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Exploring Production Practices and Market Potential of Baby Ginger in Temperate Climates

Abstract

A two-year project was developed to evaluate best management practices and determine market potential for baby ginger (*Zingiber officinale*) as a new niche crop grown in New Jersey. Field trials of baby ginger (cv. Peruvian Yellow) documented production methods at two different locations. Weekly harvest and yield data indicated the optimum harvest window for this crop, with average yields of 2.4 and 1.725 lbs. per foot in 2021 and 2022, respectively. Ginger samples were sent to 18 local businesses with surveys that indicated high levels of satisfaction with the crop and a strong likelihood of purchasing from local growers.

Abbreviations: Cream Ridge (CR), Student Farm (SF)

Keywords: Ginger, specialty crops, niche crop, high tunnel, market survey

Introduction

Ginger (*Zingiber officinale*) is a perennial herbaceous monocot that is native to tropical regions of Asia and is grown commercially as an annual crop (Jabborova et al., 2022; Kandiannan et al., 1996; Tiwari et al., 2019). Ginger is one of the earliest eastern spices known to the West (Kandiannan et al., 1996) and is commonly used in many African, Asian, and Caribbean recipes, as well as herbal teas. Ginger is typically sold fresh

whole or dried and ground (Ernst and Durbin, 2019). What many people refer to as the “ginger root” is actually the “ginger rhizome,” which refers to the underground stem of the plant (Kandiannan et al., 1996; Mahr, n.d.). The continental United States imports most of its ginger, where it is typically grown in warm and humid tropical and subtropical climates (Jabborova et al., 2022; Retana-Cordero et al., 2022). Countries that produce ginger on a large scale include India, China, Indonesia, Thailand, and some countries in the Pacific Islands and South America.

However, ginger can also be grown in temperate climates. Recently, farmers throughout the United States have been successfully growing baby ginger in high tunnels. Fresh baby ginger is a unique product that is different than the mature ginger that is sold in grocery stores and coupled with the increasing demand for locally grown food, it has potential as an excellent niche crop for farmers markets, restaurants, community supported agriculture (CSA) operations, and other direct marketing endeavors (Rafie et al., 2012). Baby ginger is tender, non-fibrous, and perishable (Sideman, 2018). It can be utilized for typical culinary purposes, and it is also well suited to be candied or pickled due to its low fiber content. Even though baby ginger is relatively perishable, it does freeze well for future cooking applications. Additionally, recent research shows that baby ginger contains significantly more polyphenols and antioxidants than mature ginger, as ginger’s phenolic content and antioxidant activity can drop as much as 50% as the ginger matures (Li et al., 2022).

While baby ginger is ready for harvest 3 to 4 months before mature ginger, it still requires approximately 200 frost free days to produce a harvestable crop. In New Jersey, this involves pre-sprouting the ginger “seed” pieces in late February or early March in a heated greenhouse before they can be transplanted into the field. The seed pieces are sections of the rhizome, generally weighing 1 to 2 ounces each. Seed size is important, as pieces that are excessively large reduce the total number of seed pieces to plant, and very small seed pieces will result in reduced growth and overall yield (Gebre and Tesfaye, 2008; Tiwari et al., 2019). When pre-sprouting, germination and yields increase significantly by bottom heat from the use of heat mats (Ernst and Durbin, 2019; Sideman, 2018).

Ginger is also susceptible to several soil-borne pathogens including bacterial wilt *(Ralstonia solanacearum*)*,* bacterial soft rot (*Erwinia chrysanthemi*), *Pythium* spp., *Rhizoctonia* spp., and *Fusarium* spp. (Meenu and Jebasingh, 2019). Purchasing disease-free seed stock is the first line of defense against these problems. Soil-borne nematodes can also be a potential pest of ginger. It is important to avoid planting in areas where other crops that are susceptible to these pathogens have been recently grown to further minimize disease pressure. Growing the crop in a high tunnel not only provides necessary temperature modification, but also protects the crop from excessive rainfall events, which can lead to overly saturated soils and the development of disease problems. Moveable high tunnels allow the crop to be rotated from one section of the field to another each year, further helping to reduce the buildup of soil-borne pathogens.

When soil temperatures in the high tunnel are consistently 55^{o}F or higher, the sprouted seed pieces can be transplanted into the soil. This is likely to be in late April or early May in the Mid-Atlantic region. Ginger requires high levels of soil nutrition and grows best with compost additions and supplemental nitrogen (100 lbs. N per acre before planting plus two additional applications of 25 lbs. N per acre during the growing season). A neutral to slightly acidic pH (approximately 6.5) is recommended, and adequate calcium is important for the crop. Drip irrigation is also recommended to conserve water and reduce moisture on leaves.

Ginger is generally harvested from late September or early October into November in the Mid-Atlantic. The leaves will begin to turn brown as temperatures drop and frost begins to occur. Ginger plants can remain in the ground as long as there is at least one inch of green tissue still living above the rhizome, but many growers will harvest sooner to ensure that frost does not reach the rhizome and cause damage. The plants are pulled from the ground using a digging fork and care should be taken not to damage the delicate skin of the rhizome. Baby ginger is perishable and will store for about two weeks in cold storage.

This project documented production practices for growing baby ginger ‘Peruvian Yellow’ in high tunnels in Central New Jersey, at the Rutgers University Specialty Crop

Research and Extension Center in Cream Ridge (CR) and the Rutgers Gardens Student Farm (SF) in New Brunswick. The baby ginger from these trials was sold at a farmers' market and samples were donated to local restaurants and other businesses with a survey to assess their satisfaction with the crop and their likelihood of purchasing it from local growers in the future.

Methods

Pre-sprouting ginger seed

For the CR trial, ginger seed pieces were spread out in a single layer in flats and covered with 1-2" of potting mix (Pro-Mix BX) in a heated greenhouse at the Rutgers University Specialty Crop Research and Extension Center in Cream Ridge, NJ. The temperature in the greenhouse was maintained at approximately 75^{o}F. The flats were placed on heat mats set to 72^{o}F to maintain an even and consistent temperature in the root zone. The medium in the sprouting trays was supplied with adequate moisture but was never over-watered. Shoots emerged out of the medium and roots developed over an 8-week period. The pre-sprouting procedure was similar at the Student Farm (SF), but heat mats were not utilized and instead, the flats were stacked and placed in a walk-in cooler that was converted into a sprouting chamber. The temperature in the chamber was maintained at approximately 73^{o}F. Once the first shoots began to emerge at 6 weeks, the flats were moved to a greenhouse to provide adequate lighting. The greenhouse temperature was maintained at 65^{o}F.

Planting ginger in the high tunnel

At CR, sprouted ginger seed pieces were planted into Collington sandy loam soil (pH 6.2), 6 inches apart and 8 inches deep into trenches spaced 2 feet apart, with a pre-plant application of organic 8-2-4 fertilizer (Sustane) equivalent to a rate of 100 lbs. N per acre. They were then lightly covered with a few inches of soil so that the tip of the shoot was still showing. Each row was 20 feet long and was repeated eight times across two moveable high tunnels, for a total of eight 20-foot rows. Approximately 26 lbs. of seed were planted across the 160 row feet in this trial. The plants were hilled two times throughout the growing season as the shoots grew taller and the underground

rhizomes began to develop. The plants also received three applications of 10-20-10 liquid fertilizer throughout the season at a rate equivalent to 20 lbs. N per acre.

At the SF, the ginger seed pieces were planted into Nixon loam soil (pH 6.7), 6 inches apart and 4 inches deep into furrows spaced 4 feet apart. Each row was 30 feet long, with a total of 4 rows. Approximately 20 lbs. of seed were planted across 120 row feet. An 8-1-1 granular fertilizer was applied equivalent to a rate of 100 lbs. N per acre prior to planting (McGeary Organics). Plants were hilled once in mid-July as the rhizomes emerged above the soil line. Prior to hilling, the plants were side dressed with the same fertilizer equivalent to a rate of 70 lbs. N per acre.

Harvesting ginger

The ginger at CR was harvested and weighed over a 4-week period (October 13 to November 3, 2021) to determine if any significant increases in size occurred during this time. Each week, eight 5–foot sections from the eight 20-foot rows were harvested, and the tops and roots trimmed and washed free of soil before being weighed. At the SF, baby ginger was harvested and weighed over a 10-week period (September 29 to December 1, 2022). In mid-November, all remaining tops were trimmed just above the soil line and multiple layers of row cover were used to protect the rhizomes from freezing. The SF ginger was sold at a farmers market located in New Brunswick, NJ.

Survey methods

Samples of baby ginger harvested from CR were donated to 18 local restaurants, breweries, and distilleries with a link to a survey about the crop. Each establishment received at least 5 lbs. of freshly harvested and washed baby ginger. A 13-question survey was given to assess the type of establishment, crop use, and quality metrics of the crop. The survey included the following questions:

- What type of operation are you representing?
- What is your current role in the operation?
- How many seats does your establishment have?
- What is served at your establishment?
- How is ginger used at your establishment?

- Have you ever used baby ginger before?
- How satisfied were you with each of the following aspects of the baby ginger sample you received?
    - Flavor
    - Color
    - Freshness
    - Ease of Use
    - Quality
    - Overall
- How likely are you to purchase baby ginger for future use?
- Are there any additional comments or feedback you would like to provide?

Statistical analysis

Statistical analyses were determined using a one-way analysis of variance (ANOVA) using the general linear model procedure of SAS (version 9.3; SAS Institute, Cary, NC, USA). Differences between the means were distinguished by Fisher's protected least significant difference (LSD) test at the 0.05 probability level.

Results

Harvest and yield data

At CR, harvested ginger yields ranged from 2.26 to 2.53 lbs. per row foot during the four-week harvest period (Figure 1), with an average overall yield of 2.4 lbs. per row foot. While trends of slight increases were observed over the course of the four weeks, these results were not statistically significant, suggesting that ginger could have been be harvested at any time during this four-week period without noticeable reductions in yield.

At the SF, harvest weights ranged from 1.39 to 1.91 lbs. per foot across a ten-week period (Figure 2), with an average overall yield of 1.725 lbs. per foot. Like CR, there was no correlation between yield and date of harvest. In fact, the initial SF harvest matched the highest average yield per row foot in 2022 at 1.91 lbs. Harvest and yield data for both sites are compared in Table 1.

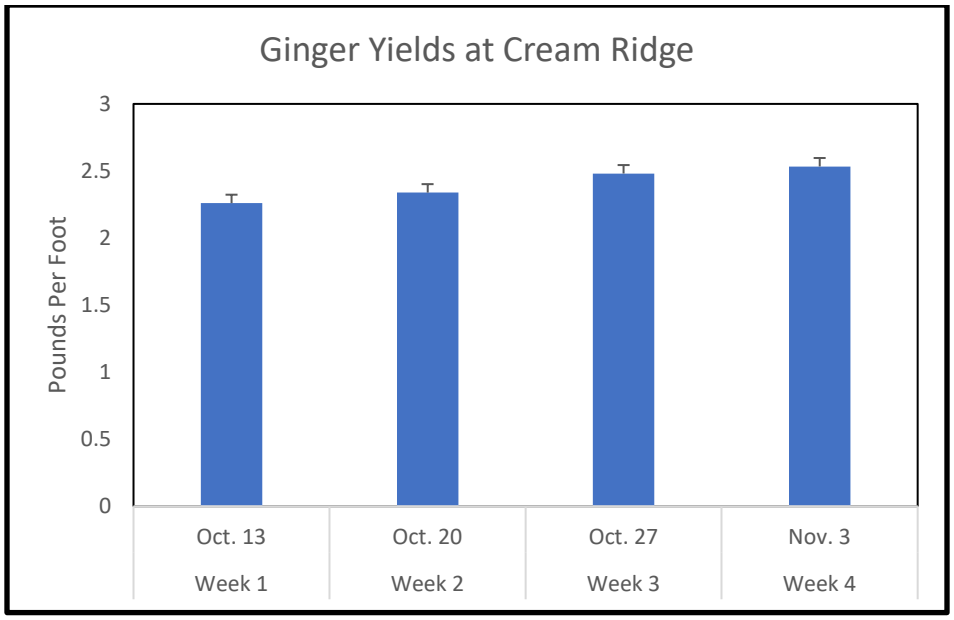

Figure 1: Ginger yields at Cream Ridge (CR), representing an average of 8 beds with 5 feet harvested per bed over a 4-week period. No significant differences were observed when comparing yields across weeks ($p < 0.05$).

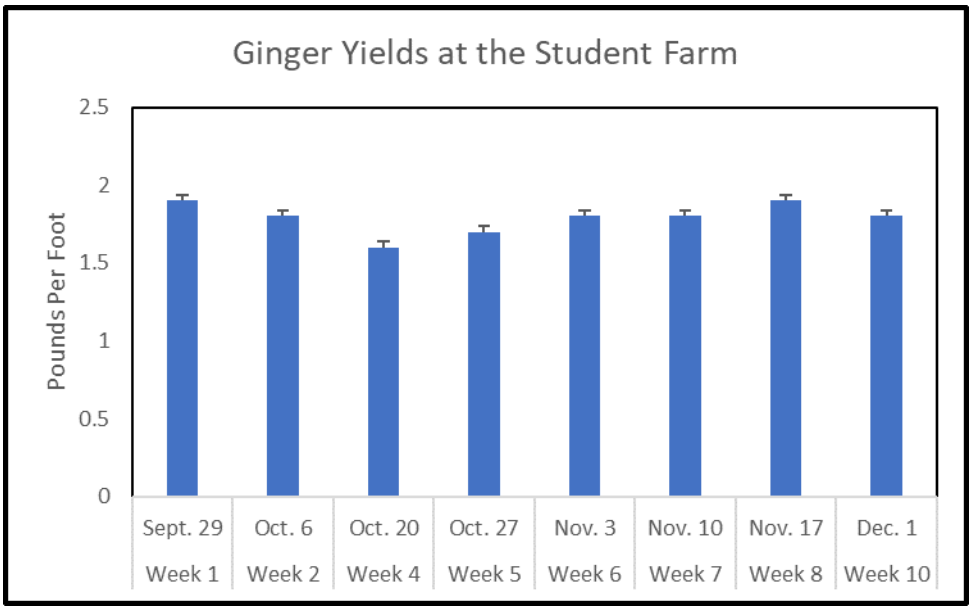

Figure 2: Ginger yields at the Student Farm (SF), representing 8 harvests over a 10-week period. There was no harvest Week 3 or Week 9. No significant differences were observed when comparing yields across weeks ($p < 0.05$).

Table 1: Harvest and yield data for baby ginger grown at two different locations in Central New Jersey.

Location	Pounds of Seed Planted (lbs.)	Total Yield (lbs.)	Yield Per Foot (lbs.)	Pounds Harvested: Pounds Planted	Value per Foot (@$16/lb.)	Total Value	Total Row Length (ft.)	Bottom Heat
Cream Ridge (CR)	26	384.5	2.4	14.8	$38.45	$6,152.00	160	Yes
Student Farm (SF)	20	207	1.725	10.4	$27.60	$3,312.00	120	No

Survey response data

Eighteen ginger samples and accompanying surveys were distributed to local businesses, with a total of 16 survey responses (*N* = 16) completed and returned by restaurants, cafes, breweries, distilleries, and educational culinary programs. Respondents defined their roles as owner (27.3%), chef (22.7%), purchaser (13.6%), marketing (4.6%), or other (31.8%), which included directors and educators. The businesses ranged in size, with 33.3% having 25 to 30 seats, 25% having 50 to 100 seats, 25% having 1 to 20 seats, and 16.7% having 0 seats. These establishments indicated that they served lunch (32.0%), breakfast (12.0%), dinner (12.0%), brunch (8.0%), craft cocktails (8%), catered meals (8%), or other (20%), which included beer, bottled spirits, and tasting dinners. When asked about how ginger is used in their establishment, 70% indicated that special menu items are sometimes prepared with ginger, 20% indicated that regular menu items are prepared with ginger, and 10% indicated that none of their menu items are prepared with ginger. Additionally, 81.8% of respondents had never used baby ginger before participating in this project. Participants indicated a high level of satisfaction with various qualities of the baby ginger samples they received, with 100% responding that they were 'Very Satisfied' overall (Figure 3). In response to questioning about how likely they would be to purchase baby ginger in the future, 91% said they were either ‘Extremely Likely’ or ‘Somewhat Likely’ to purchase it, while 9% said they were ‘Neither Likely nor Unlikely’ to purchase it. Additional feedback and comments from the respondents included: “The ginger had excellent flavor,” “The baby ginger was beautiful and tropical looking,” and “Very easy to peel and much more flavorful than any other ginger I’ve tried.”

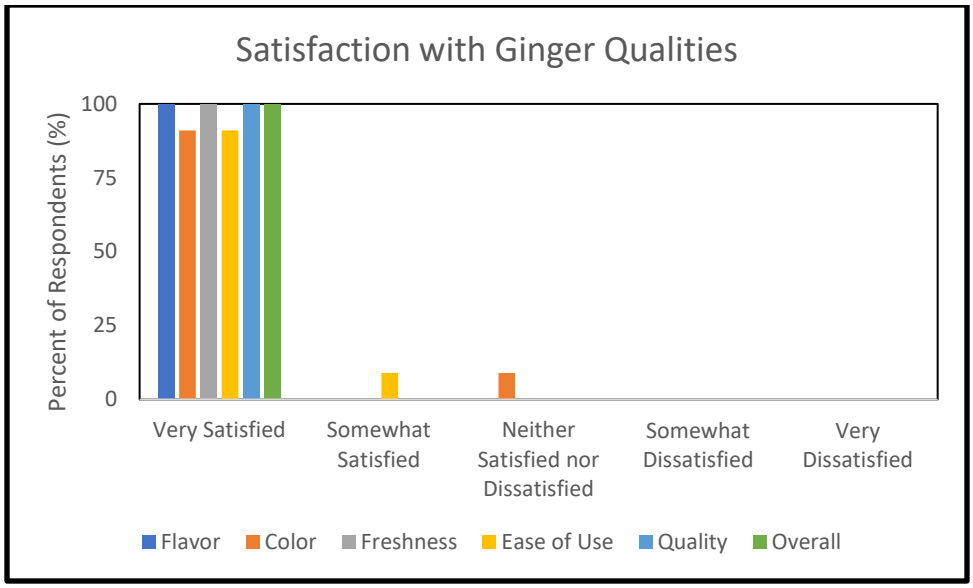

Figure 3: Responses from local businesses indicating their level of satisfaction with various qualities of the baby ginger samples they received.

Discussion

In our trials, harvested ginger yields by weight ranged from 2.26 to 2.53 lbs. per foot (CR: conventional) and 1.39 to 1.91 lbs. per foot (SF: organic). This is not direct side-by-side comparison, as the trials were conducted at different locations using different production methods across two years, but this preliminary data suggests that baby ginger can be an economically viable crop using different production systems. The total harvested yield for 'Peruvian Yellow' baby ginger at CR was 384.5 lbs. from 26 lbs. of seed planted in 160 row feet. This equates to 14.8 lbs. harvested for every 1 lb. planted and approximately 2.4 lbs. of ginger harvested per foot. At a retail price of $16 per lb., the total value of the harvest was $6,152 or approximately $38.45 per linear foot. The total harvested yield for 'Peruvian Yellow' baby ginger at the SF location was 207 lbs. from 20 lbs. of seed planted across 120 row feet. This equates to 10.4 lbs. harvested for every 1 lb. planted and approximately 1.725 lbs. of ginger harvested per foot. At a retail price of $16 per lb. at the farmers market, the total value of the 2022 harvest was $3,312 or $27.60 per linear foot.

The plants with the highest yields (CR) had received bottom heat treatment during the pre-spouting phase, which is consistent with the previous findings of Sideman (2018). At the time of transplanting, the pre-sprouted SF plants had reduced root and shoot growth relative to the CR plants that received bottom heat, which may have contributed to the differences in yield. Additionally, liquid fertilizer treatments during the growing season may have provided a more soluble and readily available source of fertility in the CR plots, compared to the organic granular fertilizer that was side dressed at the SF location. Despite the variations in yield between the two sites, baby ginger was still a very productive crop in each location, with some individual rhizomes weighing over 2 lbs. each.

The survey responses from local businesses suggest that there is demand for baby ginger and strong potential for further market development. The broad range of establishments that were represented indicates that baby ginger may be a popular crop for various food and beverage products. Interestingly, while 81.8% of survey participants said they had never used baby ginger before, 100% were satisfied with the crop overall, and 91% said they were likely to purchase it in the future. This data is promising and these developing relationships with local businesses may encourage local farmers to start growing baby ginger as a lucrative niche crop.

These results and recommended growing practices for baby ginger were communicated directly to approximately 585 growers through various outreach methods, including five in-person professional grower conference presentations (305 total participants), four in-person twilight meeting field tours (150 total participants), and three virtual presentations (130 total participants). Three separate grower conference proceedings were also published for state and regional audiences. Additional extension outputs included the production of two YouTube videos and six social media posts on growing ginger. The Rutgers Student Farm also sold ginger at their farmers market for a total of 8 weeks, with approximately 800 customers visiting the stand and 350 customers purchasing ginger during that time period.

Conclusions

Baby ginger retails for approximately $16 per pound at farmers markets and can wholesale for $10 per pound. The yields achieved in this study, suggest that retail values of baby ginger have the potential to gross between $28 and $38 per linear foot of bed space planted, making it a valuable crop for growers in temperate climates who are involved in direct market sales.

The high level of satisfaction from market customers, and local restaurants and breweries, combined with their willingness to purchase baby ginger from growers further indicates the potential for growing and marketing baby ginger as a niche crop in temperate climates.

Future work should focus on trialing additional cultivars, fine-tuning timing and fertility recommendations, and developing effective controls for the soil-borne pathogens that may affect this crop.

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Conflicts of Interest

The authors declare no conflicts of interest.

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