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Organic Greenhouse Container Herb Production in South Florida: Fertilizer and Potting Media[1]

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Background

Organic food production in the U.S. increased approximately 20% annually during the past 15 years. Organic herb sales continue to increase as consumer interest in organic food grows. Public interest in organic foods has grown since the implementation of national organic standards by the U.S. Departement of Agriculture (Greene and Dimitri, 2003).

Field production of organic crops, including herbs, in south Florida is a challenging task due to the subtropical climate and high number of pest and disease pressures. Thus, greenhouse production of organic herbs may provide an alernate to field production. However, there is little published information on selecting media and fertilizers for organic herb production in greenhouses in this climate.

Objectives

Greenhouse trials were conducted during the 2005 and 2006 growing season at the University of Florida IFAS Tropical Research and Education Center (TREC) in Homestead, Florida. The objectives of the project were to 1) compare several commercially available organic fertilizers for organic greenhouse production of container herbs and 2) compare two commercially available potting media for organic greenhouse production of container herbs.

Methods

The three commercial certified organic fertilizers used in this project were Nature Safe (Griffin Industries, 8-5-5; Coldspring, KY), Fertrell (Fertrell Company, 4-2-4; Bainbridge, PA), and Perdue (Perdue Agri Recycle, 4-2-3; Seaford, Delaware). They were compared with a control treatment of no fertilizer application.

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Two certified organic potting media were used. These were Fafard Organic formula (Conrad Farfard, Inc.; Agawam, MA) and Agro-Soils commercial potting medium (Agro Soils; Miami, FL).

The three organic fertilizers were mixed with the two potting media at specified rates (Fafard and Agro-Soils, Table 1). The different rates were due to the nutrient composition of each fertilizer. Table 1 also includes the cost per 50 lb bag of each fertilizer.

Table 1. Potting mix rates of fertilizer and potting media

Fertilzer	Composition	Grams of fertilizer per gallon of potting media	Cost per 50 lb bag
Nature Safe	Feather, meat, bone and blood meals, sulfate of potash, yeast, sugars, carbohydrates, and humus	40	$16.50
Fertrell	Aragonite, bone char, composted chicken manure, sodium nitrate, feather meal, greensand, peanut meal, sulfur, sulfate of potash	80	$16.13
Perdue	Poultry litter	80	$8.75

The Control treatment consisted of 0 grams of fertilizer per gallon of potting medium. Potting mixes were placed in 4 inch diameter plastic pots. The four treatments (Nature Safe fertilizer, Fertrell fertilizer, Perdue fertilizer, and Control (no fertilizer)) were replicated four times and each replication consisted of six pots.

Pots were seeded with basil (*Ocimum basilicum)* (Fig. 1) and dill (*Anethum graveolens*) (Fig. 2). A light pinch of seeds (about 280 mg seeds for basil and 170 mg seeds for dill) was placed in each pot on the top of the potting mix and covered with ~5 mm of potting mix.

Basil is available in many different types and has a pleasant aroma. Basil has green, tender broad leaves that may be used fresh or dried. Basil is well known for its culinary use; however, it is also a versatile landscape plant (Wetherbee, 2001). Dill is a flavoring plant (i.e., dill pickles) with a strong-aroma and fennel-like structure (Stephens, 1998). Dill has also been used to sooth digestion and hiccups.

Figure 1. Basil showing its light green, silky broad leaves
Credits: UF/IFAS: Yun Qian

Figure 2. Dill showing its finely divided thread-like leaves
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Pots were placed in a greenhouse and irrigated with time-controlled overhead sprinklers. Plants were grown to obtain a marketable product to be sold as organic potted herbs. Irrigation was adjusted during the course of the experiment to ensure this goal.

Each of the two trials lasted approximately four weeks. The quality of plants at the end of four weeks was evaluated using several different criteria, including visual quality, fresh weight and dry weight of above ground plant tissue, percent of total nitrogen (TN) and total carbon (TC) from plant tissue, nitrate (NO_3-N) and potassium (K^+) concentrations in plant sap, and pH and electric conductivity (EC) in leachate.

Leachate sampling for pH and EC was conducted as an indicator of nutrient loss from the potting mix by leachate.

Data were evaluated with analysis of variance and Duncan's multiple range test using PROC GLM program in SAS 9.1.2 to evaluate differences in mean values among fertilizer and potting media treatments. Statistics were completed for each trial separately.

Results and Discussion

Evaluation of results indicated that there were no significant differences between the two potting media for all measured parameters. Thus, the data were analyzed by fertilizer type only. Results are presented in Tables 2, 3, 4, and 5. The 'a', 'b', and 'c' values in each table represent statistical results such that values with common letters are not significantly different and values with uncommon letters are significantly different.

The visual inspection, fresh weight, and dry weight measurements for basil and dill indicated that Perdue and Fertrell fertilizers provided the most visually pleasing and largest plants (Table 2 and Table 3).

Plant tissue nutrient results differed by herb (Table 4 and Table 5). Nutrient composition for basil was highly variable. Basil plants from the control fertilizer treatment had the greatest concentration of NO_3-N for both trials. However, %TN was the lowest in the control treatment for both trials. Percent TN was significantly greater in the Nature Safe basil treatment than other fertilizer treatments. The lack of correlation between NO_3-N and %TN was likely due to the different nature of the tests. For NO_3-N, plant sap was measured from several leaves. Alternatively, %TN was measured using dried biomass of a larger sample of the plant. Another possibility is the very nature of the nitrogen form. Percent TN includes both organic and inorganic forms of nitrogen, whereas NO_3-N only considers the inorganic form of nitrogen.

Percent TC for basil treatments varied by trial. There were no signficiant differences in the first trial, and %TC was significantly greater in Natural Safe and the Control fertilizer treatments in the second trial.

For dill, NO_3-N results were inconclusive with Fertrell having the greatest concentration in the first trial and Natural Safe and Perdue having the greatest concentrations in the second trial. Similarly, K^+ results did not consistently identify one fertilizer as resulting in the greatest concentrations for dill. TN and TC percentages in dill also varied by trial; however the Natural Safe fertilizer treatment was consistently high.

Hence, plant tissue and plant sap nutrient results did not clearly identify a fertilizer treatment that was significantly better than another.

Results from pH testing of leachate offered little additional information with minimal significant variation among treatments. Similarly, there were no significant differences among any treatments when evaluating leachate EC.

Conclusions

The two potting media (Fafard and Agro-Soils) did not result in significant differences in measured plant mass production, plant tissue nutrients, or leachate chemistry. However, some differences in plant production for basil and dill were identified among the different fertilizer treatments (Natural Safe, Perdue, Fertrell, and Control). These differences were most notable for visual quality, fresh weight, and dry weight measurements. Evaluation of these parameters for basil and dill suggested that the two best fertilizers were Perdue and Fertrell. However, the differences in cost of each fertilizer and the study results suggest that Perdue is a more economic choice for organic herb production of basil and dill.

Results of these two trials for growing organic herbs in south Florida suggest that (1) there is no difference in using Fafard or Agro-Soils potting medium and (2) Perdue and Fertrell fertilizers resulted in greatest plant mass production.

Clearly appropriate potting media and fertilizer formulations are commercially available for use in greenhouse production of basil and dill.

Reference

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Table 2. Data collected for trial 1. Means with same letter are not significantly different by Duncan's multiple range test (p=0.05)

Crop	Fertilizer	Visual	Fresh weight (g)	Dry weight (g)	pH (standard units)	EC (uS/cm)
Dill	Natural Safe	2.03b	12.05b	2.08b	7.07ba	1592ba
Dill	Perdue	4.25a	61.80a	5.41a	6.66b	1493ba
Dill	Fertrell	4.47a	59.31a	5.29a	6.72a	3570a
Dill	Control	1.00c	5.53b	0.69b	7.29a	525b
Basil	Natural Safe	2.75b	79.50b	4.78b	6.77b	1643a
Basil	Perdue	4.56a	135.74a	9.03a	6.96ba	450a
Basil	Fertrell	4.81a	131.60a	9.46a	6.90ba	1772a
Basil	Control	1.00c	12.59c	1.64c	7.37a	392a

Table 3. Data collected for trial 2. Means with same letter are not significantly different by Duncan's multiple range test (p=0.05)

Crop	Fertilizer	Visual	Fresh weight (g)	Dry weight (g)	pH (standard units)	EC (uS/cm)
Dill	Natural Safe	1.19b	5.28b	0.13b	7.13ba	432a
Dill	Perdue	2.25a	14.11a	0.58a	7.05b	472a
Dill	Fertrell	2.38a	13.66a	0.56a	7.14ba	460a
Dill	Control	1.00b	4.31b	0.19b	7.21a	414a
Basil	Natural Safe	3.19b	51.78b	2.84b	7.05a	357a
Basil	Perdue	4.25a	89.88a	4.84a	7.07a	382a
Basil	Fertrell	4.31a	83.49a	4.79a	7.18a	373a
Basil	Control	1.00c	11.74c	0.66c	7.20a	396a

Table 4. Nutrient data collected for trial 1. Means with same letter are not significantly different by Duncan's multiple range test (p=0.05)

Crop	Fertilizer	NO_3-N (mg/L)	K (mg/L)	%TN	%TC
Dill	Natural Safe	1095b	1197cb	4.0a	35.3a
Dill	Perdue	682b	2167a	2.7b	34.6ba
Dill	Fertrell	5047a	1643b	4.2a	34.0b
Dill	Control	832b	843c	1.0c	34.0b
Basil	Natural Safe	1162b	682a	4.0a	36.5a
Basil	Perdue	402b	805a	2.5c	37.1a
Basil	Fertrell	918b	588a	3.1b	37.1a
Basil	Control	4645a	345a	1.0d	37.1a

Table 5. Nutrient data collected with statistical indicators for trial 2

Crop	Fertilizer	NO_3-N (mg/L)	K (mg/L)	%TN	%TC
Dill	Natural Safe	653ba	1547a	3.2a	33.4a
Dill	Perdue	762a	1577a	2.8ba	32.3b
Dill	Fertrell	345bc	1007a	2.5b	33.2a
Dill	Control	313c	1295a	1.3c	33.6a
Basil	Natural Safe	413a	235b	3.0a	35.7ba
Basil	Perdue	405a	493a	2.1b	34.8c
Basil	Fertrell	248a	410a	2.0b	35.3b
Basil	Control	452a	457a	1.2c	36.1a