Use of Interspecific Hybrids in Squash for Fresh Market, Processing, and Grafting Rootstocks for Melons

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Introduction

The term 'species' is generally applied to populations of morphologically similar plants which are able to easily hybridize or interbreed. Within the genus *Cucurbita*, the three major domesticated species of squash and pumpkin, *C. pepo* (acorn, gourds, summer squash, pumpkins), *C. maxima* (buttercup, Hubbard, show pumpkins) and *C. moschata* (butternuts, processing squash), generally conform to the usual species concept. Crosses between *C. pepo* and *C. maxima* rarely produce either fruit or seeds. Crosses between *C. pepo* and *C. moschata* will sometimes produce fruit, but rarely filled seeds. However, in some crosses of *C. maxima* (female parent) to *C. moschata* (male parent), both fruit and ample, filled and germinable seeds are produced. The F_1 progeny of the latter crosses are extremely vigorous, but sterile, requiring a pollinator strain of either *C. maxima* or *C. moschata* for setting fruit. Several bush, Golden Delicious-type processing lines were developed in my breeding program at UNH during the 1970s and 1980s, and more recently we have been breeding processing strains of *C. moschata* with support from the NH Agricultural Experiment Station. Because interspecific hybrids have been shown to have vigorous vegetative growth and to be especially resistant to soil borne pathogens, we decided to explore their use for developing processing and fresh market varieties. In addition, as a result of research on compatibility between the two species, *C. maxima and C. moschata*, by a graduate student, Jake Uretsky, we identified a bush processing strain (NH65) which gives good seed yield and well-filled seed in crosses to *C. moschata* strains.

Evaluation of Interspecific Processing Hybrids

In 2011, 2012, and 2013, growth, flowering patterns, and yields were compared among three different NH interspecific hybrids, NH65xLIC (NH1321), NH65xDF, and NH65xSC937 (NH1310) and a Dickinson Field (DF) strain of *C. moschata*, SC936, from Rupp Seeds (Waseon, OH). Growth rates were similar among all of the cultigens; however, branching patterns varied. In particular, NH1310 initiated several lateral branches close to the crown of the plant and leaf petioles were exceedingly elongated. Together with the bush habit of growth, this pattern of development resulted in a rapid, more vertical, and uniform development of the leaf canopy cover, important growth patterns for maximizing photosynthesis. In addition to the vigorous vegetative growth of the interspecific hybrids, they resist predation by vine borer, are less attractive to squash bugs than varieties of *C. maxima*, and have good tolerance to powdery mildew.

As compared to SC936, two of the interspecific hybrids, NH1321 and NH1310, exhibited exceptionally high fresh weight (FW) fruit yields and flesh dry matter (DM) for New England

climactic conditions (Table 1). Although FW yields for NH1321 and SC937 were similar, respectively, at 44.8 and 42.1 tons per acre, % dry matter (DM) in NH1321 (10.8%) was almost double that in SC937 (5.8%). The higher DM in NH1321 correlates to about a 5-fold higher starch content than in SC937. High starch content contributes to less water loss during processing and improved consistency and texture of pumpkin puree. The FW fruit yield of NH1310 (63.1 tons/acre) was 39% greater than that of SC936. The percent flesh DW was also higher in NH1310 (8.0%) than SC936, and as a result, the dry weight biomass of the pericarp or fruit flesh (economically important part of the fruit) in NH1310 was more than double that in SC936 (Table 1).

Table 1. Fresh weight (FW) and dry weight (DW) yields in 2012 of interspecific hybrids NH65xLIC (NH1321) and NH65xSC936 (NH1310) compared to SC936, an inbred processing strain of *C. moschata* (Rupp Seeds, Waseon, OH).

Cultigen	Fruit[z] FW (lbs)	Flesh % DW	Fruit No./plot	Fruit FW t/acre	Flesh DW[z] t/ha
SC936	4.3 b[z]	5.8 a[z]	30.5 a[z]	44.8 b[z]	2.3 a[z]
NH1321	3.9 a	10.8 c	31.5 a	42.1 b	4.4 b
NH1310	5.8 c	8.0 b	31.5 a	63.1 c	4.8 c

[z]Numbers within columns preceded by different letters are significantly different, $P \leq 0.05$.

Commented [JL1]:

Evaluation of Interspecific Hybrids Fresh Market Squash

With suitable round-fruited, inbred lines of *C. moschata*, it is possible through crosses to bush kabocha/buttercup strains of *C. maxima* to produce interspecific hybrid varieties with a fruit appearance similar similar to kabocha/buttercup varieties, and in addition, have the vigorous semi-bush growth habit and pest resistance described above for the interspecific processing hybrids, as well as tolerant to storage rots. We have produced and evaluated interspecific hybrids with very attractive fruit with both orange and green skin. As with the interspecific processing hybrids, fresh weight yields have been very high. However, we currently have only a few strains of *C. moschata* with the necessary kabocha fruit shape, acceptable eating quality, and compatibility to cross with *C. maxima*. Thus far, we have identified only one hybrid which may have potential for introducing to the seed trade.

Use of Interspecific Hybrids as Rootstocks for Melon Grafting

Interspecific hybrids of *C. maxima* x *C. moschata* have found extensive use worldwide as rootstocks for grafting to melon and watermelon scions. The squash/pumpkin rootstocks have a vigorous root system that affords excellent resistance to soil borne pathogens. Use of these rootstocks is especially prevalent in protected agricultural settings employing greenhouses and high tunnels where plants are grown extensively year after year in the same soil, allowing buildup of pathogens affecting melon growth. The grafting technique may offer unique opportunities for improving field melon production in New England because of enhanced melon growth in stress environments, higher yields, and more consistent fruit quality. Squash roots can withstand cooler soil temperatures than melons, so it may be possible to use earlier spring planting schedules with grafted versus traditional transplants. Janel Martin, a graduate student in Biological Sciences, has embarked on a research project to evaluate squash rootstocks for melon transplants in field melon production. She is using both currently available commercial rootstocks and some developed at UNH from our breeding program.

Experimental results in summer of 2015 were extremely encouraging. Using the UNH-developed cantaloupe variety Halona, Janel grafted melon seedlings to four interspecific rootstocks: Carnivor and Kazako from Syngenta, along with NH1320 and NH1326. Seed germination was poor for Kazako, moderately good with Carnivor and NH1326, and excellent with NH1320. Some cotyledons in seedlings of NH1326, Kazaka, and Carnivor were distorted in growth. The hybrid NH1326 exhibited poor grafting compatibility with Halona; grafting was successful with the other hybrid rootstocks and early seedling growth was normal following union of the grafts in a healing environment. Plants were set out in two separate plots at the Woodman Horticultural Farm and the Kingman Research Farm, the former considered not to have serious soil borne pathogens affecting melons and the plot at the Kingman Farm known to harbor soil borne pathogen(s) causing sudden wilt. Growth in grafted plants of NH1320, Carnivor and Kazako was similar to control (non-grafted) plants for the initial 5 or 6 weeks from transplanting. Non-grafted plants, however, set first fruits about 4 days ahead of grafted plants. As fruit approached maturity, grafted plants began to appear noticeably more vigorous than control plants in both locations. By the time of first harvest, control plants at the Woodman Farm were much less vigorous with less leaf canopy cover than grafted plants. Growth appeared to halt in control plants, but grafted plants continued to grow and set fruit, even with a heavy fruit load. At the Kingman Farm, control plants showed typical symptoms of sudden wilt prior to harvest. The yield results have not yet been completely summarized; however, total fruit weights from plots in the 'healthy field' at the Woodman Horticultural Research Farm were 250 lbs. for control plots (ungrafted), 454 lbs. for Kazako, 642 lbs. for melons grafted to Carnivor, and 667 lbs. for plants grafted to NH1320. Average fruit size was 3.3 lbs. for control plants, 4.2 lbs. for H1320 grafted plants and 4.3 lbs. for Carnovor, and 4.0 for Kazako. Mean soluble solids contents for the treatments were 11.9 (control), 10.9 (NH1320), 10.7 (Carnivor), and 10.7. Soluble solids content correlates to sugar content and sweetness of melons, and a soluble solids content of 11% or greater is required for melons to have

acceptable eating quality. Thus, the soluble solids content of many of the grafted melons would be low for good eating quality. These preliminary results suggest that it may be necessary to choose varieties with especially high sugar content for use in grafting.

Next year, Janel Martin's research will focus on different planting dates, testing different melon varieties, and perhaps testing a few more rootstock varieties.

New Cucurbit Releases from NH Agricultural Experiment Station