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This report describes a maypop planting which we raised in a hoophouse on our farm in 2012.

GOALS
(1) Collect data on expenses (including labor) and yields to evaluate the profitability of organically-grown maypops in hoophouses (a.k.a. high tunnels). Maypops are a heat-loving crop, benefit from a long growing season, and are likely well suited to hoophouse cultivation.

(2) Compare winter survival of maypops in a hoophouse when they are covered and uncovered by fabric cover and compare yields and profitability in the first and second year after planting. The maypop can be grown as an annual because it will flower and fruit prolifically in its first year, and as an annual it would fit best into crop rotations on many vegetable farms. However, it may be more profitable as a perennial if yields are higher in the second year or if the expense of establishing new plants is high. If the maypop is best grown as a perennial it is important to know whether covers are needed for overwintering within a hoophouse in our region.

(3) Compare yields of hand-pollinated and non-hand-pollinated maypops to determine if lack of insect pollination limits yield in hoophouse maypops. If so, future research could evaluate managed bumblebees or other introduced pollinators.

(4) Compare yields and growth of maypop plants from several seed dealers and nurseries. There are no named maypop varieties, but clones from some sources may be better suited to our region.

(5) Assess consumer and chef acceptance of maypops. Provide free maypop fruits to a local grocery store and restaurant and also to a sample of our CSA members and solicit feedback.

PROCESS
Plant and seed sources. I purchased approximately 100 maypop seeds from each of five commercial sources: West Seed Farm (abbreviated WSF hereafter), SmartSeeds (SS), Where The Wild Things Grow (WTWTG), Turtlegaby's Tropical Oasis (GABY), and Onalee's Home Grown Seeds (ONA). All five are eBay vendors. I obtained 13 live plants from each of five other sources: Shooting Star Nursery (www.shootingstarnursery.com, abbreviated hereafter SSN), Niche Gardens (www.nichegardens.com, NG), Brushwood Nursery (www.gardenvines.com, BN), Lazy S'S Farm Nursery (www.lazyssfarm.com, LSS), and Companion Plants (www.companionplants.com, CP). I selected the ten seed and plant sources on the basis of price, availability, and vendor reputation (as judged primarily from reviews on eBay and the Dave's Garden website).

Plant and seedling care until transplanting. Live plants were received between 3/27/2012 and 5/9/2012. The plants were small potted plants apparently grown from root or stem cuttings. We held the plants in a heated greenhouse and watered as needed but did not fertilize or provide other care until transplanting on 5/18/2012.

Figure 1. Maypop seedlings in soil blocks.

We raised seedlings similarly to the way in which we raise vegetable seedlings on our farm. On 4/6/2012, we planted seeds on 2" soil blocks made from Johnny's Selected Seeds 512 soil mix. We covered seeds with a thin layer of vermiculite, inserted the trays of soil blocks into plastic bags to maintain humidity, and placed them in a dark, heated germination chamber at 85 degrees for 7 days. After 7 days, a few seedlings had sprouted and emerged and were very etiolated. We moved the trays to a heated greenhouse. Seedlings continued to emerge gradually over several weeks and eventually about 40-50% of seedlings emerged for most varieties. On 4/25/2012 we selected the 12 most vigorous seedlings of each variety and potted them on into 4" soil blocks and grew them in those blocks until transplanting on 5/18/2012.

Transplanting. On 5/18/2012 we transplanted all plants into a 16' x 132' unheated hoophouse. I chose to raise the plants in a hoophouse because they are heat loving plants which require a long growing season to ripen a full crop of fruit. I also wanted to determine if maypops would overwinter inside a hoophouse since they are generally not winter hardy in our region. We planted in three rows 4' apart, plants were spaced 3' apart within the row. Plants were arranged in a semi-random pattern: the hoophouse was divided into 4 equal sized sections so that one-quarter of each row lay within each section. Sections 1 and 3 were designated for hand-pollination (see below), and section 2 and 4 were not hand-pollinated. Each of the ten plant sources had one plant in each row within each section. Sections 1 and 2 were designated to be covered overwinter with crop cover (see below).

Soil tests indicated that the soil there was high in nutrients and organic matter and we rototilled but applied no fertility prior to planting. We placed the plants in the ground, covered with field soil, watered each planting with 6 oz of Drammatic K fish fertilizer diluted at a ratio of 4 cups Drammatic K: 7 quarts of water and then immediately ran drip irrigation.

Irrigation. We drip irrigated thereafter once per 4-7 days depending on temperature and plant size. We used a low flow drip tape (.34 GPM per 100') and watered 10-12 hours per session.

Trellising and Training. Maypops are vigorous tendrilled vines. We provided support to keep the plants off the ground, improve airflow, and ease work. We ran 9 gauge galvanized brace wire above each plant row. The wire was suspended approximately 6' above the ground on extension hangers dangling from the purlins of the hoophouse frame. We suspended Hortonova trellis mesh from each wire by wrapping rope around the wire and trellis mesh for the entire length of the wire according to instructions from the Hortonova supplier (Johhny's Selected Seeds). During the season, we periodically tucked stray shoots from the maypops into the mesh to keep the aisles clear.

Figure 2. Maypop vines growing on trellis.

Weeding. Landscape fabric was applied to the ground between rows for weed control. We also weeded the hoophouse as needed to eliminate all weeds.

Hand pollination. Several studies have shown that maypops are self-incompatible (maypop plants cannot pollinate themselves). The most effective pollinating insects are large bees, especially carpenter bees. Small bees such as honeybees visit the flowers to collect pollen and nectar, but the flowers are so large and the parts of the flower so far apart that small bees rarely touch the female parts of the flower and deposit pollen there. Some cultivated maypop plantings receive few visits from large bees and the vines flower profusely but set few fruits, suggesting that poor insect pollination may limit fruitset. Insect pollinators are often scarce in hoophouses, and so poor pollination is particularly a concern in hoophouse-grown maypops. To test whether inadequate insect pollination limited yield, we hand pollinated all flowers on half of our maypop vines and compared yield between hand pollinated (HP) and non-hand pollinated (NHP) plants. Maypop flowers open around noon. We performed pollinations between 1:00 and 5:00 PM daily. We collected pollen from flowers and used forceps or paintbrushes to smear the pollen on stigmas of flowers from other plants. We pollinated daily between 6/28 and 8/17. Few flowers were open before 6/28, and after 8/17 very few flowers were open and these flowers were unlikely to have sufficient time to mature fruit before frost.

Figure 3. Maypop flowers in bloom.

Harvest. Maypop fruits fall from plants when ripe. Ripe fruits do not spoil quickly. We collected and counted maypop fruits approximately once per week in late summer and fall. Yield data was collected separately for each plant.

Figure 4. Maypop fruits ripening.

Overwintering. In December, plants in sections 1 and 2 were covered overwinter by lifting the trellis from the ground and covering the ground with Dupont 5131 crop cover (1.25 oz/sq yard).

Taste. Family members and I sampled numerous fruits from each variety. As yield increased later in the harvest season, we planned to supply a local restaurant, a retail store, and some of our CSA members with fruit. However, several members of our family experienced severe stomach

cramping repeatedly after eating the fruit. We subsequently chose not to distribute the fruit to our customers out of concern for their safety and our farm's reputation.

Figure 5. Maypop fruit cut open.

Cessation of research Our original grant proposal included plans to evaluate winter hardiness of maypops in our hoophouse and to collect another year's worth of data on growth and yield. However, we discontinued the study as of January 1 2013 because we felt it was a poor use of SARE program funding and our time given the stomach upset we experienced after eating the fruit.

RESULTS

Effects of hand pollination. We harvested 262 fruits from hand-pollinated plants and 142 fruits from non-hand pollinated plants. The NHP section which was at the end of the hoophouse (Section 4) produced 120 fruits, but the NHP section towards the center of the house (Section 2) produced only 22 fruits. No comparable difference was observed between the two HP sections (sections 1 and 3), suggesting that pollinating insects which enter the house may tend to stay near the end.

We observed some bumblebees loaded with pollen in the hoophouse (in an hour in the hoophouse during the afternoon, it was common to see 2-3 bumbleebees), and very rarely we saw a honeybee. Many flies visited flowers for nectar and may have provided occasional pollination. We observed small beetles eating the pollen voraciously and this may have reduced fruitset.

Future maypop growers may want to experiment with introducing managed bumblebee hives into hoophouses to increase fruitset.

Yield. Total yield was 404 fruits. Fruits typically weigh 20-40 grams. About 25-50 fruit are required to produce a cup of juice, because most of the fruit weight is in the inedible rind and seeds. Yield peaked in early September. Plants varied enormously in yield, producing 0 to 31

fruits. Plant size and yield were greatest in the middle row within the house (171 fruits), less in the southmost row (138 fruits), and least in the northmost row (95 fruits). We expect that cool spring temperatures limited the plants in both the north and south rows. (The north and south sidewalls of the hoophouse were often rolled up for ventilation in the spring.) Shading from the vigorous middle row may have further limited growth and yield in the north row.

General observations:
The plants are extremely vigorous, branch profusely and send up many suckers. We observed repeatedly that flowering is most prolific where shading is least. Plants at the edges of rows produced the most flowers and fruit. Most areas of the hoophouse were in dense shade by late July because of the vigorous maypop growth. Wider spacing or taller trellising may be appropriate.

Differences between plant sources. Plants raised from seed from the same source showed some commonalities but were variable. Purchased plants from a single source were generally quite uniform and may have been vegetatively propagated clones.

Variety	Total fruit yield	Comments
WSF	17	Large plants with very high vegetative vigor.
SSEED	17	
WTWTG	21	
GABY	30	Some plants produced fruit with pleasant, sweet, fruity flavor. Some plants also produced high yields of large fruit.
ONA	42	Some plants produced fruit with pleasant, sweet, fruity flavor. Some plants also produced high yields of large fruit.
SSN	14	Fruit with pleasant, sweet, fruity flavor.
NG	36	Large fruit with copious juice and indifferent flavor.
BN	148	Flowered and fruited early and prolifically. Small fruits with very sour and badly flavored juice.
LSS	47	Bland fruit with unpleasant aftertaste
CP	41	31 of the fruits came from a single non-hand pollinated plant at the end of the middle row

Costs of Production. After tracking time and expenses growing maypops, we prepared the following budget. It excludes time and expenses (such as recording detailed harvest data for each plant or writing this report) which were specifically research and outreach related.

Item	Cost	Description
Labor	$561.80	See separate table below
Drip irrigation line	$7.29	360 feet of 508-08-340 T-Tape
Hortonova trellis netting	$132.25	2 rolls 79"x250' hortonova mesh
Galvanized brace wire	$39.60	3 rolls 9 ga brace wire for trellis
Rope	$34.75	1/4" x 350' polyester rope for attaching Hortonova mesh to brace wire

Extension hangers	$90.32	S-hooks 12", 18", and 24" for hanging trellis
Wire staples	$35.50	Wire staples to anchor bottom of trellis netting to ground
Drammatic K fish fertilizer	$5.50	Used at transplanting
Soil mix	$64.85	3.5 60 qt bags of Johnny's 512 OG soil mix used for raising seedlings
Landscape fabric	$339.50	4'x250' 5 mil DeWitt brand
Crop cover	$78.70	15x100' 1.25 oz/sq yd for winter cover
Total	$1390.06	

Labor hours

Sowing seeds	2.5
Potting on	2.5
Watering plants in greenhouse	3
Transplanting	7.5
Erecting trellis and training plants	22
Weeding	6
Harvest	9.5
Total	53

At our farm's average labor cost of $10.60 per hour, the cost of this labor is $561.80. No marketing time is included because we did not market the maypops.

CONCLUSIONS

- We will not continue growing maypops on our farm because of their adverse gastrointestinal effects. We encourage other interested growers to proceed cautiously because of this issue.
- Wide spacing and/or pruning is needed to accommodate these vigorous plants and reduce self-shading. From our experience we would recommend only 2 rows in a 16' wide hoophouse such as ours.
- Juice yield from our planting was low and a much higher yield would appear needed to justify the high costs of hoophouse construction, trellising, and growing the plants.
- We did observe definite differences between plant sources in flavor, yield, and growth pattern, suggesting that breeding and selection might develop improved varieties.
- Inadequate insect pollination appeared to limit fruitset and growers might wish to consider introducing bumble bees hives to increase pollination.

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