CUT FLOWER CULTURAL PRACTICE STUDIES AND VARIETY TRIALS, 2011

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EXECUTIVE SUMMARY:

Wet early and late, and warm throughout can fairly summarize the weather conditions in the 2011 growing season in Ithaca. With the principal investigator supposedly working half time, the number of trials is reduced from previous years, but hopefully still of interest. The physiological and cultural practice trials are listed first, followed by the variety trials.

1. **Amaranth Topping Trial: (P. 5).** Three tall amaranth varieties were grown in the high tunnel and either topped in the seedling stage or not. Neither yield nor stem length were affected by the treatment, although topping tended to delay flowering. In this species, the topping treatment may not be beneficial.
2. **Larkspur Topping Trial: (P. 6).** The two varieties tested in the trial reacted differently to topping: the later, taller 'Sublime White' showed a yield increase, whereas 'Galilee Blue' decreased in yield. Harvests were not delayed by apex removal.
3. **Sunflower Pinching and Spacing Experiment: (P. 7).** Two branching and one single stem variety of sunflowers were grown at 6 x 6, 9 x 9 and 12 x 12 in. spacing, and either pinched at the 6-leaf stage or left alone. Pinching increased stem numbers by a factor of 3 or 4 at each spacing. The increase in stem density reduced flower size to a point below 1.5 in. diameter, judged to be non-marketable. Highest marketable yields were produced by Procut Amber Glow and Goldrush pinched at 9 x 9in. spacing, and Starburst Lemon Éclair at 6 x 6 in. not pinched.
4. **Sunflower Photoperiod Experiment: (P. 11).** Thirteen varieties were screened for daylength sensitivity by growing them for the first three weeks in either short (12 hr) or long (16 hr) daylength in a greenhouse. They were then transplanted to the field. Only two showed a short-day response: Goldrush and our standard sensitive Sunrich Orange. It is encouraging to note that all the Procut lines were insensitive to daylength, increasing their potential to be grown at other times or in other places than those providing a long summer daylength.
5. **Sunflower Pollination Experiment: (P. 15).** In a preliminary trial, sunflowers were pollinated or not, and the force required to remove the petals from the flower head was measured. With the three varieties tested, pollination did not appear to affect the tendency of petals to be lost, but this will be checked again in 2012.
6. **Varietal Differences in Sunflower Petal Detachment Force: (P. 17)**. The time course of petal retention was measured on four versions of 'Procut Bicolor' and two standard lines using our detachment force meter. Detachment force decreased with time after harvest, and varied among the varieties tested. Petals of 'Procut Lemon' and 'Procut Bicolor V.2' were significantly harder to detach, indicating their longer vase life, a finding that confirms similar tests run in 2010.

Acknowledgements: My thanks to Priscilla Thompson and Sarah Clark for competent technical help, and to ASCFG, and the following seed companies for provision of seeds for the Trials: Geo, Gloeckner, Harris Johnny's and Seed Sense.

7. **Influence of angle of pull on detachment force values: (P. 19).** Sunflower petal detachment is much easier done when the petal is pulled backward toward the stem, than if pulled forward in the direction of petal insertion on the head. Preliminary measurements indicate similar varietal differences as when the previously standard technique is used, namely pulling out the petals parallel to the surface of the disk. The ease of petal loss when flower heads are brushed against an obstruction is probably similar to the backward pull method used here.

VARIETY TRIALS:

8. **Ammi majus: (P.23).** In this small trial, Ammi 'Pink' was compared to the carrot variety 'Black Prince'. Fewer than half the Ammi plants flowered, and of those, the flower color was closer to white than pink. 'Black Prince' was more prolific, but the umbel color tended to gray rather than black.
9. **Aster (*Callistephus)*: (P. 23)**. Nineteen varieties of aster were grown in the field, either under a canopy of Typar to protect against aster yellows infection, or in the open. Contrary to expectation, there was little aster yellows, and little Fusarium Root Rot, so good yields were achieved. Most promising were the Shanghai series, especially Rose-White, White and Crimson, and the Bonita series. Both deserve to be tested again, and more widely grown.
10. **Basil: (P. 27).** Of the four lines tested, 'Aramato' stood out with excellent stem length, productivity and attractive foliage. Hydration of the cut stems was a problem with all varieties, and probably would have been improved by use of a hydration solution.
11. **Craspedia: (P. 28).** Three lines were grown both in the high tunnel as well as in the field. There were few differences among the varieties tested, but the drier high tunnel environment allowed much more vigorous growth than in the field, doubling the stem yield and improving stem length. All varieties exhibited outstanding vase life, fresh and dried.
12. **Celosia: (P. 30).** Seven varieties were compared in tunnel and field, and good growth and productivity was obtained in both places. 'Sunday Wine Red', 'Ruby Parfait Wheat' and 'China Town' were the most attractive and promising.
13. **Cosmos: (P. 32).** In a spring field planting, three 'Double Click' lines were compared to 'Sensation Mix'. The Double Click lines were productive, but we had problems keeping them hydrated after harvest. Sensation Mix is a short-day plant that began flowering in late summer on large plants.
14. **Grasses: (P. 34).** Two annual grains were directly sown in the field, while two Pennisetum lines were sown in the greenhouse and transplanted. 'White Lancer' Pennisetum was most productive, with long, thin inflorescences. Of the cereal grains, 'Silver Tip' triticale was taller and more attractive than 'Black Tip' wheat.
15. **Lisianthus: (P. 36).** Five lines were tested in both high tunnel and field. 'ABC 2-4 Yellow Improved' was vigorous and productive, whereas 'ABC 2-3 Misty Blue' was too late for our conditions, in contrast to the '1-3' line of the same name, which was productive and had attractive flowers on somewhat short stems.
16. **Mums: (P. 37).** Six lines were received as cuttings, and grown in the high tunnel. Flowering was relatively late, but with the late frost in fall, only negatively affected the latest-flowering lines,

'Yoko Ono' and 'Judith Baker'. Most promising were 'Whirl-away', an early spray-type spoon with purple flowers, and 'Maryll' a later and larger flowered spoon with red flowers.

17. **Peppers: (P. 41).** The new ornamental pepper 'Orange Globe' has small, round fruit borne at the end of branches, turning from green to yellow. The yellow color faded quickly, and the fruit became wrinkled and unattractive thereafter. 'Cappa Conic' was attractive even when dried.

WEATHER CONDITIONS:

Average air temperatures were consistently warmer for the entire season in 2011 (Fig. 1), even though the increased rainfall totals in April, May and September should have produced cloudier, and therefore cooler conditions (Fig. 2). The higher rainfall totals in August and September were the result of tropical storms, which fortunately did not result in flooding here, in contrast to other areas of New York State.

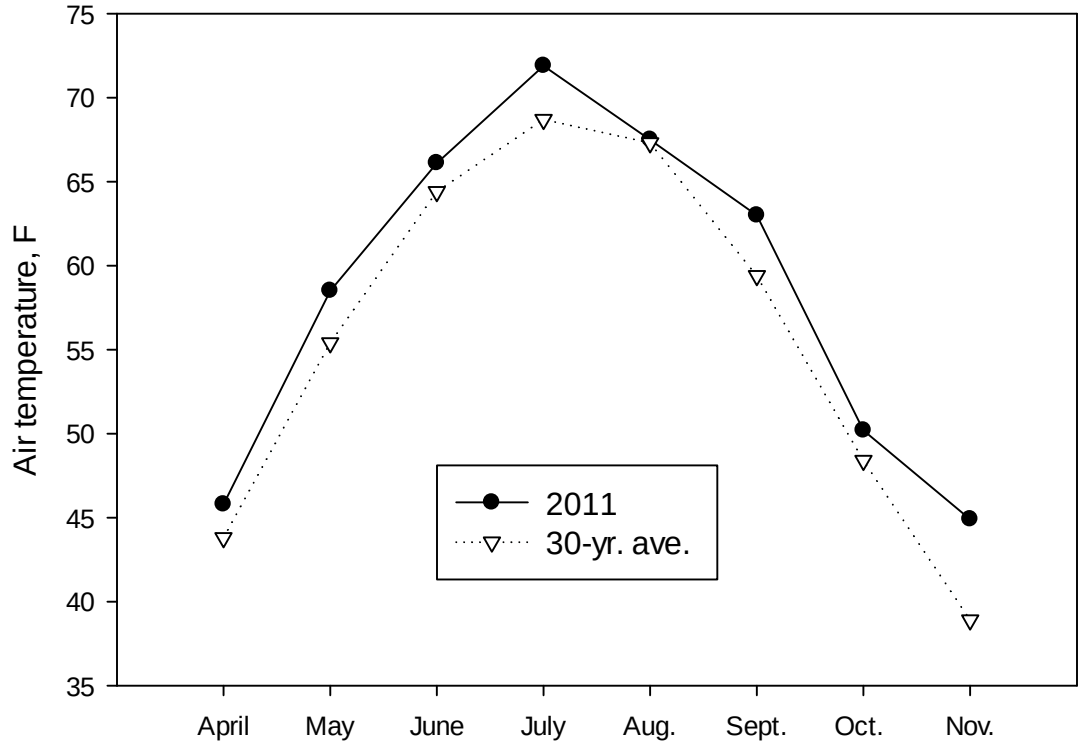

Fig. 1. Air temperature during the 2011 growing season at Ithaca, NY, compared to the 30-year average. From: www.nrcc.cornell.edu/climate/ithaca/.

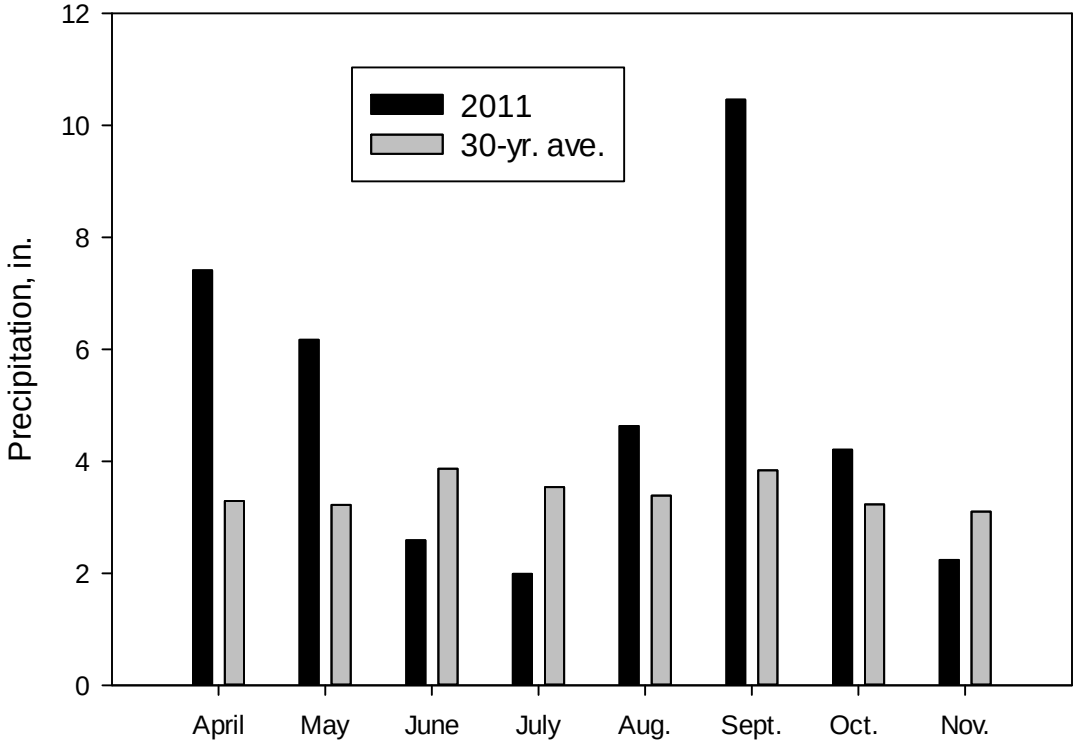

Fig. 2. Monthly total rainfall in the 2011 growing season in Ithaca, NY, compared to the 30-year average. From: www.nrcc.cornell.edu/climate/ithaca/.

GENERAL MATERIALS AND METHODS:

The 2011 cut flower trials were conducted at East Ithaca Gardens, in both the field and the high tunnel. The latter has ground dimensions of 30 ft. width and 96 ft. length, with roll-up sides and end wall vents. The sides open under the control of a thermostat-controlled, battery-powered motor with max. and min. temperature settings of 65 and 85 F. In the field, 2 in. of compost was applied in late fall 2010 and worked in. On May 11, 300 lbs. of a 20-10-10 was applied by machine to the field before beds were formed. Beds were made on 6 ft. centers, with dimensions of 5 in. height and 40 in. width, and covered with black polyethylene mulch, with two trickle irrigation lines in each. Supplemental nitrogen in the form of calcium nitrate at the rate of 30 lbs. N per acre was added once in mid-season in both high tunnel and the field, when plants showed slow growth and/or yellowing lower leaves.

About 1 in. of compost was added to the high tunnel in late fall or early winter in the high tunnel and worked in with a walk-behind rototiller. Bed formation, trickle irrigation line placement and mulch laying was carried out manually in the tunnel, but with similar dimensions as in the field.

Plants for the variety trials were started in greenhouses from seed in seedling trays in Redi-earth artificial soil mix, at recommended temperatures for the species. The time of sowing was adjusted to assume access to the tunnel in the third week of April, and outdoors a month later. Except where noted, spacing was a staggered grid of 4 rows, with 9 in. between plants and rows. There were usually 20 plants in each subplot, and 2 replications in both the tunnel and outdoor variety trials.

Plots in the tunnel were irrigated weekly all season long and twice weekly during the warmest periods. Stems were harvested at the recommended maturity stage for the species, and stem lengths were determined for each stem. Repeated harvests were made as needed, often at weekly or greater frequency. No insecticide nor fungicide applications were made to plots in the field in 2010, except that a severe attack of Colorado Potato Beetle necessitated 1 application of Spectracide to the pumpkin-on-a stick in the field. In the high tunnel, we used only OMRI-approved methods of pest control in 2011. These included the use of the natural enemy Aphidius colemani for aphid control in Craspedia, and release of Lady Bird beetles for the same purpose in late June. Weed control between the beds in the field was accomplished by three shielded sprays of glyphosate. For the rest of the season weed control was done by hand.

AMARANTH TOPPING TRIAL:

Cut flower species that produce a strong, tall central stem, followed by relatively small secondary branches sometimes benefit from having that central stem topped in the vegetative stage, so that more branches will form. Amaranth is one of these species, so three varieties were tested to see if apex removal could increase production of stems.

Materials and Methods: Three varieties were compared in the experiment: Love lies Bleeding, Autumn's Touch and Viridus Green. 'LLB' and 'Viridus'have pendent dark purple or green inflorescences, respectively, while the flower of 'Autumn's Touch is erect. Seed was sown on May 6 in 98-cell trays, grown in a greenhouse until June 6, and then transplanted into the high tunnel in 2 replications of 24 plants per plot. The topping treatment was done on June 14, when most plants had from 7 to 9 expanded leaves.

Results and Discussion: Plants grew vigorously in the high tunnel, and flower harvest began in mid-July. Topping delayed first harvest by an average of 11 days, but variability in harvest dates prevented statistical significance (Table 1). Overall, the topping treatment had no significant effect on stem length or on the number of stems harvested per plant. Comparing the three varieties, there was no difference in stem length or in yield, but the length of the inflorescence was significantly longer for LLB and Viridus compared to Autumn Touch. Although not shown in Table 1, the main stem was significantly longer than subsequently-harvested branches. Overall, the extra labor needed to accomplish the topping did not appear to result in significant yield increases, so in this species, may not be worth doing.

Table 1. Effect of apex removal in the vegetative stage on stem and flower length, yield of stems and date of first flower of three amaranth varieties grown in a high tunnel. There were no significant topping by variety interactions for any of the variables measured.

Treatments	Stem length, cm	Flower length, cm	Stems/plant	Sowing to flowering, days
Control	65	35	4.8	79
Topped	63	37	5.1	90
Stat. signif.	ns	ns	ns	ns
Love lies Bleeding	66	38	5.0	84
Autumn Touch	61	30	5.7	88
Viridus	64	40	4.2	82
Stat. signif.	ns	*	ns	ns

LARKSPUR TOPPING TRIAL:

Previous trials in the high tunnel with larkspur indicated that apex removal could increase stem yield significantly, but that first flower harvest was delayed by 5 days. The trial was repeated here to test the reaction of a new variety, Galilee Blue, to topping in the vegetative stage.

Materials and Methods: Apex removal was tested with the varieties 'Galilee Blue' and 'Sublime White', seed for which was started in the greenhouse March 1 in 128-cell trays. The trays were kept in a cool, dark area in the headhouse for two weeks, then transferred to the greenhouse until April 27. Plants were transplanted to the high tunnel on April 29, and planted at 6 x 6 in. spacing in 6 rows per bed and two replications of 30 plants per plot. Experimental design was a split plot, with topping treatment as main plots. Apex removal was done on May 9, leaving about 8 nodes on the main stem.

Results and Discussion: Unlike in previous larkspur topping trials, there was no increase in yield due to apex removal, and flowering was not significantly delayed. 'Galilee Blue' was significantly shorter than 'Sublime White', but produced 58% more stems (Table 2). Yield of stems decreased slightly with topping for 'Galilee Blue', whereas it increased from 2.6 to 4 stems per plant for 'Sublime White'. This interaction of topping and variety was significant at the 6% level. The stem length of 'Galilee Blue' in this trial was not encouraging, although other colors of this group might be better adapted to high tunnel conditions.

Table 2. The effect of apex removal on stem length, yield of stems and earliness of flowering on two varieties of larkspur grown in the high tunnel.

Treatments	Stem length, cm	Stems/plant	Sowing to flowering, days
Control	46	4.1	102
Topped	56	4.4	107
Stat. signif.	p=.09	ns	ns
Galilee Blue	42	5.2	103
Sublime White	59	3.3	106
Stat. signif.	**	*	ns
Interact. signif.	ns	p=.06	ns

SUNFLOWER PINCHING AND SPACING EXPERIMENT: (As summarized in an article in the ASCFG Cut Flower Quarterly, January 2012).

Wouldn't it be nice to cut more sunflower stems with less work? Yes, you say, but what's the catch? It comes down to whether you would rather plant, or pinch. Sunflowers grown as cut flowers can be sorted into two groups: ones which have a single stem, and do not branch under normal spacings, and those which develop a smaller central flower, but produce many harvestable branches. The former are preferred by commercial producers, the latter are marketed more to home gardeners. But the branching type forms few branches when crowded, and both types will branch if deprived of their growing point (pinched or topped) when they have about 6 fully developed leaves, before flowering. So depending on how you handle them, the 2 types tend to merge.

We conducted a field experiment at Ithaca, NY (Region 5), to determine if we could increase sunflower productivity with less effort. The study looked at three varieties, grown at three plant spacings, and either pinched or left alone (single stem). The varieties were Starburst Lemon Éclair and Goldrush, both branching types, and Procut Amber Glow, a non-branching type. These were grown on 4 ft-wide beds, at 6 x 6, 9 x 9 and 12 x 12 in., resulting in 6, 4 and 3 rows per plot, respectively. Half the plots were pinched when the plants had six leaves (3 pairs), the rest were allowed to grow normally. We harvested only the inner rows in each plot to avoid edge effects, and repeated the experiment three times.

The study confirmed the well-known fact that the more stems in a given area, the smaller the flowers. So to evaluate the results of this study, we had to decide what size of sunflower is marketable. We decided that only flowers with a disk diameter greater than 1.5 in. were acceptable, since smaller flowers were frequently misshapen, or had such thin stems that they collapsed.

At the denser spacings, stem numbers and yield increased (Table 3). Pinching also increased stem numbers, about 3 to 4 times, depending on the variety. When the two factors were combined, the number of stems per plot got so high that flower size decreased below marketable levels. The optimum combination of pinching and plant population varied with the variety. For 'Starburst Lemon Éclair', all pinching treatments resulted in unacceptably small flowers, although stem yields were high. For yields of nearly 4000 stems per 1000 ft^2, the high density unpinched treatment was best. For 'Goldrush' and 'Procut Amber Glow', pinched plants grown at 9 x 9 in. spacing produced 50% more stems than the unpinched plants grown at 6 x 6 in. spacing, and two and a half times as many as the unpinched plants grown at 9 x 9 in.

What is best in your operation? If planting at high density on your farm is a hassle, consider using a wider spacing and pinching the plants to achieve good yields. For branching varieties such as 'Starburst Lemon Eclair', high density planting without pinching suppresses branching and yields flowers of acceptable size (Fig. 3). Another factor to consider is seed versus labor costs – single stem production requires more seed, but pinching has higher labor costs. Also, smaller flowers work great for mixed bouquets and arrangements, while larger flowers are usually needed for single species bunch sales at farmers markets. If you have a variety of customers, you may want to grow a variety both pinched and single stem.

Acknowledgements: I am grateful for the competent technical assistance of Sara Clark and Priscilla Thompson, and thank Dr. Tom Heaton at NuFlowers LLC for supplying seeds and financial support for this study.

Table 3. Effect of spacing and pinching at the 6-leaf stage on yield (stems per 1000 ft^2) and flower diameter of 3 varieties of sunflower grown in a field experiment in 2011 in Ithaca, NY.

Variety	Spacing, in.	Stem yield/1000ft^2		Flower diameter, in.	
		Not pinched	Pinched	Not pinched	Pinched
Starburst Lemon Eclair	6 x 6	3,905	15,744	1.8	0.9
	9 x 9	1,792	6,904	1.9	1.1
	12 x 12	944	5,144	2.2	1.2
Goldrush	6 x 6	4,083	9,500	1.9	1.4
	9 x 9	1,679	6,272	2.2	1.6
	12 x 12	1,111	4,222	2.3	1.6
Procut Amber Glow	6 x 6	4,000	10,971	2.1	1.3
	9 x 9	1,729	5,876	2.7	1.8
	12 x 12	1,000	3,389	2.8	1.8

Fig. 3. Starburst Lemon Eclair sunflower grown at 3 spacings in the field, showing degree of branching.

Fig. 4. The sunflower pinching and spacing study, showing Procut Amber Glow in the foreground.

Additional results from the study:

Stem length differed among the three varieties when not pinched, with 'Procut Amber Glow' being the tallest, and 'Goldrush' and 'Starburst Lemon Éclair' having shorter stems (Table 2). When pinched, stem length of the first two varieties averaged 34 in. whereas 'Starburst Lemon Éclair' averaged only 18 in.

When harvesting the main stem flowers on unpinched plants, branches that had formed were lost to get sufficient stem length for the main flower. This was a consideration for 'Starburst Lemon Éclair' and 'Goldrush', but 'Procut Amber Glow' formed few branches when not pinched. Once the stem was pinched at the 6-leaf stage, branching was stimulated, with' Starburst' forming the highest no. of branches per plant (Table 4).

Table 4. The influence of pinching and variety on length of the harvested stems, and the number of stems formed per plant.

Pinching treatment	Variety	Stem length, in.	Stems/plant
None	Starburst Lemon Eclair	44	1
None	Goldrush	48	1
None	Procut Amber Glow	56	1
Pinched	Starburst Lemon Eclair	18	4.3
Pinched	Goldrush	35	3.4
Pinched	Procut Amber Glow	33	3.1
Interaction signif.		***	*

The suppression of branching that took place with increased plant density (Fig.3) was also reflected in a reduction in flower buds formed on the stem below the flower (Table 5). ' Starburst' and 'Goldrush' showed this trend clearly, but the sparsely branched 'Procut Amber Glow' produced few buds at any spacing, leading to a significant variety x spacing interaction.

Table 5. Effect of spacing on bud numbers per plant on the upper 5 nodes of the stem, for three sunflower varieties, averaged across pinching treatments. The variety x spacing interaction was significant at the 1% level.

Spacing	Starburst Lemon Eclair	Goldrush	Procut Amber Glow
6 x 6	1.2	1.6	0.9
9 x 9	2.5	2.2	0.8
12 x 12	2.5	2.3	0.9

As more plants were crowded into a given area, and the plants were forced to branch due to pinching, the increased number of stems decreased the size of the flower to a point where it became too small to be marketable. We have arbitrarily designated that point as a flower disk diameter of 1.5 in. The inverse relation between yield of stems and flower size is shown in Fig. 5. Thus the maximum marketable stem yield for 'Goldrush' and 'Procut' would be around 8000 stems per 1000ft^2, while 'Starburst', with its smaller head size when pinched, already reached that maximum at 4000 stems.

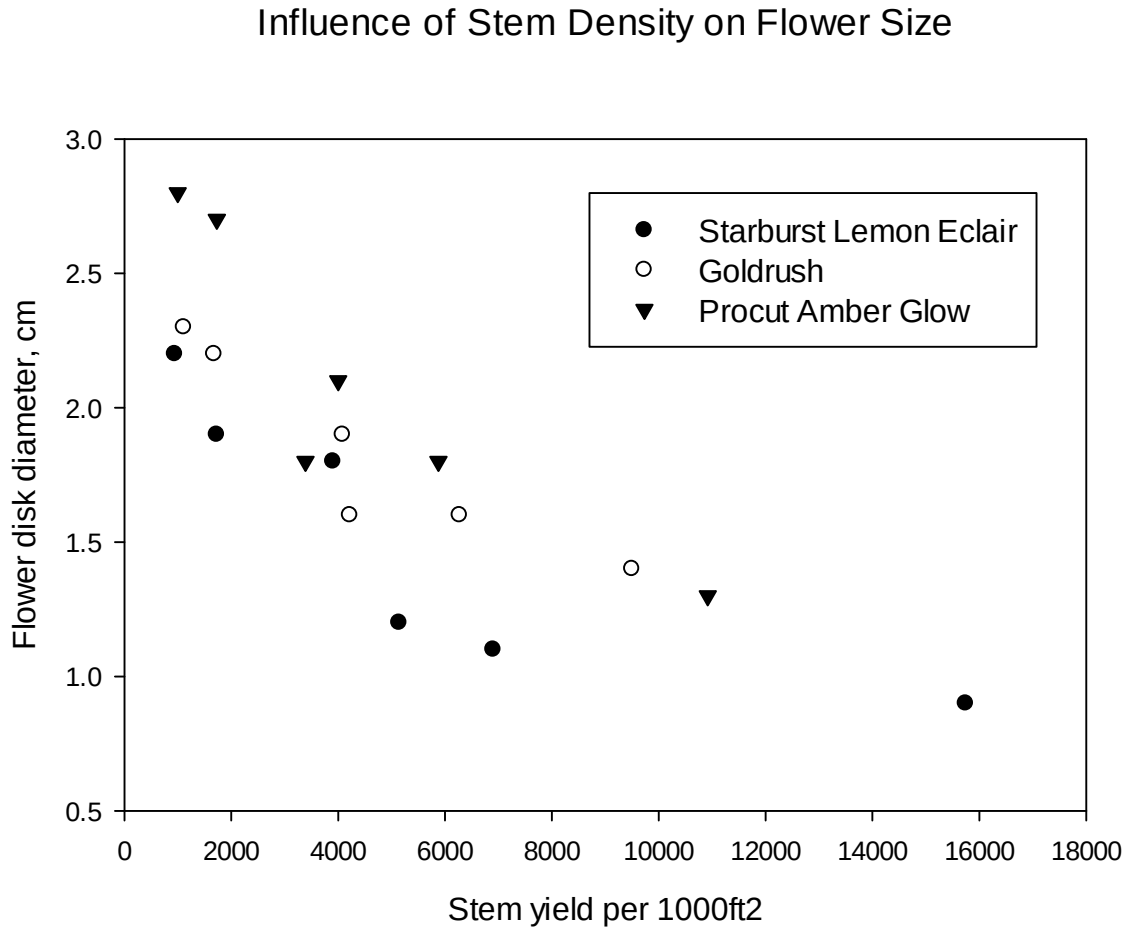

Fig. 5. The dependence of the size of the individual sunflower head on the yield of stems of three varieties of sunflower.

SUNFLOWER PHOTOPERIOD EXPT. 2011:

The daylength under which sunflower seedlings are grown in the first 3 weeks after emergence can profoundly affect the ultimate size of plant, size of flower and the flowering date. In previous experiments with new sunflower varieties developed for cut flower production, we found about 50% reacted to a 12-hour light duration in the seedling stage by flowering early, on short stems, and producing small flowers. Most of the rest did not react to daylength, and grew similarly in both short and long daylength conditions in the seedling stage. In the current trial, we compared 11 new varieties and two standard lines.

MATERIALS AND METHODS: Seeds for the study were sown in 72-cell trays in peat-perlite artificial soil mix, and placed on a daylength-controlled bench, either at a 12-hour daylength as controlled by a mechanical blackout curtain, or at a 16-hour daylength extended with artificial light. The daylength treatments were applied for three weeks after emergence, then the plants were transplanted in the field at 9 x 9 in. spacing, in two replications. Unfortunately, a malfunction of the curtain mechanism

meant that the crop received only long days for the first 4 days after emergence, but got the right treatment thereafter. The crop was sown on June 24 and transplanted July 20. As in previous trials, 'Procut Lemon' was planted as a daylength neutral control, and 'Sunrich Orange' as a short day sensitive standard variety. Data on plant and main stem flower head characteristics were taken at anthesis of each flower.

RESULTS AND DISCUSSION: The daylength treatment to seedlings in the transplant tray had the expected result, as judged by the reaction of the standard lines. 'Procut Lemon' is known to be daylength neutral, and showed no significant difference in the characteristics measured between short and long day treatments (Table 6). 'Sunrich Orange' the daylength-sensitive standard, flowered 10 days earlier after short day versus long day treatment. In contrast to other years, only one of this year's new cultivars showed a reaction to seedling daylength exposure. 'Gold Rush' was nearly as sensitive as 'Sunrich Orange', with 8 days earlier flowering after short day treatment.

Table 6. Reaction of 13 sunflower varieties to 3 weeks of controlled daylength applied for the first three weeks after emergence. After the daylength treatment, seedlings were transplanted to the field in 24-plant plots in two replications.

	Height, cm		Flower diameter, cm		Days to flower	
Variety	Short day	Long day	Short day	Long day	Short day	Long day
Gold Rush	100	130	3.9	5.6	58	66
Music Box	52	65	3.2	3.8	58	59
Procut Amber Glow	116	123	4.8	5.2	58	58
Procut Bicolor Plus	146	143	6.8	7.3	64	64
Procut Brilliance	121	118	5.8	5.6	61	59
Procut Gold	127	118	5.8	7.0	60	59
Procut Lemon	102	108	4.9	5.0	59	59
Procut Red	158	148	6.6	6.6	72	72
Procut Red Lemon Bicolor	147	132	6.9	6.8	68	68
Starburst Gold	142	147	6.3	7.3	64	64
Starburst Panache	135	143	5.2	6.2	61	63
Sunrich Orange	86	125	3.6	7.2	56	66
Valentine	57	72	3.0	3.0	54	56
Interaction significance	**		*		**	

The following description of the new varieties has been made primarily on plants given long day treatments, since this would be closest to the conditions they would face in a summer planting.

- **Gold Rush** is a heavily branched orange flowered variety with dark flower disk and moderate flower size. Main stems and basal branches can both be used in bouquets, although the latter tend to be short unless the plants were pinched early (see pinching expt., above).

- **Music Box:** shortest variety in the trial, with profuse basal branches and flower color that varied from plant to plant from lemon to orange. Flowers were pollen-producing. Plants and branches were too short to be useful as cut flowers.
- **Procut Amber Glow** has a single stem with little branching until late. Flower color is pale yellow with slightly darker inner petals. Attractive and promising.
- **Procut Bicolor Plus:** the latest version is a vigorous, tall plant with large flowers of bright orange petals with dark red centers. It is still somewhat susceptible to petal loss if brushed, but better than the original Procut Bicolor (see petal pull experiments).
- **Procut Brilliance:** A medium height plant with bright orange petals and dark centers flowering 60 days after sowing. Attractive and promising.
- **Procut Gold** : Similar in height, flower size and vigor to 'Procut Brilliance', this variety features orange petals and a greenish-yellow disk.
- **Procut Lemon** features pale yellow petals and dark centers. It flowers early on strong stems of moderate height.
- **Procut Red** is a late, strong stem plant without branches. Dark red petals and a dark disk make this variety unique. We have insufficient vase life information so far to know if it suffers from petal loss.
- **Procut Red Lemon Bicolor** is a tall, relatively late variety with less intense coloration than Procut Bicolor.
- **Starburst Gold:** A vigorous branching tall plant with multiple petals and a 'shaggy' flower appearance. Petal color is yellow throughout the head. Attractive and promising.
- **Starburst Panache:** similar in size and branching habit to Starburst Gold, with multiple petals that are black-tipped in the inner part of the head. An attractive color variation.
- **Sunrich Orange:** our standard photoperiod sensitive line that flowered early on short stems after short day treatment. The short plants had small flowers and many axillary flower buds. Flowering was not as early as in previous trials, presumably because of the delay in application of the short day treatment.
- **Valentine:** a short, branching plant with relatively small flowers. Presence of pollen and small stature will limit its use as a cut flower.

The results of this trial indicate that new cut flower varieties of sunflower are being selected for daylength insensitivity. These varieties will be easier to grow early in the season in temperate environments, and should also perform better in the short daylengths of the Tropics.


tarburst Panache


St rburst Gold


Procut Bicolor Plus

EFFECT OF POLLINATION ON SUNFLOWER PETAL LOSS:

In many flower species such as *Phalaenopsis* orchids and cyclamen, once a flower has been pollinated, the petals quickly lose turgor and fall off. To find out if sunflower petals are shed more readily once the flower has been pollinated, we conducted controlled pollinations and measured petal detachment force.

MATERIALS AND METHODS: Plants of four sunflower varieties were transplanted into the high tunnel at 9 x 9 in. spacing, with four rows per bed. The varieties were 'Procut Lemon', 'Procut Bicolor' (original version),' Cherry Rose', and a pollen parent line from Tom Heaton at Nuflowers, LLC. Flowers were covered with pollination bags before flower opening, and at anthesis, heads of the pollinator line were rubbed on the flower to be pollinated, and the flower covered again. At intervals of 3 to 7 days after pollination, the pollinated heads were harvested, and the petal detachment force measured by use of a special petal pulling apparatus (Fig.6). This machine consists of an electronic balance, on which the flower disk is placed. A clamp attached to the petal pulls upward, thereby reducing the weight of the flower head, and the weight at which the petal separates is noted. The petals are pulled in parallel to the face of the flower disk. To ensure a slow, repeatable pulling force, the clamp is attached to the shaft of an electric drill that is turning at a rate of 0.56 cm/sec.

RESULTS AND DISCUSSION: The late flowering of the pollinator line compared to the varieties being tested limited the number of comparisons that would be run. Nevertheless, none of the three varieties showed a significantly different petal removal force when the flower had been pollinated, than when it had not (Table 7). In agreement with previous studies, 'Procut Lemon' had a higher separation force than 'Procut Bicolor' or 'Cherry Rose'.

Table 7. The influence of pollination on petal separation force of three sunflower varieties.

Variety	No. of heads tested	Petal separation force, grams		Statistical significance
		Pollinated	Not poll.	
Procut Lemon	7	92	98	ns
Procut Bicolor V. 1	7	38	62	ns
Cherry Rose	4	78	52	ns

The trial needs to be repeated to substantiate these results. If it is true that sunflower petals have similar separation forces whether the flower has been pollinated or not, harvesting of sunflowers before insects might have pollinated them is not important.

Fig. 6. Petal pull apparatus showing a sunflower head lying on a balance pan, with petal attached to a clip, being pulled upward by the string attached to the shaft of an electric drill.

VARIETAL DIFFERENCES IN PETAL DETACHMENT FORCE:

Work in previous years has shown that sunflower varieties differ in how securely the petals are attached at flowering, and how quickly the detachment force decreases with time after flower harvest. This has important implications on flower vase life. In 20010 we found that different versions of' Procut Bicolor' also differ in petal detachment force, and we wanted to conduct that study a second time to check this finding.

MATERIALS AND METHODS: Versions 1, 2, 3 and Plus of 'Procut Bicolor', as well as 'Procut Lemon' and 'Strawberry Blonde', were sown in 72-cell trays in the greenhouse, and transplanted to the high tunnel on May 25. Twenty-four hills of each variety were transplanted, with two seedlings per hill. At anthesis of the flowers, they were harvested retaining about 50 cm of stem, and placed with stems in water in a storage room set at 20 C, with incandescent lights on a 12-hour timer. At 3, 5, 7 and 9 days after harvest, flowers were removed from the storage room, and petal detachment force measured as described for the pollination experiment. Values presented are an average of 5 heads, with 5 petals pulled individually on each head.

RESULTS AND DISCUSSION: Petal detachment force was highest for the first 5 days after flower harvest (Table 8), and then declined. There was considerable variation, as shown by the value of the standard error for each measurement, but 'Procut Bicolor V. 2' and 'Procut Lemon' had higher values, a finding that is similar to our 2009 results. The other four varieties had lower values, indicating that their vase life would be expected to be low. This has been known for Version 1, but for Version Plus, a new release, this is disappointing. The results are shown graphically in Figs. 7 and 8 .

It is noteworthy that 'Procut Bicolor V. 2' has higher detachment force values than the other versions, so further improvements in this variety's vase life might be achieved by crossing with this version.

Table 8. Petal detachment force of six varieties of sunflower after various times of storage at 20 C. Force measured on apparatus shown above, with petal pull parallel to the flower disk.

	Time after anthesis, days			
Variety	3	5	7	9
Procut Bicolor, V. 1	111 ± 25	92 ± 28	75 ± 32	24 ± 4
Procut Bicolor, V. 2	137 ± 18	144 ± 15	112 ± 16	46 ± 34
Procut Bicolor, V. 3	92 ± 19	59 ± 12	40 ± 19	15 ± 4
Procut Bicolor Plus	59 ± 20	72 ± 12	59 ± 29	17 ± 8
Procut Lemon	165 ± 4	112 ± 40	88 ± 29	16 ± 10
Strawberry Blonde	90 ± 13	109 ± 38	63 ± 33	16 ± 8

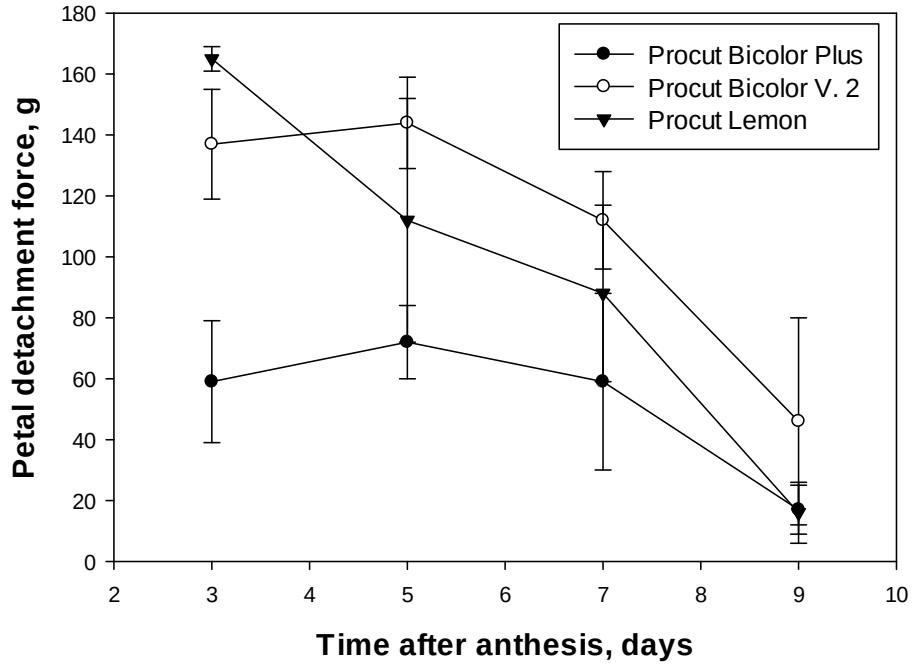

Fig. 7. Petal detachment force of three sunflower varieties grown in a high tunnel in summer, 2011.

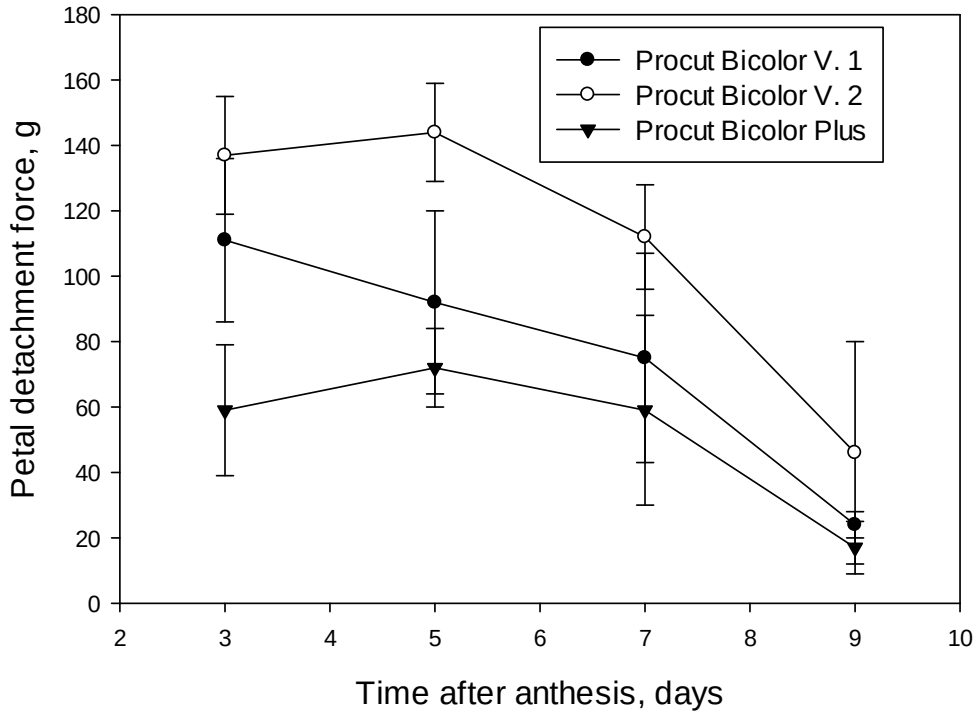

Fig. 8. Petal detachment force of three Procut Bicolor versions, with standard errors around each point.

INFLUENCE OF ANGLE OF PULL ON DETACHMENT FORCE VALUES:

The preceding detachment force values were obtained by pulling the petal in a direction parallel to the disk face. We noticed that if the angle of pull was changed, remarkably different values could be obtained. In particular, pulling back on the petal, so that it was bent back toward the flower stem, caused the petal to detach much more easily, especially compared to pulling it in line with its attachment angle (Figs. 9 and 10).

Fig. 9 (left), and Fig. 10 (below), showing the direction of petal pull in line with petal insertion, or back toward the flower stem.

MATERIALS AND METHODS: In a preliminary experiment conducted in late August on flowers harvested from high tunnel-grown plants, we compared the petal detachment forces when pull direction was altered from forward to back. Flowers were stored as in the variety comparison described above, and at 6 to 10 days after storage, petal detachment forces were determined. Heads were sliced in half with a knife, and one half used for the forward pull determination, and the other for the backward pull (along the stem direction). For the latter, sepals were cut off to prevent them interfering with the detachment of the petals. Three or four heads were typically measured for each variety for each storage duration, but in some cases, there were fewer.

RESULTS AND DISCUSSION: The most striking result of this experiment is that the detachment force from the backward pull is much weaker than when petals are pulled out of the head in line with their angle of attachment (Table 9, Fig. 10). The backward pull results in the petals "snapping" off at the abscission zone located at the base of the petal. This is particularly true for varieties that have stiff, turgid petals, such as 'Procut Bicolor V. 1' and 'V. 3'. In contrast, 'Procut Lemon' and 'Procut Bicolor V. 2'

have thinner, more flexible petals that require more force to separate at the abscission zone. The detachment force required to get petal separation in a forward pull is considerably higher (Table 7, Fig. 10), and appears to be almost opposite to the results of the backward pull forces when comparing varieties.

In both pull directions, the general trend is for values to decrease with longer storage times, but the variation in detachment force with time is considerable (Figs. 11 and 12). More work is needed to determine the backward pull values for shorter storage times for these varieties, and to see if these values could provide an indication of vase life of these and other varieties. It is also interesting to note that the backward pull technique used here is similar to the quick brushing technique that we have used to evaluate vase life of sunflowers before harvest. The backward pull technique has the advantage that it provides separation force values, and is unbiased, whereas the brushing technique is difficult to standardize.

At present it is not clear how the values gathered here relate to the detachment force values obtained in previous experiments, such as those reported last year, and those shown in the other experiments, above. When pulling petals parallel to the flower disk, the force is a combination of forward and backward pull forces. Since sepals have not been removed in these experiments, sepals could also be interfering in the separation force determination. Separating the force measurements into a value for "snapping" the petal backward on heads from which sepals have been removed, and the value for pulling the petal straight out should provide a clearer picture of how strongly the petals are attached. The backward pull measurement provides a good estimate how susceptible sunflowers are to mechanical jostling, as when they are accidentally brushed against a door frame. More work is planned in 2012 to gain a fuller understanding of these points.

Table 9. Detachment force for sunflower petals of four varieties stored for from 6 to 10 days. Petals were either pulled in the direction of attachment (forward), or back along the stem (backward). Values shown are averages of 5 petals from each of 3 to 4 heads for each storage time and variety combination.

Variety	Pull time after harvest, days	Detachment force, grams	
		Forward pull	Backward pull
Procut Bicolor V. 1	6 to 8	69	4
Procut Bicolor V. 2	6 to 10	39	12
Procut Bicolor V. 3	6 to 8	65	6
Procut Lemon	6 to 10	38	14

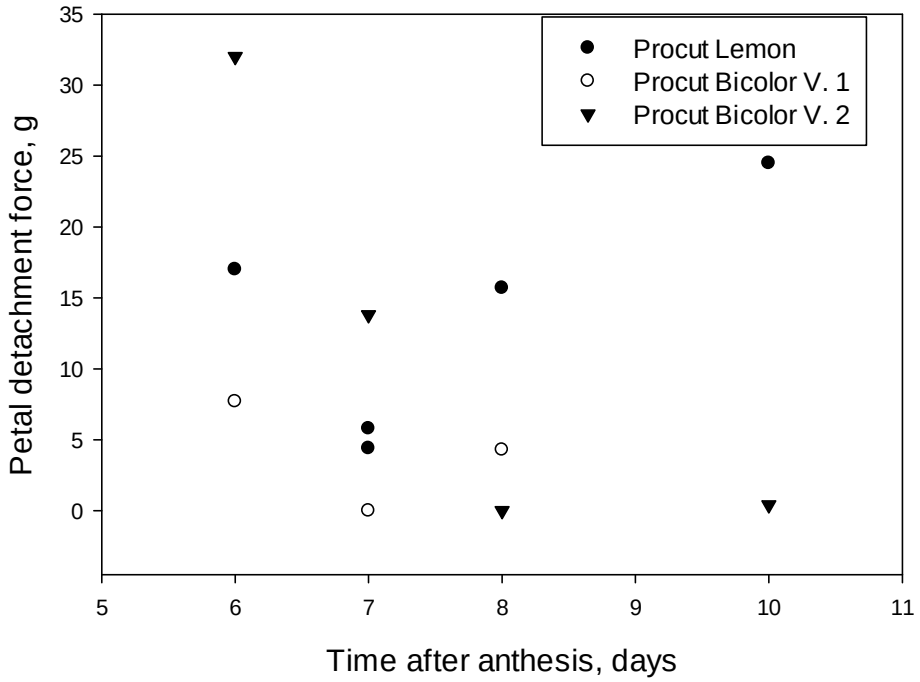

Fig. 11. The relation of petal detachment force for petals pulled backwards off the flower head, comparing 3 varieties after 6 to 10 days of storage.

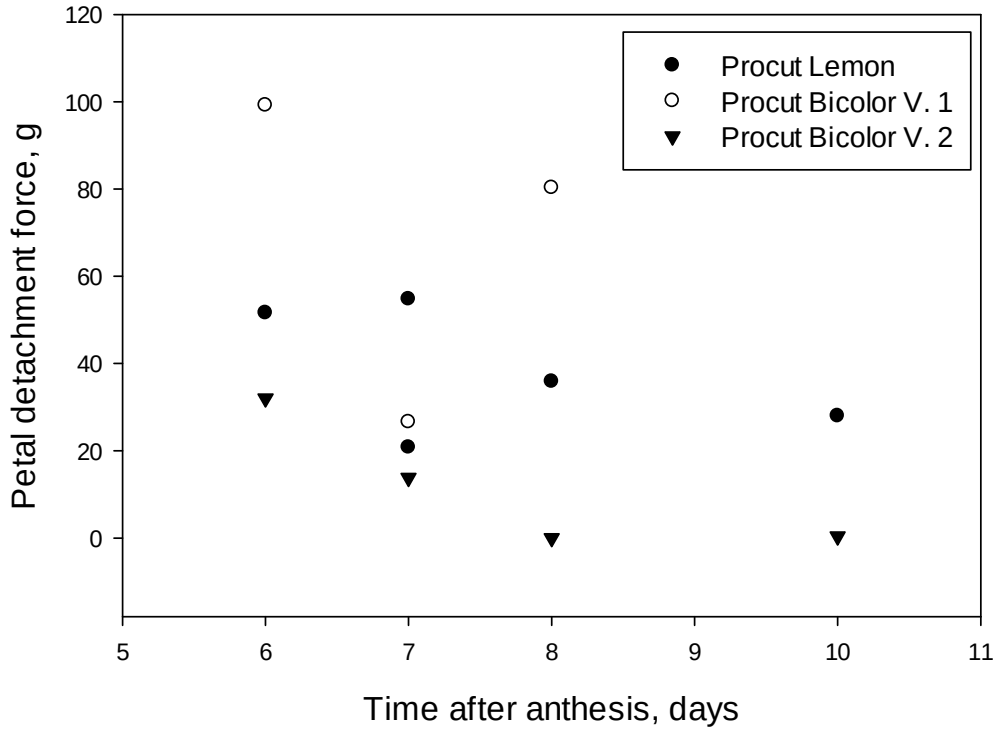

Fig. 12. Petal detachment force needed to remove petals when pulled forward, comparing 3 varieties.

VARIETY TRIALS

AMMI MAJUS:

The lacy patterns of wild carrot umbels have long made attractive additions to bouquets. Hitherto, the cultivated equivalent*, Ammi majus*, has come in only white, so the promised addition of a pink and a black-flowered addition to the menu was worthy of evaluation.

Materials and Methods: The two new entries were *Ammi majus* Pink (Genesis) and Black Knight, a quick-flowering line of carrot *(Daucus carota*) (Johnny's). Seeds of the two new varieties were sown in the greenhouse on April 7, and transplanted to the field April 1. There, they were spaced at 12 x 12 in. in 3 rows, with two replications.

Results and Discussion: Productivity of the two lines was not up to expectation, and growth and vigor did not match that of previously-tested Ammi lines. For 'Pink', 44% of the plants in Rep 1, and 28% in Rep 2 failed to produce flower stalks, but remained sessile. 'Black Prince' was twice as productive as 'Pink' (Table 10), and both had similar stem lengths. With regard to flower color, only a few of Var. 1's flowers were actually pink, with many appearing white; none of Var. 2's flowers were black, but rather a medium gray, and appeared to me as rather muddy. In all, there is room for improvement here.

Table 10. Stem length, productivity and earliness (days from sowing) of two lines of *Ammi majus* grown in the field in 2011.

Variety	Stem length, cm	Stems per plant	Days to first flower
Ammi majus Pink	39	13	94
Daucus Black Prince	43	30	83

ASTER (*CALLISTEPHUS*):

The profuse flowering, wide range of bloom colors, generous stem length and ample vase life make the annual aster a desirable cut flower. Unfortunately, susceptibility to a range of diseases, especially Aster wilt (*Fusarium conglutinans* var*. callistephi)*, and Aster yellows disease have been major impediments to field production. In 2010, our trial of new aster lines was decimated by Aster wilt, while we guarded against the spread of Aster yellows by protecting the plants from the vector, leafhoppers, by covering them from transplanting to anthesis of the earliest plants with low tunnels of 'Typar' spun-bonded material. The large number of new entries in the 2011 trial were hopefully going to include some lines more resistant to Aster wilt than those tested in 2010.

MATERIALS AND METHODS: Nineteen varieties were included in this trial, including the two standards used in 2010. Seeds were sown on May 17 in Promix in 72-cell trays in the greenhouse and transplanted on June 20 at 9 x 9 in. spacing, with 24 plants/plot in two replications. For this experiment,

only Rep 1 was covered with Typar; Rep 2 was left uncovered. The cover was removed on Aug. 5, and flower harvest commenced about two weeks later.

RESULTS AND DISCUSSION: In contrast to the previous year, growth of the plants in the trial was vigorous and largely unimpeded by disease, even among the two control varieties that came down heavily with Aster wilt in the previous year. Harvesting the many stems of this large trial became a major chore, as high yields were achieved (Table 11). Incidence of Aster Yellows appeared to be very low in the trial, and it was difficult to see differences in incidence of that disease between covered and uncovered replications. In 17 out of the 19 varieties, stem lengths at harvest were larger in the covered than the uncovered rep. Stem lengths averaged 35 cm vs. 32 cm overall, respectively. Since these treatments were not replicated, we cannot say if this difference is due to the effect of covering, or other location effects.

Table 11. Stem length, yield and earliness of 19 aster (*Callistephus*) varieties grown in a field trial in 2011.

Variety	Source	Stem length, cm	Stems per plant	Days to first flower
Beautiful Day Rose	Gloeckner	27	15	93
Beautiful Day Yellow	Gloeckner	31	13	94
Lady Coral Rose	Gloeckner	29	12	98
Lady Coral Chamois	Gloeckner	26	6	99
Lady Coral Lavender	Gloeckner	30	8	105
Rose of Shanghai Rose-white	Gloeckner	42	12	100
Rose of Shanghai White	Gloeckner	36	17	96
Rose of Shanghai Crimson	Gloeckner	41	10	104
Jewel Red Shadow Mix	Gloeckner	30	11	98
Jewel Thodilit Carmine	Gloeckner	31	12	98
Jewel Purpurit Lilac Rose	Gloeckner	30	11	98
Syringa	Gloeckner	33	10	96
Bonita Rose	Sakata	40	12	100
Bonita White	Sakata	32	10	98
Bonita Blue	Sakata	36	15	98

Bonita Scarlet	Sakata	37	12	99
Bonita Pink	Sakata	34	8	96
Bouquet Powderpuff Mix	Harris	39	12	102
Giant Princess Form. Mix	Johnny's	36	14	98

Comments on the varieties:

Beautiful Day lines: relatively early and productive, but of short stature. The rose variety seems more suitable for bedding plant or small pot use than as a cut.

Lady Coral lines: relatively short stems and moderately productive; all three exhibited moderate tip necrosis after Typar was removed: Aster wilt?

Rose of Shanghai lines: longest stems in trial, productive and promising; large flowers useful in bouquets.

Jewel lines: medium stem length and productivity, worth another look.

Bonita lines: small flowers on short branches on an upright strong stem. Flower sprays are too large to arrange when grown at 9 x 9 in. spacing; should either be crowded more or pinched to produce tall stems with fewer flowers. Excellent vigor and may have some disease tolerance.

Bouquet Powderpuff Mix: wide variation in flower size, stem strength and color in the mix: too variable for reliable use in arrangements.

Princess Formula Mix: Similar to Bouquet mix.


Jewel Red Shadow Mix


Mix


Syringa


Bonita Blue

BASIL:

Although basil is normal considered to be a kitchen herb without application as a cut flower, tall varieties with long stems and leaf color other than green have suggested that basil might enhance a bouquet's eye appeal and scent. Accordingly, this trial was conducted to evaluate the use of four basil lines as cut flowers.

MATERIALS AND METHODS: The four varieties were sown in 72-cell trays on April 7 and transplanted into the high tunnel on May 18; for the field planting the corresponding dates are April 23 and June 17. Spacing in both tunnel and field was 9 x 9 in., with 24 plants per plot except for Cardinal, for which fewer plants were available. Individual stems were harvested when they began to flower.

RESULTS AND DISCUSSION: Basil is another species that thrives in the high tunnel environment, producing more stems with generally greater stem length than in the field (Table 12). 'Cinnamon' appeared to be an exception to this trend, with equal performance in both locations.

Comments on individual varieties:

Aramato: tallest variety in the trial, with attractive dark red stem and leaves. It is hard to keep hydrated after cutting, but once hydrated, lasts at least two weeks in the vase. It has a less pronounced basil odor than culinary varieties.

Cardinal: a very leafy, slow growing variety with ball-like dark red flower mass, fleshy green leaves and dark red stem. Odor is strong, with overtones of liquorish and spice.

Cinnamon: early flowering, with green pointed leaves and red stem and flowers. Scent is faint, and stem length marginal for cut flower work.

Thai Magic: Too short and late flowering for cut flower use.

Table 12. Stem length, yield per plant and first flower date for four varieties of basil grown as cut flowers in the high tunnel and in the field in 2011.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
Aramato (Genesis)	66	58	8.8	5.4	66	86
Cardinal (Harris)	57	42	7.4	1.0[z]	143	119
Cinnamon (Johnny's)	44	47	6.8	7.7	60	84
Thai Magic (Johnny's)	43	37	5.4	4.3	102	102

[z]Frost in field before this variety flowered

CRASPEDIA:

A native of the highlands of Australia and New Zealand, the round yellow flower heads borne on long stalks have become popular as cut flowers in fresh and dry arrangements. We tested three varieties in both high tunnel and the field.

MATERIALS AND METHODS: Seeds were sown in 72-cell trays on March 2 and March 16 for tunnel and field, respectively. Plants grew vigorously in the seedbox, and were somewhat root-bound by the time of transplanting on April 29 and May 20. Several seedlings failed and had to be replaced in the high tunnel, taking care to score the roots to stimulate root branching. In both locations, there were 18 plants per plot grown in 3 rows at a 12 x 12in. spacing, in two replications.

RESULTS AND DISCUSSION: Growth was vigorous in the high tunnel, with plants quickly filling out the space between them. An infestation of aphids in mid-June was controlled by release of the aphid parasite *Aphidius colemani*, and two packages of Ladybird beetles. Appearance of the vegetative and reproductive plants was very similar among the three varieties, and flowers were also indistinguishable. Growth and yield was much less vigorous in the field, perhaps because we could not satisfy its need for dry and well-drained soil conditions there (Table 13). 'Billy Buttons' had significantly more yield than the other two varieties in the tunnel, but not in the field. Vase life was outstanding in both water and in dried arrangements, with no change in appearance of the flower head as a result of drying. This attractive and productive plant is an important addition to flowers that should be grown in high tunnels.

Table 13. Stem length, stem yield per plant and earliness in flowering of three Craspedia varieties grown in the high tunnel and the field in 2011.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
Sun Ball (Genesis)	70	56	18	10	119	122
Billy Buttons (Harris)	61	51	29	7	124	122
Goldstick (Johnny's)	67	64	17	4	122	125

CELOSIA:

New varieties of celosia, both plume and cockscomb types, have been developed in recent years, and need to be evaluated to see how they would fit into a cut flower production program. We tested seven lines, most of which were plume types, but a couple of which varied between the two types.

MATERIALS AND METHODS: The trial was conducted in both the high tunnel and the field. Sowing dates were May 4 and May 19 for tunnel and field, respectively, with the corresponding transplant dates of June 8 and 17. Seeds were sown in 98-cell trays. Plots consisted of 20 plants at 9 in. spacing in 4 rows and two replications.

RESULTS AND DISCUSSION: Growth and yield were good in both high tunnel and field, with slightly taller stems and higher yield in the tunnel (Table 14). There were considerable differences among varieties, and these are detailed below:

Table 14 . Stem length, stem yield per plant and relative earliness of flowering of 7 celosia varieties grown in the high tunnel and the field in 2011.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
Sunday Dark Pink (Kieft)	46	41	18	16	72	67
Sunday Wine Red (Kieft)	38	37	16	22	75	67
Orange Peach (Genesis)	60	63	13	14	79	86
Tornado Red (Genesis)	40	35	7	5.5	72	68
Pampas Plume (Johnny's)	69	65	17	15	70	69
Ruby Parfait Wheat (Johnny's)	44	42	34	25	63	60
China Town (Johnny's)	41	36	24	18	74	69

Sunday Dark Pink: Average stem length, yield and earliness; flower a slightly rounded plume that blends in with the medium green foliage.

Sunday Wine Red: Better height and productivity in field than tunnel; attractive dark red foliage and inflorescence; flower smaller and appears lumpy, but overall attractive and worth a try.

Orange Peach: Late, tall green plume type with variable flower shape and size.

Tornado Red: Short plant with small dark red cockscomb flower; low productivity; more suited as a bedding plant?

Pampas Plume: Tall plant varying in leaf color from light green to red, inflorescence mostly small plumes, with color from orange, pink to dark purple.

Ruby Parfait Wheat: Uniform dark red- - purple plume on green leaves. Flowering early and concentrated in a short period, but most productive in the trials: promising.

China Town: Dark red foliage with bright red plume inflorescence, attractive and uniform: promising.

COSMOS:

Single-flowered cosmos has been a popular cut flower in mid-summer and early fall bouquets for many years. The development of double-flowered varieties of the 'Double Click' line has heightened interest in this flower, and stimulated the conduct of this trial.

MATERIALS AND METHODS: Seeds were sown in 72-cell trays on April 28, and transplanted to the field on May 25 at a 12 x 12in. spacing, with 18 plants per plot in 3 rows and 2 replications. No planting was made in the high tunnel.

RESULTS AND DISCUSSION: Plants of the 'Double Click' varieties were vigorous and began flowering in mid-summer. On the plant, the double petals were attractive, but once cut, appeared to droop in the vase. This may have been a hydration issue, but we did not succeed in improving the vase display of these varieties despite repeated attempts. High yields and adequate stem lengths were found for all the varieties tested (Table 15). 'Sensation Mix' is a short-day plant, and started flowering very late in the plots, after having made massive vegetative growth. Among the Double Click lines, 'Cranberries' was earliest and the most attractive to this reporter with its dark purple petals (Fig. 13).

Table 15. Length of harvested stems, stem yield and first flowering dates of four cosmos lines grown in a field experiment in 2011.

Variety and (Source)	Stem length, cm	Stems per plant	Days to first flower
Double Click Rose Bonbon (Harris)	67	24	69
Double Click White (Harris)	62	23	69
Double Click Cranberries (Harris)	65	23	61
Sensation Mix (Harris)	78	29	86

GRASSES:

Ornamental grasses can offer important decorative elements in fresh and dried bouquets, and a number of species have been selected for this use. The present experiment is a comparison of three annual and one perennial species.

MATERIALS AND METHODS: The varied growth habits and growth rates required the use of two spacings in the trial: a 6 x 6in. spacing in 4 rows, totaling 32 plants for the wheat and triticale varieties, and a 12 x 12in. spacing in 3 rows, totaling 18 plants per plot, for the Pennisetum varieties. 'Jester' and 'White Lancer' were sown in a 72-cell seedling tray in a greenhouse on May 17, while the annual grains were direct-seeded in the field on June 8, using one seed per hill. 'Jester' was transplanted on June 15, whereas 'White Lancer' was transplanted on June 8.

RESULTS AND DISCUSSION: Of the two Pennisetums tested in 2011, 'Jester' was faster and more vigorous in growth, producing a thick, dark red inflorescence that provides a unique accent in arrangements when harvested before the anthers shed. The dark red foliage with light green inner parts is also of ornamental value. 'White Lancer', although more productive over the long season, lacks vigor in seedling growth, and in this trial showed chlorotic foliage in the seedbox (Table 16). Eventually, it was the tallest and most productive entry in the trial, although the seedheads looked a bit thin in contrast to 'Jester'. The two annual cereals grew quickly after being direct-seeded and tillered profusely. The wheat variety was marginal with regard to stem length, and was not attractive with the black awns appearing gray and muddy, compared to the taller and light tan ears of 'Silver Tip' (Figs. 15, 17). In commercial plantings, the two cereals would be planted several times, starting in early spring, to provide fresh material over the summer and fall. In informal vase trials, the cereals and 'White Lancer' held up well in dried arrangements. Drying of 'Jester' was not attempted.

Table 16. Stem length, yield and earliness of flowering for four grasses grown in the field in 2011.

Variety and (Source)	Stem length, cm	Stems per plant	Days to first flower
Pennisetum White Lancer (Harris)	95	21.5	105
Pennisetum Jester (Harris)	87	9.6	83
Triticale Silver Tip (Johnny's)	74	8.6	83
Wheat Black Tip (Johnny's)	41	8.0	83

Fig. 14. Pennisetum ‘White Lancer’

Fig. 15. Triticale ‘Silver Tip’

Fig. 16. Pennisetum ‘Jester’

Fig. 17. Wheat ‘Black Tip’

LISIANTHUS:

The 2011 variety trials with lisianthus were conducted to get a second year of performance data on promising new lines, and a first look at newer materials.

MATERIALS AND METHODS: Seeds were started in the greenhouse for both a high tunnel and field trial. Unfortunately, seed germination limited the number of seedlings for transplanting, so that only a few plots in both locations had a full complement of 20 seedlings. Plants were spaced at 9 x 9in. in 4 rows in both locations. Due to the slow growth of some seedlings in the Feb. 14 sowing, it was reserved for the field planting, while the March 1 sowing was transplanted to the high tunnel on June 1. The field transplanting was carried out on June 15.

RESULTS AND DISCUSSION: In addition to the seedling growth issues encountered in these trials, growth of the transplants in the high tunnel was not as vigorous as in previous years, so that there was no consistent advantage in stem length or yield in the high tunnel (Table 17). Observations on the individual lines are as follows:

ABC 2-4 Yellow Improved: Vigorous and productive line of creamy-yellow flower color (Fig. 18)

ABC 2-3 Misty Blue: A later version of the Misty Blue (1-3) tested last year. Stems of this version were 10 cm longer, but less than half as productive as the earlier line. The seed supplied of this line had poor germination and vigor.

ABC 1-3 Misty Blue: As productive as in 2010, but stems are somewhat short. Attractive flower color (Fig. 19).

ABC 1-3 Green: Taller and more productive in the field than in the tunnel.

Echo Champagne: Our standard line, productive and early, with attractive flowers.

Table 17. Stem length, yield and earliness of flowering for five lisianthus varieties grown in the high tunnel and the field in 2011.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
ABC 2-4 Yellow Improved (Ball)	41	38	6.6	6.8	146	163
ABC 2-3 Misty Blue (Ball)	40	41	4.6	3.6	152	174
ABC 1-3 Misty Blue (Ball)	32	31	6.6	9.2	144	161
ABC 1-3 Green (Ball)	32	37	4.4	7.6	146	164
Echo Champagne (Johnny's)	33	38	4.5	7.1	147	161

Fig. 18. ‘ ABC 2-4 Yellow Improved’ in field trial

Fig. 19. ‘ABC 1-3 Misty Blue’

The earliness designation put on new varieties by the seed company appear to work well when comparing lines within a color, such as the Misty Blue lines tested here, but are less indicative when comparing across colors, as between Misty Blue and the other colors.

CHRYSANTHEMUMS:

South American imports dominate the cut flower chrysanthemum market, and make production in New York State a questionable proposition. The ASCFG sponsored a trial of 6 varieties supplied by King’s Mums (Ray Gray), supplied as vegetative rooted cuttings, and we planted it in the high tunnel.

MATERIALS AND METHODS: The rooted cuttings were planted on June 15 in black plastic mulch at a 12 x 12in. spacing, with 6 plants per plot, and two replications. After some uncertainty about disbudding of lower branches, we decided to only disbud ‘Judith Baker’ and ‘Symphony’, both of which were described as capable of producing a strong central flower. No netting was installed for stem support.

RESULTS AND DISCUSSION: Plants grew vigorously and soon filled up the available space, and without support, tended to sprawl at the outer edges. The varieties with shorter stature (‘Vesuvio’ and ‘Symphony’) were shaded by the adjacent varieties and were less productive as a result. A hard freeze

on Oct. 28 ended the production season, as we had not installed a secondary covering over the plants, and probably disadvantaged the late varieties (Table 18). Observations on the varieties:

Vesuvio: Relatively short stature and weak stem put this variety at a disadvantage. Flower a pale yellow spoon.

Judith Baker: A late flowering bronze spider with large blooms when disbudded.

Whirlaway: Productive purple spoon type with yellow center. Many relatively thin stems, but early and promising.

Yoko Ono: Erect, relatively late flowering pompom with bright green color. Strong stems, but relatively brittle, with considerable flower breakage at harvest.

Symphony: Bronze spider with yellow petal tips. Plants too short to compete well with taller neighbors, hence not productive.

Maryll: Tall, robust spray type with dark red spoon flowers; productive and promising.

Although the varieties tested here could be grown well and were quite productive, the limited marketing season in comparison to cut mums available from South America will limit their usefulness as a domestically-grown cut flower. The late flowering also restricts their production to either high or low tunnels in our hardiness zone. Their tall stature will require use of support netting.

Table 18. Stem length, yield and earliness of flowering of six cut flower chrysanthemums raised from vegetative cuttings, supplied by King's Mums and planted in the high tunnel.

Variety and (Source)	Stem length, cm	Stems per plant	Days to first flower
Vesuvio	62	17.5	126
Judith Baker	72	15.2	144
Whirlaway	53	42.0	125
Yoko Ono	72	16.2	140
Symphony	73	8.6	136
Maryll	58	34.5	128

Fig. 20. ‘Vesuvio’

Fig. 21. ‘Whirlaway’

Fig. 22. ‘ Maryll’ chrysanthemum.

PEPPERS:

The presence of small, brightly colored fruits on long stalks has enhanced fall arrangements, and lent them an air of fall. We compared a new pepper line with standards, and a new pumpkin-on-a-stick accession.

MATERIALS AND METHODS: Seeds were sown on March 22 in 72-cell trays and placed in a greenhouse. They were transplanted to the high tunnel or the field on May 18 and May 23, respectively, and placed at a 12 x 12in. spacing, with 15 plants per plot and 2 replications. Harvest was begun when fruits on branches had turned to their mature color.

RESULTS AND DISCUSSION: Plants in both high tunnel and field grew well, and there was little difference in earliness or stem length, but field-grown plants had the highest yield (Table 19). Other observations are given in the descriptions of individual varieties:

Orange Globe: Erect plants with dark green foliage and round 1-2 cm dia. fruits clustered at the end of branches. Fruits turn from green to orange, but become wrinkled and less attractive when mature. Plants retain leaves at fruit maturity (Fig. 23).

Cappa Conic: Open plants with fruits distributed throughout the branches. Fruits blunt conical, yellow when immature to light red at maturity. Attractive and long-lasting in the vase, even when dry. Needs manual defoliation (Fig. 26).

Pumpkin pepper *(Solanum integrifolium*, "Pumpkin-on-a-stick"): Thornless green stems of nearly 1 m height, but somewhat weak when loaded with fruit, and requiring support. Fruits bright red, slightly rough, attractive and holding well in the vase. Little defoliation required because leaves fall off at fruit maturity (Fig. 24).

Nippon Taka: Relatively short plant with short, erect branches. Fruits 8-10 cm long, 1 cm wide, erect and clustered at the end of the stems, turning red from green (Fig. 25). Main stem fruits mature earlier on shorter stems than branches, and are difficult to use. Plants require defoliation at harvest.

Table 19. Stem length, yield of stems and relative earliness of three pepper and one ornamental eggplant (Pumpkin pepper) grown in both high tunnel and field in 2011.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
Orange Globe (Genesis)	40	36	8.4	12.4	176	178
Cappa Conic (Harris)	38	40	8.3	11.0	176	183
Pumpkin pepper (Harris)	63	60	4.6	5.8	174	174
Nippon Taka (Johnny's)	47	40	6.2	9.7	174	178

Fig. 23. 'Orange Globe'

Fig. 24. 'Pumpkin' pepper

Fig. 25. ‘Nippon Taka’

Fig. 26. ‘Cappa Conic’