HYDROPONIC PRODUCTION OF FRESH GINGER ROOTS (ZINGIBER OFFICINALE) AS AN ALTERNATIVE METHOD FOR SOUTH FLORIDA

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Abstract. Ginger (Zingiber officinale Rosc.) is considered an important ingredient for most Asian cuisines. The imports of ginger to the United States rose from 13,449 t in 1997 to 20,097 t in the year 2000. China is considered the main supplier of fresh ginger to the United States. Hawaii is the only state in the U.S. that is currently commercially producing fresh ginger. The wholesale prices for fresh ginger are better in the months of July to September. An experiment was conducted to compare the yield and quality of fresh ginger under a greenhouse hydroponic production system with that of a field-grown system. The hydroponic system produced more yield and better quality rhizomes. Preliminary observation showed that costs of production were lower under the hydroponic system due to reduced maintenance associated with disease, insect, and weed control.

Ginger (Zingiber officinale, Rosc.) is one of the most ancient plant species known to man and is used for many purposes. It is believed to be native to Malaysia or India in Asia (Rafie, 2000). Ginger has an excellent reputation in ancient Indian and Chinese medicine and is used to spice food as in most Asian cuisines. It has many medicinal properties (Davies, 2000). Ginger is mainly produced in tropical and sub-tropical regions. The plant produces underground rhizomes, which are harvested 8-10 months after planting. The world production of ginger in 2002 was 988,182 t in which India, China, and Indonesia are considered the leaders, producing a total of 67% of the world production (FAO, 2003). Hawaii is the only state in the United States that is currently commercially producing ginger. In the year 2002, Hawaii produced 6,545 t of fresh ginger (USDA, 2003). Figure 1 shows the volume of imported ginger roots from different countries to the United States from 1997 to 2002. The total imports rose from 13,449 t in 1997 to 20,097 t in 2002. Chinese export of ginger roots to the United States rose from 2,361 t in 1998 to 12,459 t in 2002. However, Central American export of ginger roots to the United States decreased from 6,676 t in 1997 to as low as 1,715 t in 2002 (USDA, 2003). Prices for fresh ginger roots vary from year to year. In general, prices are higher during the months of July to September (Fig. 2; FHIA, 2003).

Traditionally, ginger is grown in the field. No publications were found on the hydroponic production of ginger under greenhouse conditions. An experiment was conducted at the production facility of Shenandoah Growers, an herb growing and marketing company in Homestead, Florida, to compare the yield and quality of greenhouse hydroponically produced ginger with field-grown ginger.

Materials and Methods

The treatments for this experiment were production of ginger hydroponically in the greenhouse and outdoors in raised beds. For both treatments, pieces of ginger rhizomes (4 oz) were sectioned, treated with Vitavax fungicide, and prepared as “seeds”. The “seeds” were planted in Mar. 2002, 1 ft apart in the rows and 1.5 ft between rows. For the hydroponic system, the “seeds” were planted inside in trays filled with a medium of coarse perlite. The nutrient solutions for the hydroponic production system were prepared in three different tanks. In tank number one, three 25-lb bags of PRO.SOL 5-11-26 Hydroponic Formula (HF; Frit Industries, Inc., Ozark, Ala.) were used to make a 30-gal stock solution. Minor elements such as boron (15 g), manganese (1/4 lb), magnesium

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(4 lb), iron (4 oz) were added to the PRO.SOL stock solution. In tank number two, one 50-lb bag of calcium nitrate was used to make a 30-gal stock solution. In tank number three, 5 gal of sulfuric acid per 100 gal of water was prepared. All three stock solutions were added into a 1,050-gal holding tank to be injected as needed. A controller, electric conductivity (EC) meter, and pH meter were used to maintain fertilizer and acid within the set ranges. For the raised bed production system, the same amount of N-P-K fertilizer and minor elements were calculated and applied in four different occasions, starting 3 months after planting. Each treatment was replicated 10 times with each plot containing five ginger plants. Three months after planting, the outdoor plants showed symptoms of leaf spot (*Phyllosticta zingiberi*). For the outdoor treatment, a total of five applications of Bravo fungicide (Syngenta Crop Protection, Greensboro, N.C.) were made at 2-week intervals to control the leaf spot. Outdoor plots were weeded five times. Beginning 4 months after planting, individual plants of both treatments were mounded every 2 months for four times during the season. Mounding is a common practice with commercial ginger production and it is done to cover with soil the newly developed rhizomes that grow upward in the soil. Mounding prevents exposure of the rhizomes to sunlight. All plots for both treatments were harvested in Jan. 2003, when the foliage parts of the plants were completely dried out. The rhizomes from individual plants for each plot were classified according to market standards as “Extra Large”, “Large”, and “Medium” grades (Table 1; FHIA, 2003). The retail market in the United States is mainly interested in the “Extra Large” grade and only buys “Large” and “Medium” size grades when there is a short supply of fresh ginger in the market.

### Results and Discussion

Data for the total yield and grade “Extra large” were analyzed using a “t” test to determine if the differences between the treatment means were statistically significant.

Table 2 shows the total yield and grade “Extra Large” weight of ginger roots per plant for both treatments. The hydroponic production system produced 7.65 lb of fresh rhizomes per plant compared to 4.75 lb per plant for the outdoor raised bed production system, a 62% increase that was statistically significant. For grade “Extra Large” ginger rhizomes, the hydroponic production system produced 5.2 lb per plant in comparison to 3.15 lb per plant for the outdoor raised bed production system, a 2 lb per plant difference that was statistically significant.

Also, it was observed that in the plots in the hydroponic production system, leaves did not show any symptoms of disease or insect damage. Furthermore, no weed control was needed, it was easier to mound the plants, and easier to wash the ginger rhizomes after harvest in comparison to the plots in the outdoor raised bed production system. Considering the cost of the labor necessary to produce ginger outside, the hydroponic system appears to be a good alternative. Both yield and quality of ginger rhizomes produced are better under the hydroponic system, and the cost of production is lower. There is now a need to do an economic analysis to compare production costs for the two systems.

Some of the ginger rhizomes harvested from the hydroponic plots showed symptoms of rotting. This was believed to be due to the continuous flow of water and nutrients after the plants had reached maturity. There was no rotting in the outdoor raised bed plots.

### Literature Cited


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