CUT FLOWER CULTURAL PRACTICE STUDIES AND VARIETY TRIALS, 2012

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EXECUTIVE SUMMARY:

1. **Aster Root Rot Experiment (Page 5):** Vermicompost and fungicide drench treatments were not successful in reducing incidence of what appeared to be Aster fusarium wilt. There were clear varietal differences, however, with 'Princess Dark Red' being susceptible, and 'Matsumoto Scarlet' and 'Bonita Deep Blue' much less affected. We did not succeed to confirm the identity of the pathogen. A late attack of Aster Yellows was severe and non-discriminating.
2. **Sunflower Photoperiod Experiment (Page 8):** Twelve sunflower varieties were exposed in the seedling stage to either 12 or 16 hrs daylength. They were then transplanted to the field, and their time to flowering measured. Five lines were day-neutral, 2 showed moderate and 3 strong reaction to the short day exposure, and two showed a moderate response to long days.
3. **Sunflower Pinching and Spacing Expt. (Page 12):** Three branching varieties of sunflower were grown at 3 plant spacings, and either pinched at the 6 leaf stage, or not pinched. Pinching increased plant stem numbers by a factor of 4, but in the process reduced flower diameter from 5.8 to 4 cm. If the minimum acceptable flower diameter is fixed at 3.8 cm, the maximum stem density would be 8 stems per square foot. A similar figure was obtained in 2011.
4. **Sunflower Pollinations Expt. (Page14):** With some flower species such as orchids, once the flower has been pollinated, the petals fall off. To test if pollination hastened petal abscission, we compared the petal retention force of four sunflower varieties if pollinated or not, and found that pollination made no difference in the tendency of sunflower petals to fall off.
5. **Sunflower Petal Pull Expts. (Page 16):** We continued research to determine if a mechanical pulling device attached to sunflower petals can measure and predict flower vase life. When pulled in the direction of petal attachment, the pulling force is larger than if the petal is snapped back toward the stem. Although there are varietal differences in pull force in the former direction, these differences do not become apparent until about 5 days after flower harvest, thus not serving any predictive value.

VARIETY TRIALS:

1. **Carthamus (Safflower) (Page 19) :** Of the five varieties tested in a field trial, only 'Dark Orange Red' was tall enough to have reasonable stem length, but was 14 days later in flowering than the other varieties.
2. **Celosia (Page 20):** Seven varieties were planted in both high tunnel and field. As in past years, plants in the tunnel flowered earlier, and were more productive than those in the field. Three plume types were most promising: 'Sunday Orange' and 'Sunday Wine Red' , both from Kieft, and 'Sylphid' from Johnny's.
3. **Chrysanthemum (Page 23):** This trial was planted from vegetative cuttings in spring 2011 in the high tunnel, harvested for the first time that fall, and allowed to overwinter for this season. Four out of the six varieties had good survival, and produced from 40 to 91 stems

per plant. Since flowering occurred well past the severe first frost on Oct. 13, it was essential to have the protection of the high tunnel for this trial.

4. ***Cynoglossum* (Page 24):** With flowers resembling 'Forget-me-not' (*Myosotis*), this species was disappointing with its poor germination and short stems. Vase life was also problematic, with hydration problems. 'Mystic Pink' was more vigorous and taller than the other 3 lines.
5. ***Eucomis* (Pineapple Lily (Page 25):** A bulb crop originating in South Africa but further developed in New Zealand, we planted it in the high tunnel to determine if it could become a flowering perennial there. In this first year, only 'Reuben' averaged on flower per three plants, the other three had fewer. Flowers last for weeks or months in the vase.
6. ***Gomphrena* (Globe Amaranth) (Page 27):** All four varieties grew vigorously in both field and high tunnel, with very little difference in productivity or stem length. The varieties Qis Red, Strawberry Fields and Flashing Light were indistinguishable in all characteristics.
7. **Larkspur (*Consolida*) (Page 28):** Four lines of the 'Genesis' series compared favorably in productivity, stem length and earliness, with attractive double petals and a vase life of about a week.
8. **Lisianthus (*Eustoma*) (Page 31):** In spite of a month's delay in seedling growth, the five varieties tested performed well in high tunnel and field. 'Arena 2 Kilimanjaro' was particularly note-worthy, with large white flowers and strong stems. 'Cinderella Pink' and 'Echo Champagne' were attractive but with shorter stems.
9. **Marigold (Page 33):** Productive in both high tunnel and field, the four varieties tested were also noteworthy for a vase life of around 2 weeks. 'Babuda Gold' had the most attractive flowers, but was also a Japanese beetle magnet.
10. **Pepper (*Capsicum baccatum*) (Page 35):** Selected from a USDA plant introduction collection grown by Dr. Michael Mazourek in 2011, we grew 27 lines along with 3 commercial varieties in the field in 2012. With heights of more than a meter, these vigorous plants produced from 14 to 21 stems each. A vase test of each line revealed some lines that maintained turgor, and these will be distributed to ASCFG members for further testing in their locations.
11. **Snapdragon (*Antirrhinum*) (Page 44):** A trial of six varieties was conducted in both high tunnel and field. 'Chantilly Purple' is a Group 1-2 variety that did not develop adequate stem length, although the open throated flower and dark red color were attractive. 'Opus Bright Red' was the most promising of the later varieties tested.
12. **Stock (*Matthiola*) (Page 45):** 'Cheerful Yellow' and three 'Katz' lines produced a good crop by late May in the tunnel.
13. **Solanum mammosun (Nipple Fruit) (Page 46).** This wild species is used as an ornamental for its dried fruits in Southeast Asia. A planting of three varieties in the high tunnel produced plants covered in spines on leaves and stems, and fruits the size of large eggs that turned yellow at maturity. Spinyness and fruit rot tendency will limit its use as an ornamental.

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WEATHER CONDITIONS:

Compared to many parts of the country, the Ithaca area was spared some of the weather extremes. Temperatures rose above normal in May, and stayed that way through July (Fig. 1), but then followed normal long-term averages. The first hard frost came relatively early this year: temperatures dipped to 13 F on the morning of Oct. 13.

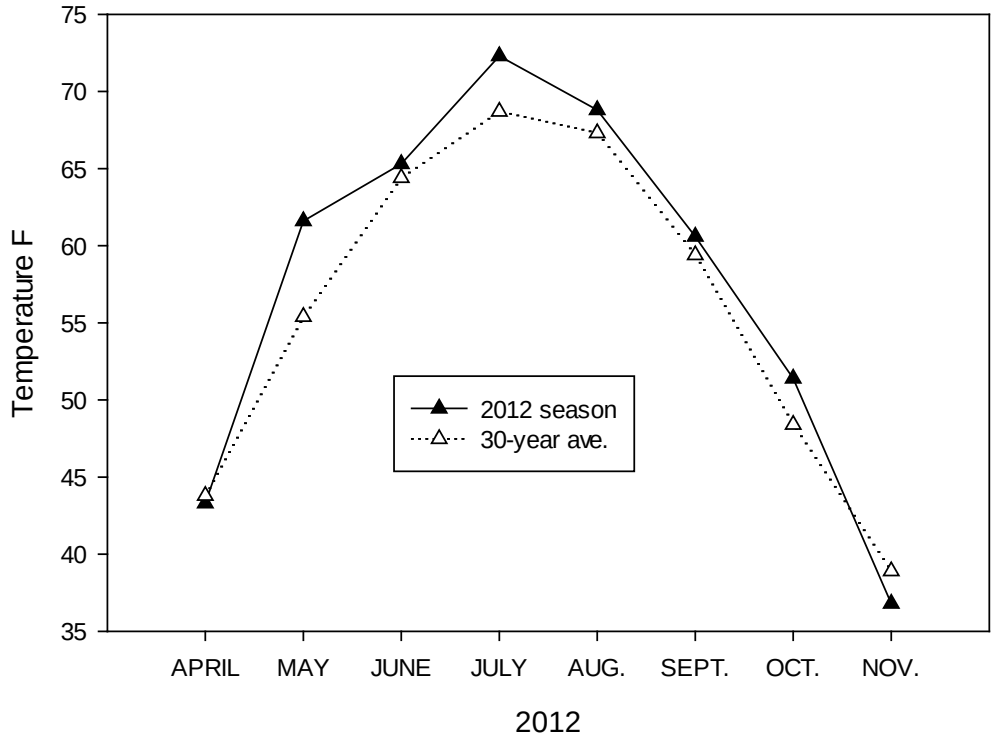

Fig. 1. Temperature during the growing season in 2012, and the 30-year average, for Ithaca, NY. From: www.nrcc.cornell.edu/climate/ithaca/.

During the warm June and July period rainfall was less than half of normal, came close to average conditions for the rest of the growing season, but was below normal again in November (Fig. 2).

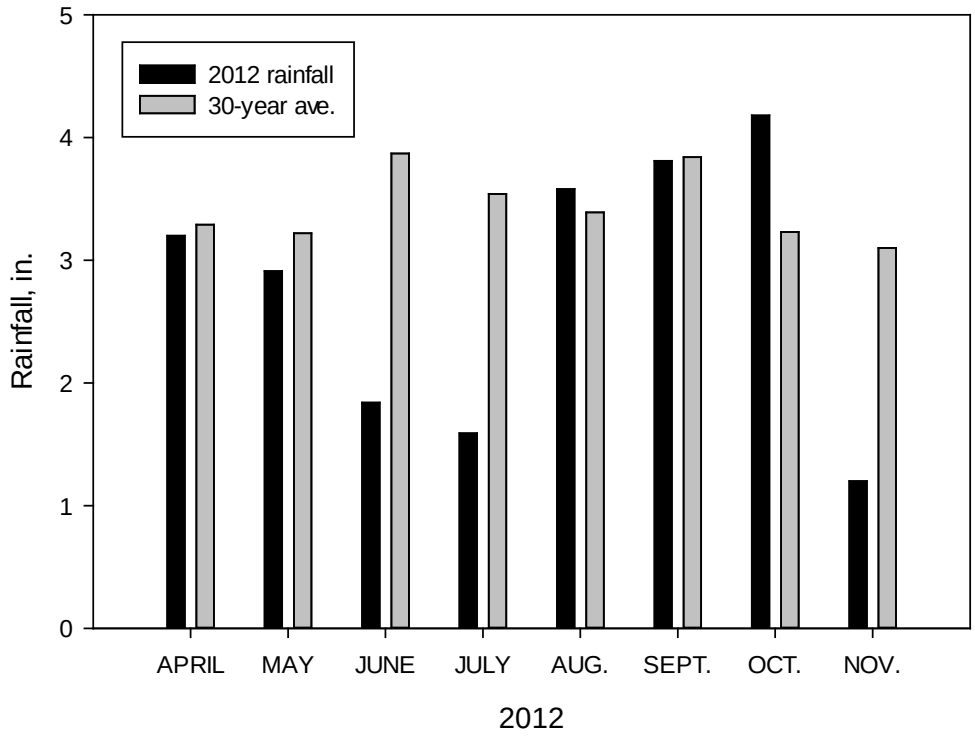

Fig. 2. Rainfall distribution in the growing season of 2012, compared to the long-term average. From: www.nrcc.cornell.edu/climate/ithaca/.

GENERAL MATERIALS AND METHODS:

The 2012 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.

There was no compost addition nor general fertilization with inorganic fertilizer in the high tunnel this year. Three trickle irrigation lines were placed In each of the high tunnel beds.

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 during the dry period 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 or fungicide applications were made to plots in the field in 2012, except to control an infestation of sucking insects on the snapdragon variety trial. In the high tunnel, we controlled spider mites by releasing Neoseiulus californicus and Mesoseiulus longipes on three occasions. Aphids were not well controlled by ladybird beetles in the tunnel snapdragon trial in late fall. The natural enemies were supplied by IPM Labs, Locke, NY. 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.

ASTER ROOT ROT EXPERIMENT (with Dr. Eric Nelson and Ellen Crocker, Dept. of Plant Pathology)

China Aster (*Callistephus chinensis*) is often affected by a root rot that causes the plant to stop growing and abort flowers. It is commonly caused by *Fusarium conglutinans var. callistephi*, which appears to be endemic in some parts of our field plots in N-4 at East Ithaca. Evidence from other plant species suggests that vermicompost may suppress this and other pathogens when added to the soil. From previous variety trials with Aster, there appear to be varietal differences in susceptibility to this disorder, so we will compare the performance of three lines of varying degrees of susceptibility.

Materials and Methods: The trial was conducted in an area of our cut flower field that was heavily affected by fusarium wilt in 2010. Treatments compared an untreated control with two rates of vermicompost (10% and 20%), and a drench at transplanting of Etridiazole fungicide. The vermicompost was mixed into the transplant hole, with rates being calculated on the volume of soil removed by the bulb setter used to make the hole. Of the three varieties used in the trial, 'Princess Deep Red' was considered susceptible to fusarium wilt, while 'Matsumoto Scarlet' and 'Bonita Blue' are rated as resistant. The trial was planted twice, May 16 and June 15, with transplant dates of June 15 and July 11, respectively.

To isolate potentially pathogenic fungi, soil and disease symptomatic aster seedlings were collected from field trial plots. In an initial trial, aster seeds were planted in the potentially infested soil and seedling emergence and diseased symptoms were recorded. Any symptomatic seedlings were plated on Potato Dextrose Agar to isolate fungi. Of cultures obtained in this way, we then tested the pathogenicity of the 9 most commonly isolated fungal phenotypes on seedlings of 3 aster cultivars: Princess Deep Red, Sakata Matsumoto and Bonita Blue in the greenhouse. Symptoms were recorded weekly.

Additional isolations were made by collecting several wilt-symptomatic plants from the field trial plots and returning them to the lab to isolate fungi from symptomatic lesions. Necrotic tissue was placed in a fungal-selective media and as fungi grew they were transferred to clean Potato Dextrose Agar. Symptomatic plants and necrotic tissues are shown in the Figure above. Three of the more common fungal phenotypes were selected and their pathogenicity to surface-sterilized aster seeds of the Sakata Matsumoto variety was evaluated. To do this, seeds were placed on the surface of water agar plates that were either sterile (as a control) or inoculated with one of the 3 fungi. After 2 weeks seed germination and seedling health was assessed.

Results and Discussion: The first two replications started showing symptoms of wilting and stunting in 'Princess Deep Red' about 54 days after transplanting (Fig. 1). Plants showed a pronounced wilting, while others failed to show stem elongation, and remained stunted. The progression of symptoms was steady so that by 28 days after the signs first appeared, nearly all of the plants were affected. There appeared to be little difference in symptoms due to the treatments applied. Plants of the other two cultivars did not show these symptoms.

By 82 days after transplanting, most of the plants in the first two replications showed a general yellowing and leaf edge necrosis. These signs were general throughout the experiment, and did not differ significantly among cultivars or treatments. Plants not affected by the wilt and stunt signs noted earlier stopped growing, so that few marketable stems could be harvested from the trial. We suspect that these symptoms were caused by the mycoplasma Aster Yellows, transmitted by leafhoppers.

The plants in Reps 3 and 4 began showing wilt symptoms about 56 days after transplanting, and the incidence was again mostly confined to 'Princess Deep Red', with little difference among treatments. By day 71, however, the symptoms of Aster Yellows had overwhelmed the signs of wilting and stunting, and again prevented any useable cut stems to be harvested from the trial.

Protection of aster plants in the field from leafhopper attack by covering them with insect-proof netting was practiced in one replication of our 2011 trial, but only low incidence of the disease was seen in that trial. The 2012 trial indicated that such protection would have been useful . It is noteworthy that incidence of wilting and stunting of aster in a field infested with *Fusarium* can be prevented by use of resistant varieties.

Although many of the fungi isolated from both of our experiments appeared to be species of *Fusarium*, none were pathogenic, suggesting that either this assay is not appropriate for determining pathogenicity or that the isolates we obtained were indeed not pathogenic. In subsequent assays from field-collected plants, again, none of the isolates were pathogenic in this assay, despite having morphological similarities with *Fusarium* species. However the number of seeds provided for these assays was too small to determine significance. This suggests that either this assay is not ideal for detecting symptoms caused by wilt causing pathogens or that the fungi we isolated are not responsible for the observed wilt.

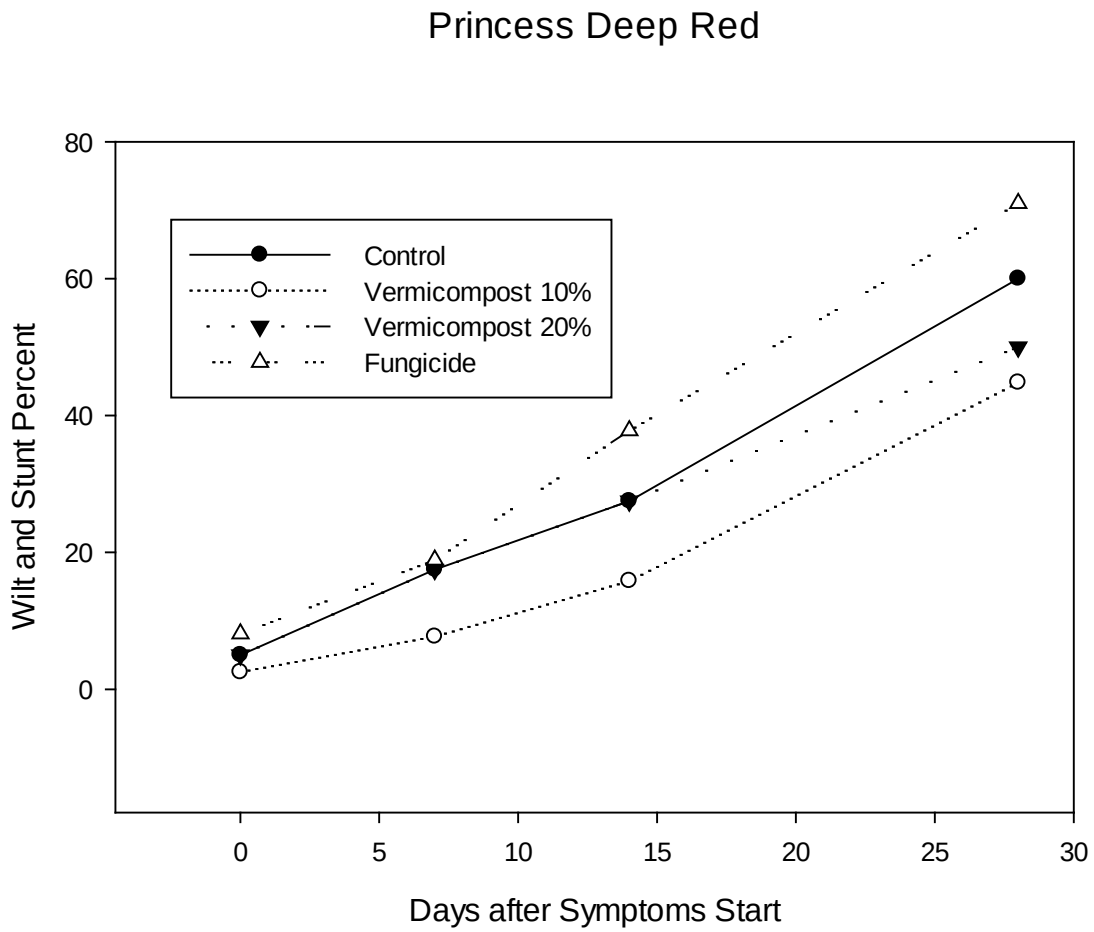

Fig. 3. Progress of wilting and stunting symptoms on 'Princess Deep Red' aster plants in the field, as influenced by soil treatments applied at transplanting. Lines are an average of only two replications and are unlikely to be statistically significantly different.

SUNFLOWER PHOTOPERIOD EXPERIMENT:

As we have for many years, we again tested the reaction of new cut flower sunflower varieties to daylength in the seedling stage. This requires that the new lines are exposed to either short or long daylength in the first 3 weeks after emergence, before being planted in the field, and the flowering date and plant and flower sizes noted. This year, the reaction was more varied than in many previous trials.

Materials and Methods: Seeds for the study were sown in 72-cell trays in peat-vermiculite 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. The crop was sown on May 16 and transplanted June 11. There were 10 varieties that were being tested. 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.

Table 1. Reaction of 12 sunflower varieties to short or long days, imposed for 21 days after seedling emergence. Plants were then transplanted to the field.

Name	Daylength[z] reaction	Days to first flower		Plant height	
		Short day	Long day	Short day	Long day
Brilliance	Neutral	60	60	99	89
Coconut Ice	Neutral	64	58	114	107
Dafne	Strong SD	52	74	70	128
Double Quick Orange	Mod. LD	84	72	153	111
Frilly	Mod. LD	78	66	168	116
Giant Sungold	Neutral	99	97	170	169
Goldy Double	Neutral	86	89[y]	162	146
Procut Lemon	Neutral	61	56	105	94
Sunbright Supreme	Strong SD	47	72	69	144
Sunrich Orange	Strong SD	50	70	68	127
Vincent Choice	Mod. SD	47	56	77	81
Vincent Fresh	Mod. SD	47	55	73	87

[z]Daylength reaction = Neutral: less than 7 days difference in flowering between short and long day; mod. SD: Plants flower 8-20 days earlier in SD; Strong SD: More than 21 days delay with LD treatment; Mod. LD: 7-14 days delay with SD treatment.

[y]Data from one replication only

Table 2. Summary table of the response of four classes of response to daylength, showing averages for days to first flower, diameter of the flower at anthesis, and the number of flower buds in the upper four nodes of the main stem.

Daylength reaction class	Days to first flower		Flower diameter, cm		Bud no.	
	Short day	Long day	Short day	Long day	Short day	Long day
Day neutral	75	71	6.0	6.3	0.5	0.4
Mod. SD	47	55	4.2	4.5	3.0	1.4
Strong SD	51	70	4.1	7.5	2.7	0.1
Mod. LD	82	68	7.2	5.7	1.4	1.4

Results and Discussion: Nearly half (40%) of the new varieties were not sensitive to daylength in the seedling stage (Table 1). Aside from flowering at nearly the same time regardless of daylength treatment, plant height, flower diameter and the number of buds in the upper nodes were similar (Tables 1, 2). With increases in sensitivity to daylength, flowering occurred earlier, the plants flowered on shorter stems that had smaller flowers, and there was an increase in bud number. Two varieties, namely 'Double Quick Orange' and 'Frilly' showed a delay in flowering under short days, with an associated increase in stem length and flower diameter. The daylength treatment did not affect bud number for these varieties.

VARIETY DESCRIPTIONS:

1. Sunbright Supreme: Under long day conditions, a standard orange petals variety with dark center. The most sensitive to short days of the varieties in this test. Short day-treated plants were short, early with numerous flower buds in the upper nodes.
2. Vincent Choice: A short, early flowering standard orange with small flower heads and rounded petal tips. Moderately sensitive to short days, showing axillary flower buds even in long day conditions.
3. Vincent Fresh: A sister line to #2, with green-yellow center, but otherwise similar in daylength response, earliness, stem length and flower size. Informal tests show this variety to have a vase life of only 5 days.
4. Goldy Double: A tall, late large-flowered variety with double petals, insensitive to daylength.
5. Double Quick Orange: Earliest of the double varieties in the trial, moderately delayed by short days. Head size large at the 9 x 9 in. spacing used.
6. Giant Sungold: Latest of the double varieties, forming large plants and heads. Plants susceptible to a leafspot affecting the lower leaves that can be unsightly.
7. Dafna: Standard orange variety with dark center. Very sensitive to short days, flowering early on short stems if exposed to 12 hr. daylengths in the first three weeks after emergence.
8. Frilly: Novelty flower with dark center and thin, short inner petals . Attractive, but moderately delayed in flowering with early short days.
9. Coconut Ice: Flowers with pale yellow petals with dark centers. Medium height and earliness, daylength neutral.

10. Brilliance: likely Procut Brilliance, tested in 2011. Attractive standard orange sunflower of medium earliness, height and flower diameter. Did not react to daylength in the seedling stage.


OUBLE QUICK
ORANGE


DAFNA


RILLY


COCONUT IC

SUNFLOWER PINCHING AND SPACING EXPERIMENT:

Increasing the productivity of sunflower has been a goal of our cut flower research program for many years. Removal of the main growing point at the seedling stage (pinching) forces the plant to branch, and thus increases the number of stems produced several-fold. In 2011, we showed that this technique also worked for branching sunflowers. The current experiments was conducted to test additional branching varieties, using the same three plant densities as in 2011.

Materials and Methods: The study looked at three varieties, grown at three plant spacings, and either pinched or left alone (single stem). The varieties were Starburst Panache, Goldrush and Greenburst, all branching varieties. 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, in three replications. 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.

Results and Discussion: The pinching treatment had the familiar effect of increasing stem numbers per plant (Table 3). However, as the number of stems per unit area was increased, branching of individual plants was suppressed, leading to a significant pinching by spacing interaction. Stem yield per unit area was highest for the pinched closely spaced plants, and declined at wider spacing. Increased crowding also reduced flower diameter, especially in plants that had not been pinched. Stem length was reduced by about 50% by pinching, but even these stems would still be commercially acceptable.

Table 3. Effect of pinching at the 6-leaf stage and plant spacing on yield per plant, per unit area, flower diameter and stem length for three branching sunflower varieties grown in 2012.

Treatments		Yield		Flower	Stem length,
Pinching	Spacing, in.	Per plant	Per 1000ft^2	diameter, cm	cm
None	6 x 6	1.0	4139	4.8	144
None	9 x 9	1.1	1910	6.0	144
None	12 x 12	1.1	1093	6.7	138
Pinched	6 x 6	2.4	9611	3.7	64
Pinched	9 x 9	4.3	7672	4.2	72
Pinched	12 x 12	5.6	5639	4.2	74
Statistical signif.	Pinching	**	**	*	**
	Spacing	***	***	***	ns
	Interaction	***	ns	***	**

Of the three varieties, 'Goldrush' had 19% shorter stems when not pinched, but similar stem length as the other varieties after pinching (Table 4).

Table 4. Stem length of three sunflower varieties at harvest after pinching, or not, in the 6-leaf stage. The interaction was significant at the 1% level.

Variety	Not pinched	Pinched
Starburst Panache	150	63
Goldrush	123	72
Greenburst	153	74

As noted above, the increased stem density per unit area due to pinching and increased plant population resulted in a decrease in flower disk diameter to the point at which the stems might not be marketable. In 2011, we arbitrarily fixed that limit at 1.5 in. (3.8 cm). When stem density is plotted against flower diameter (Fig. 3) a similar negative relationship is produced, with a maximum acceptable yield of 8000 stems per 1000 ft^2. Varietal differences were not distinct at highest densities.

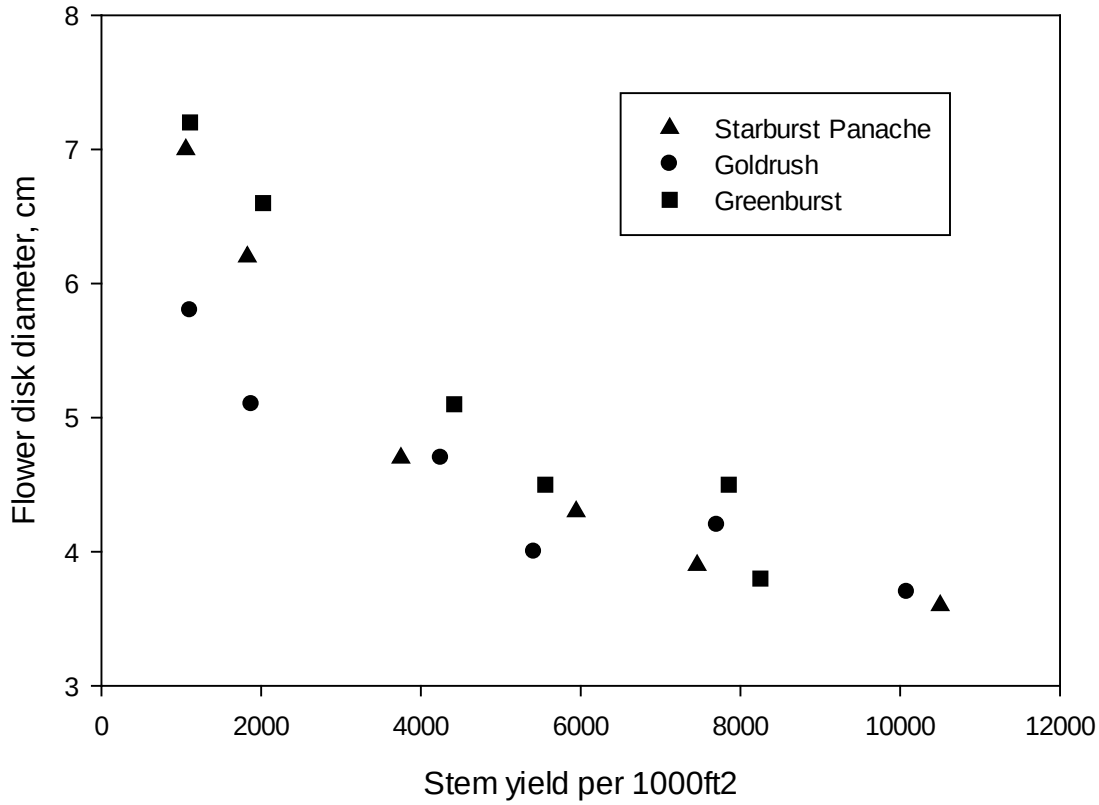

Fig. 3. The relationship of flower disk diameter with the density of sunflower stems in a spacing and pinching trial, for three cut flower sunflower varieties grown in 2012.

Fig. 4. Appearance of variety Goldrush at flowering, as influenced by spacing and pinching. Note the larger flower size of the unpinched plants (left).

SUNFLOWER POLLINATION EXPERIMENT: (As summarized in the ASCFG Cut Flower Quarterly, Fall 2012)

Flower growers have lots to worry about during the growing season: production issues such as the weather, pests and weeds, labor, marketing, taxes, etc. Here is one issue that we have just found **not** to be a problem: sunflower pollination.

Some flowers, notably snapdragons, some orchids and the potted plant cyclamen, shed their petals soon after the flower has been visited by a bee, or the pollen has been shaken onto the female part of the flower. Rather annoying for the consumer, or the cut flower grower, who is expecting at least a week of petal life.

What about sunflowers? Most cut flower varieties of this species have been selected to not produce pollen, because pollen makes unsightly stains on table cloths. But some varieties are pollen-producing, as are all those grown for snack food, birdseed and oil. And so it might be possible that in a mixed planting, bees will busily transfer pollen amongst them.

To find out if pollination matters with regard to flower longevity, we conducted a couple of tests in our high tunnel, either pollinating the flowers, or keeping them from being pollinated. We then harvested the flowers, kept them for 5 or 7 days in water at room temperature, and then measured the petal retention force. The weaker the force holding the petals on the flower head, the closer they are to falling out, thereby ending the flower's vase life.

We did the experiment in the 2011 and 2012 growing seasons, and in both, pollinated and unpollinated flowers had similar petal retention force after 5 and 7 days of flower storage. So don't worry about the bees in your sunflower plantings; the flowers you harvest will last an equal length of time.

Pollenless sunflower

Sunflower producing pollen

The 2012 data from which the information in the article above were derived is shown in Table . Plants were grown in the high tunnel at 9 x 9 in. spacing, with 4 rows per bed. At anthesis of each flower, the heads were covered with plastic pollination bags supplied by Dr. Tom Heaton (NuFlowers LLC). Pollination was accomplished by rubbing the heads with heads of a pollen source also growing in the tunnel (Line 4RL98), supplied by Dr. Heaton. After pollnation, stems were harvested, placed in water in a 20 C storage room with 12-hour ligh duration. Five days after pollination and harvest, petal retention was determined by use of the petal pull meter developed the previous year. Self-pollination of these male sterile varieties consisted of vigorously rubbing the heads to be pollinated with other heads of the

same variety. This was meant to cause comparable physical injury to these heads that received no pollen, as those that were pollinated.

Although there was considerable variation, there were no instances where the pull strength of the cross-pollinated petals was less than that of the self-pollinated heads (Table 5). These results should be reassuring to growers of cut flower sunflowers, for it frees them from isolating their sunflower plantings from other sunflowers that may produce pollen.

Table 5. Petal retention force on the sunflower head of four sunflower varieties grown in a high tunnel , 5 days after pollination.

Variety	Self-pollinated			Cross-pollinated		
	Mean	Std. dev.	No. of flos.	Mean	Std. dev.	No. of flos.
Procut Lemon	90	50	13	93	47	7
Procut Bicolor V. 1	113	36	8	119	14	13
Procut Bicolor V. 2	102	33	8	140	15	7
Strawberry Blonde	80	30	4	101	11	16

SUNFLOWER PETAL PULL EXPERIMENTS:

Research in previous years indicated that we could measure differences in sunflower vase life by determining the resistance to petal detachment after a few days in the vase. Petal detachment force was measured by pulling on individual petals at a slow, measured rate, while the flower head was lying on a balance. The weight of the head at the time of petal detachment was then taken as the force required to remove that petal. Detachment force varied with the angle of pull, with a forward pull in the direction of petal attachment, much higher than when petals were pulled back at an acute angle to the line of attachment, so they 'snapped off' (Figs.).

Materials an Methods: Plants for the greenhouse experiment were started in seedling trays and transplanted to 12 in. pots in mid-March in a greenhouse set at 80/70 F day/night temperature, with supplementary metal halide lamps. When the plants reached anthesis, stems were harvested into buckets of water, and stored in a laboratory at 68 F, with a 12 hr day/night cycle. Five and seven days after harvest, heads were cut in half, and placed on the balance, with a heavy weight holding down the stem. For one half of the head, the direction of pull was forward (in direction of attachments of the petals), for the other half, sepals were removed to allow pulling of the petal back toward the stem (Figs. 5,6). For each half flower head, five petals were pulled, and for any one storage time, from 4 to 10 heads were measured.

Fig. 5. Petal pulling apparatus, showing an electric drill, to which a pulley mechanism is attached, so that the direction of pull is in the direction of attachment of the petal. The flower head is resting on the scale, held down by a lead weight.

Fig. 6. Halved sunflower head with petal clamp pulling the petal backwards. Note that the green sepals of the head have been removed with scissors to allow the petal to be pulled at an acute angle without impedance.

Results and Discussion: The greenhouse trial indicated that the direction of pull makes a big difference in the resistance values (Table 6). Pulling backwards tends to snap off the petals, whereas the forward pull appears to measure the detachment force of the abscission layer more directly. Varietal differences

were most distinct after 7 days of storage, but also more variable at that time, since some heads had begun to lose petals with very little detachment force, and others of the same age had petals firmly attached.

In the field trial, only forward pulling was undertaken. Detachment forces were similar at both Day 2 and 5, but declined on Day 7 (Table 7). Variability again increased with flower age, and the varieties Procut Bicolor and Strawberry Blonde again had lower detachment force readings than Procut Gold or Procut Lemon.

The results of these trials are not encouraging for the use of the petal detachment meter to predict vase life of sunflower varieties. The technique is fairly time-consuming, and requires harvesting and storage of flowers for almost as long as the vase life of the flower. Detachment forces determined at the start of the storage period are little different among varieties. In addition, petals from such freshly harvested flowers tend to detach by tearing, rather than separating at the abscission zone.

Table 6. Resistance to detachment of sunflower petals after 5 and 7 days in room temperature storage. The three varieties were grown in a greenhouse in spring. Data shown are means and standard deviation.

	Day 5		Day 7	
Variety	Back pull	Forward pull	Back	Forward
Procut Bicolor V. 1	8.6 (6.1)	121 (24)	3.3 (0.9)	40 (23)
Strawberry Blonde	14.9 (11.0)	104 (16)	1.2 (1.5)	50 (8)
Procut Gold	33 (20)	135 (12)	--	96 (30)

Table 7. Resistance to detachment of sunflower petals at days 2, 5 and 7 days after flower harvest. Plants grown during the summer season in the field. Values are means and standard deviations, from forward direction of pull only.

Variety	Day 2	Day 5	Day 7
Procut Bicolor V. 1	96 (11)	76 (13)	30 (18)
Strawberry Blonde	111 (12)	92 (4)	10 (13)
Procut Gold	103	103	74 (52)
Procut Lemon	140 (35)	137 (14)	81 (36)

CUT FLOWER VARIETY TRIALS

CARTHAMUS (SAFFLOWER) VARIETY TRIAL:

This member of the Compositae family is principally grown as an oil-seed crop, but the upright stature and orange thistle-like head are attractive enough to have spurred development of varieties that are grown as ornamentals, both in the fresh and dry state.

Materials and Methods: The first field trial was sown on April 9 into 72-cell trays in Metromix, and transplanted to the field on May 19. Plants were spaced 6 x 6 in., with 30 plants per plot, in two replications. When most of the varieties in this planting had stunted early growth, a second sowing was made on June 20 and transplanted on July 11.

Results and Discussion: Growth of the first trial was disappointing in that all varieties except 'Dark Orange Head' flowered early and thus had very short stems (Table 8). Branching was restricted to short stems close to the top of the plant, so that each plant only produced one stem that could be cut. 'Dark Orange Head' was 2 weeks later, and in that period produced more stem growth and thus more satisfactory stem length. Flower appearance for this species is an acquired taste, and was not pleasing to this grower or his assistants. The central flower opens a week before the side flowers, and tends to fade and look unattractive by the time the side flowers open. The pale color of 'Grenade White' was also not attractive. Perhaps a pinching treatment combined with late flowering, as with 'Dark Orange Head' would be a way of obtaining a more attractive and productive cut flower.

The attempt to obtain better vegetative growth and stem length in the second planting did not succeed. This trial was besieged by a groundhog that was nesting in the fence row, and which concentrated on feeding on just this species. However, the few plants that were not destroyed by this animal did not grow any better than in the first trial.

Table 8. Stem length, stem yield and days to flower of 5 carthamus varieties grown in the field in 2012.

Variety and (Source)	Stem length, cm	Stems per plant	Days to first flower
Dark Orange Red (Genesis)	58	1	96
Orange Head	31	1	82
Grenade Orange (Kieft)	33	1.2	81
Grenade White	31	1	81
Zanzibar (Johnny's)	31	1	82

CELOSIA VARIETY TRIAL:

New varieties of celosia are regularly released, ensuring that this species continues to be a popular and attractive cut flower. The current trial was conducted in tunnel and field to evaluate 4 new entries against 3 standard lines.

Materials and Methods: Seeds were sown in 72-cell trays on May 7 and May 21 for the tunnel and field trials, respectively. Seedlings were transplanted to their respective locations on June 8 and 25.

Results and Discussion: Both plantings grew vigorously, and the warmer conditions in the tunnel allowed harvests to start in early July, with the field planting a month later. Tunnel-grown plants were 26% more productive, but the field planting produced stems that were on average 14% longer (Table 9).

Table 9. Stem length, yield and relative earliness of 7 celosia varieties grown in high tunnel and field in 2012.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
Dark Rose (Genesis)	59	73	11	4	96	100
Tornado Red	37	39	7	5	91	96
Sunday Orange (Kieft)	41	50	12	15	60	74
Sunday Wine Red	43	51	14	11	70	86
Enterprise Wine Red (Harris)	59	68	20	15	63	86
Ruby Parfait (Johnny's)	52	49	26	21	63	77
Sylphid	64	76	17	10	77	86

Description of individual varieties: Dark Rose: Medium height with mid-green leaves. Flowers are small compound combs, dark red. Latest variety in the trial. Undistinguished.

Tornado Red: Another late variety; short stems, low productivity. Comb dark red; some plants fascinated and without branches; not promising.

Sunday Orange: Light green leaves and a bright orange plume of medium size. Earliest variety in the trial with intermediate yield and stem length: promising and attractive.

Sunday Wine Red: similar in plant and plume size to 'Sunday Orange'. Dark red leaves turning lighter green at the plant apex. Promising and attractive.

Enterprise Wine Red: Tall, wheat-type plume plant with medium green foliage. Plume dark purple. Medium productivity and earliness.

Ruby Parfait: Similar in plume color and size to 'Enterprise Wine Red', but on a shorter, more productive plant.

Sylphid: A medium height plant with light green leaves and light green medium-sized plume. Airy, attractive, a usefull filler in bouquets. It is pictured in the field planting, below.

CHRYSANTHEMUM VARIETY TRIAL:

This variety trial was planted on June 15, 2011, in Bed 1 of the high tunnel, from rooted vegetative cuttings supplied by King's Mums. Results of the 2011 harvest were reported last year. When it became apparent that the plants in many of the plots had overwintered successfully, we decided to conduct the trial for another year.

Materials and Methods: The planting consists of 6 varieties, with 6 plants per plot, spaced at 12 x 12 in., 3 rows per bed. At the end of the 2011 growing season, plants were cut back to the ground and allowed to grow back up in early 2012. Plastic support netting was put in place at the start of the 2012 season, and adjusted to about 1 ft. above the ground by June. As the plants grew through the netting and became tall, they were pruned down to the level of the netting twice through the season. No thinning of stems was practiced, so by the time of flowering, the planting consisted of a dense stand of crowded stems.

Results and Discussion: Performance of the varieties in 2012 was significantly influenced by plant survival (Table 10). 'Vesuvio', 'Symphony' and 'Maryll' had poor stands in one replication and thus had

lower overall yields. Stem length was adequate for all varieties, and might have been longer, if we had pruned the plants to the ground in June, and had not practiced a later topping (advice from Ray Gray, owner of 'King's Mums').

Table10. Plant survival, stem length and yield of harvested stems of 6 chrysanthemum varieties in 2012, planted in the high tunnel in 2011.

Variety	Plant survival, %		Stem length, cm	Stems per plant	Flower date
	Rep 1	Rep 2			
Vesuvio	33	87	75	16	Oct. 24
Judith Baker	100	100	61	50	Nov. 2
Whirlaway	100	87	54	91	Oct. 19
Yoko Ono	100	100	52	39	Oct. 26
Symphony	100	33	58	44	Oct. 26
Maryl	87	33	52	25	Oct. 26

Descriptions of individual varieties (for pictures, see our 2011 trial report): Vesuvio: Anemone-flowered white spray type. Stems thin and slow growing, leading to suppression by adjacent varieties in Rep. 1 and low survival.

Judith Baker: Bronze quill flower, latest in the trial; good survival and yield.

Whirlaway: Early purple spoon, very productive although stems tend to be thin.

Yoko Ono: Vibrant green pompom with stiff, upright stems; flowers tend to break off when handled.

Symphony: Large bronze spider with yellow petal tips. Stems somewhat weak and shaded by adjacent varieties, especially in Rep. 2.

Maryl: Dark red spoon with yellow center. Strong stem but poor stand in Rep. 2.

CYNOGLOSSUM VARIETY TRIAL:

A species that is little used for cut flowers, it resembles the spring-flowering 'forget-me-not' (*Myosotis*). When it became available in bright blue, white and pink flower colors, it was worth exploring as a cut flower.

Materials and Methods: Seeds were sown on April 16 and May 2 for the tunnel and field experiments, respectively. Seeds were started in 72-cell trays, but germination was poor in both plantings, averaging 30%. Attempts to improve seed performance by seed scarification or nicking with a knife only made

germination worse, so I can only conclude that the seed was of low vigor and germination to begin with. The tunnel planting was put in on June 8, and the field planting on July 4.

Results and Discussion: The seedlings were very slow growing in the seedling trays, but began to flower already in the tray. Stem length was very short, and only usable in small bouquets. There was also some difficulty in keeping the harvested stems hydrated, with wilting common at harvest. Of the varieties tested, only 'Mystic Pink' appeared promising (Table 11). It's productivity was good in the tunnel, but marginal in the field. In summary, this species has too many problems to use as a cut flower.

Table 11. Stem length, yield and relative earliness of four cynoglossum varieties grown in high tunnel and field in 2012.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
Avalanche White (Ivy Garth)	33	28	68	25	96	96
Blue Showers	31	27	39	19	80	88
Firmament	37	30	26	17	85	88
Mystic Pink	41	39	22	4	100	110

EUCOMIS VARIETY TRIAL:

A native of South Africa, this geophyte, also known by the popular name pineapple lily, produces an imposing flower stalk covered with miniature lily flowers, and topped by a small whorl of leaves resembling a pineapple. The species survives outdoors in Zone 7, and our trial is testing the possibility

of having it survive and produce flowers for several years in a high tunnel. The planting material originated from the New Zealand-based breeding program of Dr. Ed Welch.

Materials and Methods: After short-term storage in a 40F storage, the bulbs were planted in the high tunnel at 12 x 12 in. spacing, with 18 bulbs per plot and two replications, on April 11. To protect the bulbs, a low tunnel of spun-bonded polyester was placed over the entire trial at planting, and removed on May 29, when shoots were beginning to emerge.

Results and Discussion: Emergence was fairly uniform for all varieties except Megaru, which finally had a full stand in late June. Flowering also only occurred in 15% of the plants (Table129), so information on flower stalk height and yield is unreliable in this first year of production. Flower harvest was concentrated in early August, after which there was a prolonged period of leaf growth, until the leaves were killed by frost in the tunnel in mid-October. It is hoped that this period will have sufficed to build up plant resources and permit more widespread flowering in 2013.

Table 12. Stem length, productivity and flowering time of Eucomis lily, grown in the high tunnel .

Variety	Stem length, cm	Flowers/plant[z]	Flower date, days after planting
Reuben	42	0.36	105
Innocence	55	0.06	105
Tugela Jade	43	0.06	111
Megaru	50	0.11	112

[z]Only a minority of plants produced any flowers

GOMPHRENA VARIETY TRIAL:

Globe amaranth is a productive cut flower that grows well in warm conditions and is a useful filler in mixed bouquets. The introduction of the' Qis' lines prompted the conduct of this trial.

Materials and Methods: Seeds were sown in the greenhouse on April 9 and 23 for the tunnel and field trials, respectively. We used 72-cell trays and Metromix artificial soil. In both locations, plants were spaced 12 x 12 in. apart, with 15 plants per plot, two replications. Seedlings were transplanted on June 4 in both locations.

Results and Discussion: Plants grew vigorously in both locations and began to flower in late June and early July in the tunnel and field, respectively. With the exception of Qis Carmine, which had a dark pink flower color, the other three varieties were remarkably similar in flower color, stem length and productivity (Table 13). They had bright red flower heads with tiny yellow florets. The field planting had 27% lower yield than the plants grown in the tunnel. Gomphrena thus confirmed its reputation as a relatively trouble-free cut flower with excellent productivity.

Table 13. Stem length, yield and relative earliness of four gomphrena varieties grown in tunnel and field in 2012.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
Qis Carmine (Kieft)	47	44	44	30	84	89
Qis Red (Kieft)	48	45	49	36	81	84
Strawberry Fields (Johnny's)	49	47	45	37	81	89
Flashing Light (Harris)	47	45	47	32	82	92

LARKSPUR VARIETY TRIAL:

Larkspur is an attractive crop for high tunnels because it can be transplanted in early spring and harvested by late June, therefore providing room for other crops. The current trial was conducted to test new varieties of the Galilee group, furnished by Genesis Seed Co.

Materials and Methods: Seeds were sown on March 1 in 98-cell trays in Rediearth artificial soil and placed in a cool (ca. 55 F) dark room for germination. When seedlings began to emerge, in about 10

days, they were transferred to a greenhouse and grown until April 25 for transplanting in the high tunnel. Spacing on beds was 6 x 6 in., with 36 seedlings per plot.

Results and Discussion: Growth of the planting was marred by a moderate incidence of a root disease which caused plant collapse and death. There appeared to be no clear varietal differences in disease incidence. Nevertheless, the varieties produced enough stems to evaluate the varieties being tested for productivity and attractiveness. Harvesting began in early June, and proceeded until the first week of July. The varieties were similar in stem length, productivity and relative earliness (Table 14). Since the varieties had not been topped, they produced one main stem, and perhaps one more stem per plant. Postharvest performance was satisfactory, with a vase life of about 6 days before the petals began to fall.

The 'Galilee' lines had similarly ruffled double petals that made the flowers appear full and substantial. Aside from the colors, shown in the images below, there were few discernible differences among the lines. They are certainly worth growing again.

Table 14. Stem length, yield and relative earliness of five larkspur varieties grown in the high tunnel in 2012.

Variety and (Source)	Stem length, cm	Stems per plant	Days to first flower
Galilee Carmin (Genesis)	65	2.2	112
Galilee Pink Perfection	63	2.1	112
Galilee Salmon	76	1.4	112
Galilee White	73	1.2	112
Sublime Dark Blue	73	1.6	110

Galilee Carmin larkspur, in our high tunnel trial.

Galilee Salmon larkspur

Larkspur variety trial, ‘Galilee White’ in center. ‘Galilee Pink’ in foreground

Sublime Dark Blue larkspur

LISIANTHUS VARIETY TRIAL:

Materials and Methods: The tunnel and field trials were sown on Feb. 17 and 28, respectively in Rediearth artificial soil in 98-cell trays. Early growth was very slow, and when we finally realized that the seedlings needed to be fertilized, they had been delayed for weeks. Consequently, they were transplanted relatively late, on June 27, in both tunnel and field.

Results and Discussion: Fortunately, the early delay in growth did not appear to have negatively affected subsequent growth, and we could get an evaluation of the varieties in both trials (Table 15). Flowering in both trials began in early August, and continued to the end of the season, mid-October in the field, and late October in the tunnel. Stem length was slightly longer in the tunnel than in the field, whereas productivity varied among varieties and showed no consistent trend.

Varietal descriptions: Arena 2 Kilimanjaro: Tallest variety in the trials, with a strong stem that tended to lean, suggesting the need for netting. Flowers double, large and showy white with a small eye and ruffled petal edges. Attractive and promising.

Falda 2 Yellow: Erect, medium height plant with relatively few branches and low yield. Flowers pale yellow, single, with ruffled petal edges.

Cinderella Pink: Medium tall productive plant with pale pink double flowers that have a prominent dark eye.

Misty 2-3 Pink: Medium stem length, average productivity and relatively early. Flowers double, color is a pale pink, somewhat deeper at the petal edges, but not prominent enough to be termed 'picotee'.

Echo Champagne: Productive but only moderate stem length, this variety is a standard among cut flower growers. Flowers medium sized doubles, pale pink with pronounced yellow throat, attractive.

Table 15. Stem length, yield and relative earliness for 5 lisianthus varieties grown in the tunnel and the field in 2012.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
Arena 2 Kilimanjaro (Takii)	42.2	40.2	3.3	3.6	182	184
Falda 2 Yellow	41.8	35.4	2.6	1.3	187	181
Cinderella Pink (Johnny's)	41.4	38.1	4.6	2.9	182	176
Misty 2-3 Pink (Gloeckner)	37.8	34.2	3.4	2	177	166
Echo Champagne (Johnny's)	35.9	36.2	3.8	4.4	174	169


YELLOW


CINDERELLA PINK


MISTY 2-3 PINK

MARIGOLD VARIETY TRIAL:

The development of long-stemmed varieties has increased the popularity of marigold as a cut flower, especially among people of Asian origin. Although some still object to the smell of marigold foliage, the odor appears to be weaker in these newer lines.

Materials and Methods: Seeds were sown in 98-cell trays on April 2 and 16 for the tunnel and field trials, respectively. They were transplanted to these locations on April 30 and May 29, with a spacing of 12 x 12 in., with 15 plants per plot in the tunnel, and 18 plants in the field. Harvesting began on June 15 in the tunnel, and July 6 in the field, and continued until late summer in the tunnel, and the end of the field season outside.

Results and Discussion: The early tunnel planting allowed for an extended harvest season, in which the field planting started to produce as the tunnel planting was starting to decline. Productivity averaged 20 stems per plant in both trials (Table 16). Stem length was16% longer for plants in the tunnel. 'Jedi Orange' and 'Optiva Orange' were similarly tall, with deep orange flowers of about 2 in. diameter. 'Narai Orange' had the shortest stems, but flowers averaged 3 in. diameter. 'Babuda Gold' had intermediate stem length, and bright yellow flowers of 3 in. size. This variety was noticeably more attractive to Japanese beetles in both tunnel and field. In summary, these marigold varieties are a useful addition to the cut flower repertoire. Vase life of around 2 weeks, and the attractive appearance add to their appeal.

Table 16. Stem length, yield and relative earliness of four marigold varieties grown in tunnel and field in 2012.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
Jedi Orange (Gloeckner)	68	56	17	20	79	114
Narai Orange(Gloeckner)	43	38	19	17	76	86
Babuda Gold (Geo)	48	44	22	18	79	99
Optiva Orange (Geo)	67	53	21	24	79	98

TESTING THE POTENTIAL OF "WILD" PEPPER LINES AS FALL CUTS: (Article published in the ASCFG Quarterly in the Jan. 2013 issue: Vol. 25(1): 38-39 with Dr. M. Mazourek)

PURPOSE: To evaluate 26 pepper accessions from the Plant Introduction Collection for suitability as cut ornamentals for fall harvest of stems with colorful fruits attached.

PREAMBLE: In the germplasm collections of the United States Dept. of Agriculture there is a rich collection of pepper lines (primarily *Capsicum baccatum*) that have not been evaluated for their decorative potential in fall bouquets. A field planting of 400 plant introduction lines in the 2011 season revealed some very attractive pepper plants that could be valuable as fresh cuts or dried materials. In addition to having a profusion of red, yellow or purple pods, they were significantly taller than most pepper varieties now used as cut materials. Many also had an important advantage over the commercially-available materials: they lost most of their leaves as the fruits matured, thus sparing us from the time-consuming task of defoliation. The present trial was conducted to look at the most promising of the 400 lines in a field planting, and to compare them to one standard and two new lines of *C. annuum* grown for cut flower use.

MATERIALS AND METHODS:

Pepper Accessions:

Variety no.	Mazourek No.	P.I. No.
1	1002	159252
2	1005-1-7	439338
3	1005-2-5	439338
4	1022r-4	639128
5	1025r-1	Grif 9198
6	1044	188481
7	1081-3-6	260506
8	1082-1-6	260536
9	1087-3	260542
10	1154-2	441525
11	1155-2-4	441528
12	1164-2-2	441542
13	11-1171-2	441552
14	1173-1-1	441554-1
15	1173-1-3	441554-2
16	1187-2	441575
17	1189-3-6	441577
18	1239-4	439383
19	1276-4	159244
20	1314-1	370004
21	1315-1	439362
22	1337-2	441530-2
23	1337-3	441530-1
24	1349-1	441572
25	1355-1	441589
26	1360-3	441594
28	Rio Light Orange	Takii
29	Rio Yellow	Takii
30	Cappa Conic	Harris

Seeds for the trial were sown on April 20 in 72-cell trays in 'Rediearth', and transplanted to the field on June 6. For Reps. 1 and 2, plants were spaced about 12 in. apart in two rows on a 4-foot wide bed. For the third rep, there were three rows per bed with plant spacing of 12 by 12 in. There were 10 plants per plot.

RESULTS AND DISCUSSION: Plants of the commercial varieties (lines 28-30) began flowering about a month after transplanting, with the accessions following by about 7 weeks. High temperatures during the summer appeared to delay fruitset, and to allow the plants to grow vegetatively for an extended period. As a result, many plants got quite large, and as fruits developed, they fell over, because no supplementary support had been provided. There were clear differences in height, and degree of lodging among accessions, and these are noted in Table 17.

Table 17. Plant and fruit characteristics of 26 pepper accessions and 3 ornamental pepper lines, taken in late September, 2012, in a field planting at Ithaca, NY. Promising lines are highlighted in yellow.

Variety no.	Plant[z]		Lodging?	Fruit[z]		Fruit hanging?	Color		Hot?[x]	Promising?
	height	spread		length	width		immature	mature		
1	125	184	No	2	1.5	No	Ylo.	Red	Mod.	Yes
2	100	220	Yes	8	1.7	Yes	Grn.	Red?	Mod.	
3	95	235	Yes	6	1.7	Yes	Grn.	Orange	No	
4	95	155	No	3	1.5	No	Grn.	Red?	Hot	
5	105	180	Slight	17	1.3	Yes	Lt. grn.	Ylo./prpl	No	
6	105	230	Yes	3.5	2.5	Yes	Ylo	Red	No	
7	115	250	Slight	3.5	2.5	Yes	Purple	Purple	Mod.	Yes
8	130	200	No	6	6	Yes	Grn.	Red	No	
9	85	250	Yes	2.5	2.5	Yes	Grn.	Ylo/orge	Mod.	
10	120	205	No	7.5	1	No	Ylo.	Red	Hot	Yes
11	115	225	Yes	7.5	2.5	Yes	Grn.	Red	Hot	
12	105	210	Slight	3	1.5	No	Ylo.	Red	Hot	Yes
13	125	175	No	4	3.5	Yes	Grn.	Red	Mod.	
14	95	135	No	7.5	2	Yes	Grn/prple	Red	Hot	
15	100	185	Slight	10.5	2	Yes	Grn.	Red	Mod.	
16	80	145	No	5	1	Yes	ylo/purple	Red?	No	
17	115	240	Yes	7.5	2	Yes	Grn.	Red	Hot	
18	100	130	No	9.5	1.5	No	Grn.	Red	Hot	
19	75	185	Yes	17	2	Yes	Ylo.	Orange	Mod.	
20	85	175	Slight	5.5	2	No	Grn.	Red	Hot	
21	90	170	No	3	1.5	No	Grn/prple	Red	v. hot	
22	125	180	No	4	4	Yes	Ylo.	Red?	No	Yes
23	125	175	Slight	7.5	1.5	No	Ylo.	Red	v. hot	Yes
24	100	180	No	4.5	4	Yes	Grn.	Red?	No	
25	120	185	No	9	2.5	Both	Dk. Grn.	Red	Mod.	yes
26	125	205	Slight	3	3	Yes	Grn.	Red	Hot	
28	100	125	No	3	2.5	No	Ylo/purple	Ylo.	Hot	
29	70	120	No	2.5	3	No	Grn.	Ylo.	Hot	
30	80	115	No	4.5	3	no	Ylo.	Red	Mod.	Yes

[z]Plant size and fruit size in centimeters (1 inch= 2.54 cm)

[y] Degree of hotness judged by the senior author and Priscilla Thompson, two gringos with moderate taste buds

To obtain an estimate of stem length and the number of marketable stems per plant, four plants of the accessions that were not severely lodged were harvested in Reps 1 and 2 (Table 18).

Table 18. Stem length and yield of marketable stems of ornamental pepper lines grown in the field in 2012. Stem lengths and yields are averaged over four plants in two replications.

Variety no.	Stem length, cm	Stems per plant
1	123	16.0
5	120	14.0
7	125	18.9
10	128	17.8
12	126	17.9
13	125	20.2
14	146	21.8
16	116	17.6
21	120	25.4
22	130	18.2
23	146	18.6
24	136	14.2
25	132	15.0
28	88	19.0
29	58	13.8
30	102	18.4

Stems of the plant introduction lines were significantly longer than those of the named varieties (No's 28 to 30). All lines grown in the trial had similar stem yields, averaging 15 to 25 stems per plant. These yields were probably encouraged by the relatively wide spacing used in the experiment, measuring 12 x 18 in.

On Sept. 21, typical branches of the most promising lines were harvested and placed in water or in hydrator solution (Chrysal 3), and observed for wilting for the following three weeks. Final notes on these branches were made at 5 weeks after cutting, on Nov. 2, and are shown in Table 19.

Table 19. Degree of hydration of leaves at up to 5 weeks in vase, and leaf and fruit loss after 5 weeks.

Variety no.	Foliage condition in vase			Foliage drop?	Fruit drop?
	1 week	3 weeks	5 weeks		
1	Turgid	Turgid	Wilted	Old leaves	Young only
7	Sl. wilted	Turgid	Turgid to wilted	Variable	No
10	Sl. wilted	Turgid	Dried	No drop	No
12	Turgid	Turgid[z]	Young lvs. dried, old wilted	Slight	No
13	Turgid	Turgid	Wilted and dried	One stem no lvs.	No
16	Sl. wilted	Turgid[z]	Turgid and green	No drop	No
22	Turgid	Turgid	Wilted and dried	No drop	No
23	Turgid	Turgid[z]	Dried: one plant	Moderate	No
25	Turgid	Turgid[z]	Wilted	No drop	No

[z]Vase water discolored after 3 weeks

The trial was a process of elimination, with some lines being dropped from consideration because the plants lodged in the field (Table 17). All lines were given a vase life test on Sept. 21, and only those that did not have completely wilted leaves after one week were continued (Table 19). All of those retained still had turgid leaves after three weeks in the vase. There was no significant difference in performance of the lines between plain water and hydrator solution.

The branches were kept for another two weeks to see if the leaves would begin to drop from the stems. The results of the leaf loss test were variable within some lines, with complete leaf loss occurring in one, and not the other stem in the same vase, such as with varieties 7 and 13. Varieties 1, 12 and 23 appeared to lose leaves more readily than the other lines. In the longer warm fall season that we experienced in 2011, leaf loss tendency was more marked than in 2012. The first killing frost occurred on Nov. 5 in 2011, but on Oct. 13 in 2012. Our results indicate that pepper branches can be cut and kept hydrated if an early frost threatens. These branches make attractive fresh displays, and may also be easier to defoliate with longer storage. Additional vase life studies are needed to determine conditions needed to facilitate defoliation, and these are planned for 2013.

OBSERVATIONS ON PROMISING LINES:

Var. 1 (PI 159353): Large mounded bush with small round yellow immature fruits that ripen red. Showy, good branch strength. Has tendency to drop immature yellow fruit after 2-3 weeks in vase.

Fig. 7. Var. 1 (PI 159252) at harvest.

Var. 7 (PI 260506): Large bush with purple stems and purple fruits, with relatively long internodes and low fruit no. per plant. Attractive in mixed bouquets. Leaf drop varies from plant to plant.

Fig. 8. Var. 7 (PI 260506)

Var. 10 (PI 441525): Erect upright bush with erect, thin fruits that are yellow when immature, and red on ripening. Looked good fresh, but failed to lose leaves with time in the vase.

Fig. 9. Var. 10 (PI 441525). Immature fruits have erect posture but droop down as they become larger.

Var. 12 (PI441542): Blunt pale yellow fruits on broadly erect plant. Slight leaf drop in the vase.

Fig. 10. Var. 12 (PI 441542).

Var. 13 (PI 441552): Oval, pendent fruits hanging from sturdy branches. Some branches with significant leaf loss in vase.

Fig. 11. Var. 13 (PI 441552) after two weeks in the vase.

Var. 16 (PI 441575): Erect sturdy branches with small pointed fruits. Fruit color varies from yellow with pink blush in immature stage to red when mature. Leaves were retained without wilting after 5 weeks in the vase.

Fig. 12. Var. 16 (PI 441575).

Var. 22 (PI 441530-2): Erect sturdy plant with round, pendent fruits that are yellow when immature, turning red at maturity.

Fig. 13. Var. 22 (PI 441530-2) after two weeks in the vase.

Var. 23 (PI 441530-1): Long, thin fruits on broad plants. Fruits yellow when immature, red at maturity.

Fig. 14. Var. 23 (PI 441530-1)

Var. 25 (PI 441589): Sturdy erect plant with long thin fruits, green when immature, red when ripe. Leaves did not come off during 5 weeks in vase.

Fig. 15. PI441589.

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SNAPDRAGON VARIETY TRIAL:

Modern snapdragons come in a variety of sizes and types, with cut flower varieties continuing to be a mainstay of the cut flower industry. The introduction of another color in the 'Chantilly' series by Takii prompted this comparison of early to late varieties. The crop is productive in both high tunnel and in the field, so we started with a spring trial in the field, and concluded the growing season with the same varieties in the tunnel.

Materials and Methods: The spring trial was sown on April 2 in 128-cell trays in Rediearth artificial soil, and transplanted to the field on May 15. The fall trial was sown on June 1 and transplanted to the tunnel on July 9. In the fall trial, one replication was pinched shortly after transplanting, leaving 6 nodes, the other was left unpinched.

Results and Discussion: We started harvesting the field experiment on June 15, and continued until early October, although yields declined during the heat of summer. The tunnel experiment started producing marketable flowers on July 30, and continued to Oct. 26, when an infestation of aphids became too difficult to control by organic means. With the longer season, the field trial had a 42% higher yield, although stem length was greater in the tunnel trial (Table 20).

Table 20. Stem length, yield and relative harvest date of six snapdragon varieties grown in the field and the high tunnel in 2012.

Variety and (Source)	Stem length, cm		Stems per plant		Days to first flower	
	Tunnel	Field	Tunnel	Field	Tunnel	Field
Chantilly Purple (Takii)	47	39	12	21	71	77
Maryland Red (Gloeckner)	54	45	15	22	62	77
Maryland White	52	39	10	13	67	84
Overture Ivory (Geo)	54	43	11	13	62	79
Opus Bright Red	66	54	10	15	76	92
Rocket White (Harris)	51	46	11	14	67	90

Observations on individual varieties**: Chantilly Purple:** An open-faced variety with attractive maroon petal color. Shortest stems in the trial, and problems with floret development during the heat of summer. This variety was not adapted to summer field conditions.

Maryland Red: Short to medium length racemes on medium-length stems; productive.

Chantilly Purple

Maryland White: Short to medium length raceme on short stems. Good bud distribution on raceme.

Overture Ivory: Medium length raceme and stem. Flower color white with yellow throat.

Opus Bright Red: Tallest and latest variety in the trial. Florets rather widely spaced on raceme. Flower color a dark, velvety red; most promising in the trial.

Rocket White: Late variety with medium stem length and strong, thick stems; standard in the industry.

STOCK (*MATTHIOLA INCANA*) VARIETY TRIAL:

Materials and Methods: The trial was sown in 98-cell trays in the greenhouse on March 1, and transplanted to the high tunnel on April 17 at a 6 in. spacing, with 36 plants per plot.

Results and Discussion: The trial flowered over a short period, starting on May 30, and finishing on June 11. Plants all produced one stem, and were of similar height. Detailed descriptions of the varieties have been given in previous years, so will not be repeated here (Table 21). Stocks are a quick, attractive flower that can be quickly produced to fill an early market niche. The pronounced spicy scent is also attractive to most consumers.

Table 21. Stem length, yield and relative earliness of four stock (*Matthiola incana*) varieties, grown in the high tunnel in Spring 2012.

Variety and (Source)	Stem length, cm	Stems per plant	Days to first flower
Cheerful Yellow	52	0.8	61
Katz Purple	54	1.0	61
Katz Bright Rose	55	1.0	62
Katz Lavender Blue	53	1.1	61

***SOLANUM MAMMOSUM* (Nipple Fruit)**

On travels to Thailand early in 2012, I found stalks of dried *Solanum mammosum* being sold in Chiangmai flower market (Fig. 16). To see if we could grow this crop in our high tunnel as an ornamental, we received seed of three germplasm lines from the USDA Plant Introduction Station in Tifton, GA.

Materials and Methods: Seeds were sown in the greenhouse on April 20, and transplanted to the high tunnel on May 30 at a 12 x 12 in. spacing. A few seedlings were also planted in the field. For comparison, seedlings *of Solanum integrifolium* (Pumpkin-on-a-Stick) were also started at the same time. The planting was maintained until late October, at which time the plants were measured and fruit characteristics determined.

Results and Discussion: The plants grew vigorously in the high tunnel, and had reached a height of nearly 6 feet by early September. The plants started to flower in late July. A moderate infestation of powdery mildew began about that time, but was not severe enough to cause defoliation. Spider mites completely defoliated the Pumkin-on-a-Stick so these plants were uprooted to prevent the infestation from spreading. The nipple fruit plants were covered with spines on leaves and stems, so that passage near the bed was made an unpleasant experience. Two of the varieties (PI 245968 and PI 30045) were similar in height (180 cm), fruit size and shape (Fig. 17). PI 413675 was only 150 cm tall, had more numerous spines, and the fruit size was significantly smaller. The fruit also did not turn yellow, perhaps not having reached maturity.

In arrangements, the varieties with basal nipples looked attractive with dried grasses (Fig. 18). The fruits did develop a fruit rot after a couple of months, and some fell off the stem while in the vase, even before the fruit rot set in. The horticultural value of these accessions is somewhat limited, due to the presence of the spines and the tendency of fruit rot and dehiscence.

Fig. 16. Solanum mammosum fruits in Chiangmai market in northern Thailand.

Fig. 18. S. mammosum in a dried arrangement

Fig. 17. PI 245968 (left), PI 413675 and PI 370045 (right), harvested from our trial in the high tunnel in 2012.