mix 200 growing media in a 200 cell (1x1 inch) transplant tray. Seeds of basil, cilantro, dill, and chives were planted in the trays on 5 Sept 2003 (Table 1). A second basil crop was seeded on 21 Oct 2003. Oregano and spearmint rooted cuttings were obtained from Shenandoah Growers, Live Oak, Florida on 30 Oct 2003. Pots (3-gal) were filled with a soilless media mix (Fafard #30) from Conrad Fafard Inc. (Anderson, SC). The Fafard #30 mix is a special blend approved for certified organic production. Pots used for either Nature Safe (Griffin Industries Inc., Cold Spring KY) or Fertrell (Bainbridge, PA) treatments had each nutrient source added to the media prior to filling the pots as listed in Table 2. In both the Nature Safe and Fertrell treatments, pots were irrigated with water only via a micro-irrigation spray-stick emitter system. The hydroponic solution treatment (Table 3) was supplied at each irrigation event via a separate micro-irrigation system also using a spray-stick emitter (Hochmuth, 2001). Neptune's Harvest Fish Fertilizer (Gloucester MA) was added by hand to those pots weekly beginning 3 Dec, adding one cup of a stock solution mixed at a rate of one tablespoon per gallon of water. The nutrient content of the hydroponic standard treatment is listed in Table 3. Irrigation schedule was set by timer to irrigate, as needed, to supply at least 10% leachate at each irrigation event.

Plots were arranged in a split-split plot design with four replications. The main plots were herb crop, the sub plots were nutrient treatment, and split plots were with or without Neptune's Harvest Fish Fertilizer.

Herbs were harvested as a fresh cut product when stems were 6-8 inches long. Harvested product was graded as either marketable or cull based on standards used by Shenandoah Growers, Inc. Live Oak, Florida for packing in small clear plastic containers (clam shells). Cull product included excessive stems. Graded product was weighed and recorded.

Pests were managed in the greenhouse by a variety of biological control tactics (Osborne, 2001 and Osborne et. al., 1998) and sprays approved by certified organic standards (Table 4). The primary target pests included silverleaf whitefly (*Bemesia argentifolii*), fungus gnats (*Bradysia coprophila*), and broad mites (*Polyphagotarsonemus latus*).

Results and Discussion

The first planting of basil on 10 Oct was reseeded on 21 Oct and planted on 24 Nov. The basil was re-established in all plots due to extreme salt damage in Nature Safe and Fertrell plots in the first planting. The damage was observed after the first top dressing of Nature Safe and Fertrell. The method used in this top dressing was to randomly apply the fertilizer material to the top surface of the media in the pot and results in some of the material directly or nearly contacting the stem of the plants. Basil was the only herb in the trial that suffered from salt damage from both Nature Safe and Fertrell treatments. Hydroponic solution pots of all herbs were unaffected. The method of top dressing was altered slightly for the remainder of the trial in all Nature Safe and Fertrell pots. The method was changed to place the fertilizer material in a depression created in the media away from the stems of the plants, but immediately under the irrigation emitter. No further damage was observed in any herb for the remainder of the trial.

Primary Fertilizer Treatments: All herbs, except spearmint, produced much higher season yields in the hydroponic solution treatments with no significant difference between the Nature Safe and Fertrell treatments (Table 5). The exception to this result was found in spearmint where no significant difference was found in any of the main fertilizer treatments, each producing about 300 grams per plant of marketable and total product. Each of the other herbs; basil, chives, cilantro, dill, and oregano, produced approximately half of the marketable and total yield with Nature Safe and Fertrell treatments in comparison to the Hydroponic Solution treatment.

The quality, including color, of each herb from the various fertilizer treatments was excellent overall. Most cull product was excess stem. This extra stem section was

removed and graded as cull to allow the remaining product to meet the grade specifications of 6-8 inches to fit in the clamshells used for packaging.

Neptune's Harvest Treatment: The addition of weekly applications of Neptune's Harvest Fish Fertilizer had no effect on the seasonal marketable or total yield of any herb in this trial (Table 6). Only basil yield in December and total cull yield of chives showed any significant difference; however, the numbers were so low, the result is not considered important. This treatment was applied according to manufacturer's recommendation.

Pest Observations: Primary pests in the trial included silverleaf whitefly, broad mites, and fungus gnats. The population of fungus gnats was difficult to control in this trial. In fact, at the end of the season the population of fungus gnats was very high and still increasing. Silverleaf whitefly and broad mite populations were managed adequately with implemented practices listed in Table 4. In addition to fungus gnats, which inhabited the soilless media, two other Diptera (fly) species were observed at high levels at the end of the trial. The other two flies were identified and one was a member of the family Sphaeroceridae, and the other a Drosophila species. All three of these Diptera (fly) species inhabited the media, especially in the area of the top dressed organic fertilizers. The adults emerge and fly in the production area and serve as a nuisance and a potential contaminant in the harvested product. Additional research in controlling these Diptera pest species will be needed.

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Table 1. Herb crops propagation information and planting arrangements that were evaluated in an organic production system.

Crop	Cultivar	Source	Propagation Method	Propagation Date	Transplant Date	No. of Plants per Plot
Basil	Nufar	Johnny's Seed	Seed	5 Sept/21 Oct[z]	10 Oct/24 Nov	1
Cilantro	Santo	Johnny's Seed	Seed	5 Sept	10 Oct	2
Dill	Boquet	Johnny's Seed	Seed	5 Sept	10 Oct	2
Chives	Staro	Johnny's Seed	Seed	5 Sept	10 Oct	2
Spearmint	Local Selection	Shenandoah Growers	Cutting		30 Oct	1
Oregano	Greek	Shenandoah Growers	Cutting		20 Oct	2

[z] Basil was reseeded on 21 Oct and replanted in the trial on 24 Nov due to the first transplanted basil crop in Nature Safe and Fertrell pots exhibiting extreme "salts" damage on stem.

Table 2. Organic nutrient sources and amounts used to grow six herbs in three gallon plastic pots.

Nutrient Source	Initial Amount per 3 gal pot (g)	Top dress Amount per 3 gal pot (g)
Nature Safe 8-5-5[z]	112	28
Fertrell 4-2-4[z]	225	56
Hydroponic Solution[y]	-	-
Neptune's Harvest Fish Fertilizer[x]	-	-

[z] Nature Safe (8-5-5) and Fertrell (4-2-4) top dressing applications were made on 21 Oct, 7 Nov, 10 Dec, 6 Jan, 26 Jan.
[y] Hydroponic nutrient solution was delivered with every irrigation event for those treatment pots.
[x] Neptune's Harvest Fish Fertilizer top dressing applications were made on 3, 10, 17, 24, 31 Dec; 7, 14, 21, 28 Jan; and 4 Feb. Neptune's Harvest Fish Fertilizer top dressing applications were made with a solution of one tablespoon per gal and a rate of 1 cup per pot.

Table 3. Nutrient solution concentrations used in hydroponic solution treatment.

Nutrient	**Concentration (mg/L)**
N	150
P	50
K	200
Ca	150
Mg	80
S	60
Fe	2.8
Cu	0.2
Mn	0.8
Zn	0.3
B	0.7
Mo	0.05

Table 4. Target pests and management strategies used to grow organic herbs.

Primary Target Pest	**Management Strategies**
Silverleaf whitefly	Banker papaya plant system to rear and release parasitic wasp, *Encarsia transvena*, or sprays of insecticide soaps.
Fungus gnat	Beneficial nematode, *Steinernema feltiae*, application to media.
Broad mites	Banker sorghum plant for predatory mite, *Neoseiulus californicus*

Table 5. Effect of three primary fertilizer programs on the monthly and seasonal yield of six herbs grown in a greenhouse.

Herb	Fertilizer Program	Yield (grams/pot)								
		Oct	Nov	Dec	Jan	Feb	Season Market	Season Cull	Season Total	Relative Yield (% of hydroponic)
Basil	Fertrell	0	0	3 b[z]	33 b	26 b	63 b	1 b	64 b	40
	Hydroponic	0	0	6 a	90 a	56 a	152 a	8 a	159 a	100
	Nature Safe	0	0	3 b	35 b	28 b	66 b	3 ab	69 b	43
	Significance[y]	NS	NS	**	**	*	**	*	**	
Chives	Fertrell	0	18 b	18 b	11 b	24 b	71 b	0 b	71 b	46
	Hydroponic	0	45 a	39 a	25 a	43 a	152 a	1 a	153 a	100
	Nature Safe	0	21 b	26 b	17 ab	37 ab	101 b	0 b	101 b	66
	Significance[y]	NS	**	**	**	*	**	**	**	
Cilantro	Fertrell	0	25 b	78 b	55	0	168 b	77 b	244 b	54
	Hydroponic	0	88 a	118 a	72	0	278 a	174 a	453 a	100
	Nature Safe	0	39 b	70 b	59	0	168 b	91 b	259 b	57
	Significance[y]	NS	**	**	NS	NS	**	**	**	
Dill	Fertrell	17 a	94 b	57 b	0	0	168 b	72 b	240 b	59
	Hydroponic	15 ab	156 a	93 a	0	0	263 a	145 a	407 a	100
	Nature Safe	13 b	75 c	57 b	0	0	146 b	64 b	209 b	51
	Significance[y]	*	**	**	NS	NS	**	**	**	
Spearmint	Fertrell	0	5 b	38	242	0	285	4	288	86
	Hydroponic	0	9 a	56	265	0	330	5	335	100
	Nature Safe	0	4 b	49	280	0	313	9	322	96
	Significance[y]	NS	**	NS	NS	NS	NS	NS	NS	
Oregano	Fertrell	0	4 b	33 b	108 b	72 b	217 b	2	219 b	56
	Hydroponic	0	8 a	71 a	184 a	129 a	391 a	0	391 a	100
	Nature Safe	0	5 b	39 b	125 b	76 b	249 b	2	251 b	64
	Significance[y]	NS	**	**	**	**	**	NS	**	

[z] Means are separated by Duncan's Multiple Range Test. Means for each crops in a column with different letters are significantly different.
[y] Treatment effects were significant at the 1% level (**), 5% level (*), or not significant (NS).

Table 6. Effect of Neptune's Harvest Fish Fertilizer on the monthly and seasonal yield of six herbs grown organically in a greenhouse.

Herb	Addition of Neptune Harvest	Yield (grams/pot)							
		October	November	December	January	February	Season Market	Season Cull	Season Total
Basil	No	0	0	3 b	54	40	97	4	101
	Yes	0	0	5 a	52	33	90	4	94
	Significance[y]	NS	NS	**	NS	NS	NS	NS	NS
Chives	No	0	28	27	17	32	105	1	106
	Yes	0	28	28	18	37	111	0	111
	Significance[y]	NS	NS	NS	NS	NS	NS	**	NS
Cilantro	No	0	54	90	54	0	198	113	311
	Yes	0	54	87	70	0	211	115	326
	Significance[y]	NS	NS	NS	NS	NS	NS	NS	NS
Dill	No	15	109	66	0	0	190	95	285
	Yes	15	108	71	0	0	194	92	286
	Significance[y]	NS	NS	NS	NS	NS	NS	NS	NS
Spearmint	No	0	6	50	272	0	328	5	333
	Yes	0	6	46	239	0	291	7	298
	Significance[y]	NS	NS	NS	NS	NS	NS	NS	NS
Oregano	No	0	6	46	142	95	290	1	291
	Yes	0	6	49	137	89	282	2	283
	Significance[y]	NS	NS	NS	NS	NS	NS	NS	NS

[z] Means are separated by Duncan's Multiple Range Test. Means for each crops in a column with different letters are significantly different.
[y] Treatment effects were significant at the 1% level (**), 5% level (I), or not significant (NS).