THE 2008 CUT FLOWER TRIALS

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EXECUTIVE SUMMARY: In a season of normal temperatures and rainfall, the cut flower variety and cultural practice trials performed well and produced interesting results. In this report, we have combined the two types of trials, and present both below. Highlights include:

Lisianthus Transplant Study (p. 5): We evaluated if planting lisianthus seedlings directly from plug cells would lead to detrimental effects on growth and yield, compared to transferring them first to larger cells, and transplanting 2 weeks later. Neither method significantly affected growth and yield. This was contrary to expectations, so the study will be run again in 2009.

Godetia Transplant Study (p. 6): In an experiment similar to the lisianthus study, above, Apple Blossom and Flamenco Salmon godetia were transplanted to the field from plug trays or from larger cells. In an early transplanting, seedlings from plug cells were 20% shorter at flowering than if transferred from larger cells. Delaying transplanting by another 2 weeks caused additional stunting, especially if the seedlings had remained in the plug cells. Timely transplanting is extremely important with this species.

Effect of compost on plant stand of delphinium and statice (p. 7): We hoped to overcome problems of poor plant stand and early plant death of these two crops by using 3 different composts added to the transplant medium and the transplant hole. The statice (*Limonium suworowii*) declined rapidly at flowering, without noticeable influence of the compost treatments. Beneficial influence of compost was also hard to discern in the delphinium, where stand was better than in the past 2 years in all plots.

Pepper Topping Experiment (p. 10): Ornamental peppers and 'Pumpkin-on-a-Stick' make beautiful additions to fall bouquets and can also be dried. We topped the plants in the seedling stage to determine the effect on yield and stem length. The treatment increased the no. of stems per plant by 15%, and did not significantly affect earliness or stem length. Thus topping may not be worth the additional labor.

Sunflower Topping Experiment (p. 11): In a repetition of a 2007 experiment, we compared the effect of apex removal on two sunflower varieties grown at 2 spacings. As in the previous year, increasing the spacing from 9 x 9 in. to 12 x 12 in. increased flower size, and stems per plant on the topped plants. Procut Orange produced more stems on topping than Sunrich Orange, but the diameter of topped plants' flowers was larger for the latter variety. The results affirm the value of combining topping with wider spacings to allow the topped flowers to reach adequate size.

Sunflower Photoperiod Experiment (p. 14): This trial was conducted to determine when during the first three weeks after emergence the daylength-sensitive sunflower is most sensitive to short daylength. By shifting the seedlings of two varieties of

sunflowers in and out of short and long day treatments at one-week intervals, we found that sensitivity is highest in week 2, but that week 1 and 3 also contribute. Both Sunrich Orange and Solara acted similarly.

Sunflower Photoperiod Variety Screen (p. 15): As in previous years, we tested 9 new varieties for sensitivity to daylength in the seedling stage, compared to two standard lines. Two varieties, Sunflower 337 (Carmel) and Sunrich Orange, showed a delay of 2 weeks or more in long days. The majority of lines tested fell into the 'moderately sensitive' category, and only 3 could be classed insensitive: Sunflower 717 Arbel, Sunflower 460 Galilee Adami; and Procut Lemon, the insensitive control variety.

Stock Variety and Date of Planting Trial (p. 18): Two early and two late varieties of stock were transplanted into the high tunnel on three dates, from late March to early May. The early varieties Cheerful Yellow and Katz White flowered in all three plantings, whereas Prouesse Deep Blue and Lucinda Cream had a lower flowering percentage in the later plantings. Stem lengths were similar among the varieties, so it is advisable to only plant early varieties in high tunnels.

Larkspur Variety and Date of Planting Trial (p. 19): Four varieties were transplanted into the high tunnel on April 7 and 21. All performed well, with main stems averaging 110 cm, although the later planting reduced stem length by 25%.

Calendula Variety Trial (p. 21): To fill out the high tunnel growing season, five varieties of calendula were transplanted into the high tunnel on August 12. The varieties made good growth, and most were attractive with interesting colors or flower forms. Particularly noteworthy were Kablouna Mix and Art Shade Mix had significantly longer stems; Flashback Mix has dark backs of the petals.

Campanula Variety Trials (p. 22): Four varieties of annual campanula were grown both in the high tunnel and in the field, with transplant dates of April and May , respectively. Plants in the tunnel were 20% taller and 35% more productive, but differences among varieties in these characteristics were minimal. Champion Lavender reached anthesis a week earlier than the others.

Lisianthus Variety Trials (p. 24): Thirteen varieties were compared both in the field and in the high tunnel. Lodging limited yield and earliness in the tunnel. Particularly noteworthy in the trials were Advantage Cherry Sorbet, a full, large double-flowered line, and Arena 2 Green, a double-flowered variety with attractive deep green ruffled petal edges.

Statice Variety Trials (p. 27): Statice is a crop that really thrives in the high tunnel environment. In this trial of 7 varieties, productivity was 63% higher, averaging 21 stems per plant, and the plants started flowering nearly 3 weeks earlier than in the field. Although Sunset Mix was most productive, its drab colors did not please me, although others liked it. Turbo Mix had reasonable productivity and brighter colors.

Sweet Pea Variety Trial (p. 29): A preliminary trial of 4 sweet pea varieties was transplanted on March 31 into the high tunnel. Plants were trellised on Hortanova netting on a trellis 6 ft. high. After an early setback due to frost, the plants yielded well. Mammoth Choice Mix was the most productive with 34 stems per plant, with Elegance White next.

Trachelium Variety Trials (p. 30): Flower quality of 3 varieties tested in high tunnel and field was much better in the tunnel, but yields were reduced by 22%, and the plants were 19 days later in the tunnel. The three varieties were equally attractive, but Summer Pandora was slightly earlier than the other two.

Zinnia Variety Trials (p. 31): Several new zinnia lines mandated a varietal comparison. A spring trial was planted in the field, and proved very productive, with 12 stems per plant. The fall trial was sown in July, but the cooler dark weather of the fall increased disease pressure, especially Botrytis, and reduced yield to 48% of the field trial. Noteworthy varieties in the trial included the Benary Giant lines, Uproar Rose and Zowie Yellow Flame.

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INTRODUCTION: The 2008 cut flower trials were conducted at the East Ithaca Gardens, both in the field, and in the high tunnel. Some accessions came from the Association of Specialty Cut Flower Growers national variety trials, while others were obtained by direct request from seed companies.

MATERIALS AND METHODS: The field trials were conducted on an Arkport sandy loam soil, to which compost had been added in November 2007 to a depth of about 2 in.. During spring land preparation a 20-10-10 fertilizer was applied on the field at a rate of 50 lbs/A N and disked in. The high tunnel is situated in the adjacent field of the same soil type, and has had compost additions in 2004 and 2005, 2006 and a double rate of that applied to the field in Oct. 2007. It also received 50 lbs/A N from a 20-10-10 fertilizer prior to application of black plastic on the soil beds. Prior to planting of the fall crops in the tunnel, soil in the beds was tilled and 50 lbs/A N was raked in using calcium nitrate. The same rate of nitrogen sidedressing was applied on an as-needed basis in the field beds up to twice during the growing season.

Beds were constructed in the field and in the tunnel on 5 ft. centers, ca. 5 in. high and 40 in. wide at the top. Two trickle irrigation lines were placed on the surface under the 5 ft wide black polyethylene mulch. The trickle lines were placed between plants 1 and 2, and between plants 3 and 4 across the bed, when a 9 x 9 in. spacing was used.

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 experiments.

Plots in the tunnel were irrigated weekly all season long and twice weekly during the warmest periods. The outdoor plots required some irrigation in May, August and September, when rainfall fell below average (Fig. 2).

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 fungicide applications were made to plots in the field in 2008, but a severe attack of Japanese Beetle necessitated 3 applications of Spectracide to the zinnia field trial. In the high tunnel, we used only OMRI-approved methods of pest control in 2008. These included release of ladybird beetles on several occasions for aphid control from late August on, and two applications of Cease fungicide to the fall zinnia and calendula trials for control of powdery mildew and botrytis. In the field, weeds in the walkways were controlled by shielded sprays of glyphosate, applied before the weeds became large. This became necessary on 5 separate occasions.

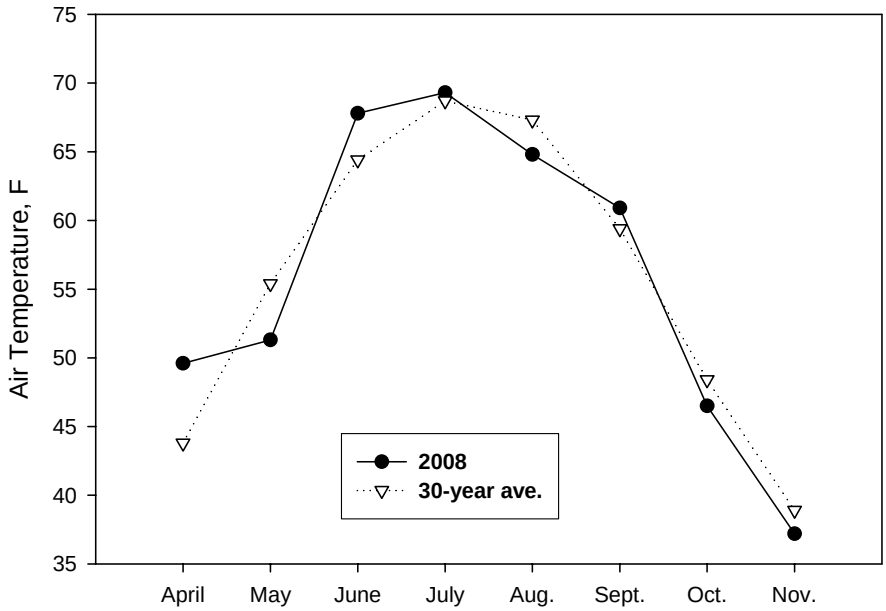

Fig. 1. Air temperature during the 2008 growing season at Ithaca, compared to the 30-year average. Source: Northeast Regional Climate Center, Ithaca.

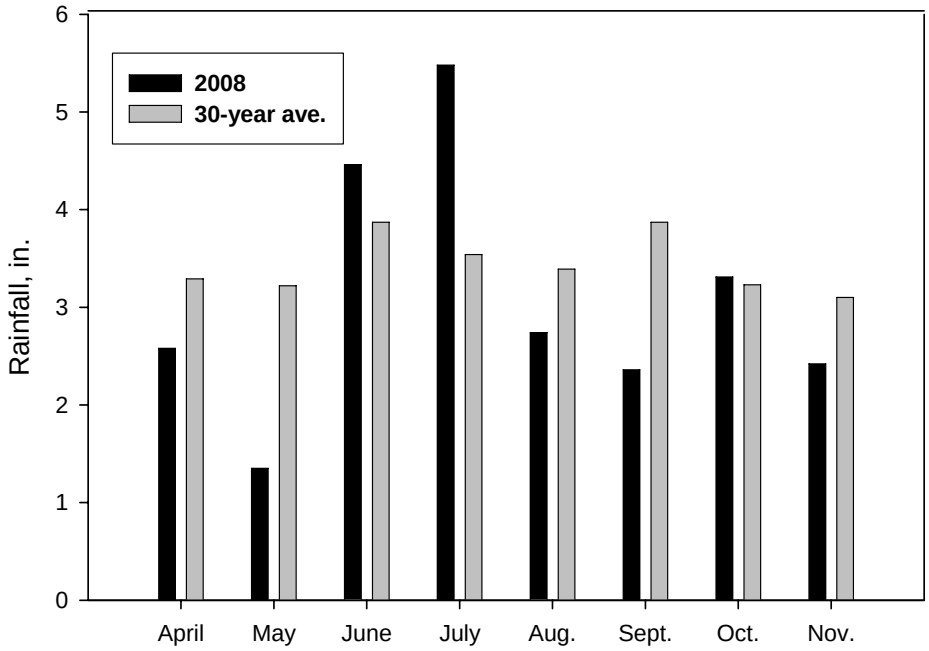

Fig. 2. Monthly rainfall totals in the 2008 growing season, compared to the 30-year average. Source: Northeast Regional Climate Center.

LISIANTHUS TRANSPLANT STUDY 2008:

In past years, lisianthus varieties transplanted relatively late out of seedling trays into the field or high tunnel appeared to be permanently stunted by the late transplanting, and produce a limited yield of stems. On the other hand, seedlings produced by commercial plug suppliers are grown and shipped in 210-cell trays, in which the individual seedlings have very limited root volume. If planted when young, these seedlings might suffer from the harsh field conditions; if planted late, crowding may be detrimental. The present experiment was carried out to find out if either problem would manifest itself.

Materials and Methods: Lisianthus seeds were planted in 210-cell plug trays on Feb. 21 in a greenhouse, and either transplanted to the field on May 5, or two weeks later. A third treatment consisted of transferring seedlings from the small cells to a 72-cell tray on May 5, followed by field transplanting on May 19. There were two varieties: ABC 2-3 Blue, and ABC1-3 White, and 3 replications. Individual plots consisted of 24 seedlings spaced 9 x 9 in. apart, with 4 rows on the 36 in. bed. Beds were covered with 1 mil. thick black plastic mulch, under which 2 trickle irrigation lines had been laid on the soil surface.

Results and Discussion: There was very little reaction of either variety to the transplant cell sizes and transplanting dates imposed (Table 1). Only the seedlings that were

transferred from small to large cells two weeks before transplanting showed a slightly earlier first flower date, but neither productivity nor stem length was affected.

As would be expected, ABC 2-3 Blue was 6 days later in coming to flower than ABC 1-3 White, and had 4 cm longer stems on average. ABC Blue had a higher stem yield when transplanted early from small cells, but a lower yield than ABC White when transplanted late after transfer to larger cells, leading to a significant treatment by variety interaction.

Because the results do not reflect our previous experience with late transplanting of lisianthus, the experiment will be repeated in 2009.

Table 1. Effect of transplant cell size and date of transplanting on yield of stems per plant, stem length and date of first harvest of two varieties of lisianthus grown in the field.

Treatment	Stems/plant	Stem length, cm	Days to first flower
Early, small	4.2	60	171
Late, small	5.0	61	170
Late, small to large	4.4	59	166
Stat. signif.	ns	ns	*
ABC 2-3 Blue	4.4	62	172
ABC 1-3 White	4.6	58	166
Stat. signif.	ns	**	***
Interaction signif.	*	ns	ns

GODETIA TRANSPLANT STUDY:

The concern with stunting of late-planted seedlings expressed with lisianthus above is also present with Godetia. With this species, the limiting size of the transplant cell may induce additional stress, and prevent the production of large plants in the field, even if the transplant date is not delayed. The present experiment was designed to check the influence of transplant age and cell size on stem length and earliness of flowering.

Materials and Methods: The experiment compared the performance of Flamingo Salmon, obtained from Johnny's Seeds, with Apple Blossom, from Thompson and Morgan. Seeds were sown on March 25, either into 210-cell or 72-cell trays. Treatments were as follows:

1. Transplanting May 5 from 72-cell tray
2. Transplanting May 5 from 210-cell tray
3. Transplanting May 19 from 72-cell tray
4. Transplanting May 19 from 210-cell tray
5. Transplanting May 12, after transfer April 25 from 210 to 72-cell trays

Plants were transplanted into black plastic mulch-covered field beds at 9 x 9 in. spacing. There were 20 plants per subplot and two replications. Given the low number of replications, no statistical analysis was conducted. Plant heights were measured at anthesis, but the plants were left in place to further observe their growth.

Results and Discussion: 'Apple Blossom' flowered about a week earlier than 'Flamingo Salmon' (Table 2) and was 20cm taller than the latter. Both varieties reacted similarly to the transplant treatments, with earlier flowering for the treatments that spent longer in the warm greenhouse before transplanting.

Plant height at flowering was greatest for the plants raised in the large transplant cells. When transplanted on May 5, plants were 20% shorter at flowering if raised in small rather than large cells. Delaying transplanting by 2 weeks resulted in a more severe stunting of the plants raised in small cells at flowering of 32%. The early transplant date resulted in plants that were 62 cm tall, compared to those transplanted on May 19, that averaged 53 cm , indicating that delayed transplanting had a stunting effect on the seedlings. Transferring seedlings from the small to the large cells 3 weeks before transplanting to the field reduced the stunting effect of the earlier restriction, and may be an acceptable way of avoiding the detrimental influence of delayed transplanting.

Table 2. Effect of age at transplanting and transplant cell size on earliness and plant height of two varieties of Godetia grown in the field.

Treatments	Time of flowering, DAS	Plant height at first flower, cm
Flamingo Salmon	128	48
Apple Blossom	120	68
Transplant treatments:		
May 5, large	125	69
May 5, small	126	55
May 19, large	120	63
May 19, small	123	43
May 12, small to large	126	59

EFFECT OF COMPOST ON PLANT STAND OF DELPHINIUM AND *LIMONIUM*:

Cultivar trials of delphinium in our East Ithaca fields have suffered from loss of plant stand, presumably due to incidence of a root disease that was not identified. One species of statice (*Limonium suworowii*) has also suffered a rapid decline shortly after flowering, thought to be caused by a root pathogen. Reports of the suppressive effects of certain kinds of compost on soil-borne pathogens stimulated this preliminary trial to improve plant stands of these two species with compost addition to the seedlings before and at

transplanting. This work was guided by Drs. Eric Nelson and Alison Jack in the Dept. of Plant Pathology at Cornell.

Materials and Methods: Delphinium 'Aurora Mix' and *Limonium suworowii* were used in this experiment. Seeds were sown in 72-cell trays, with the artificial soil mix (Redi-Earth plug mix) amended by a 20% by volume addition of the following organic composts:

1. Control (none)
2. Endicott compost
3. Vermicompost
4. Field of Dreams compost

In addition to the seedbox treatment, an additional cup of compost was added to the transplant hole at planting in each case. Plants were spaced 12 x 12 in. apart on black plastic mulch-covered beds with 18 plants per plot. There were 3 replications, and compost treatments formed subplots to the main plots of the flower species in a split plot design. Plant stands in the field were monitored monthly, and disease samples were taken at intervals by Dr. Jack. Regular cut flower harvests were made of both species and stem yield and stem length determined.

Results and Discussion: Contrary to previous experience in the same field, the plant stand of the untreated controls of both species was excellent (Table 3), preventing the appearance of a plant stand improvement with compost treatment. Then, shortly after the stand count of Aug. 14, the Limonium showed a mass die-back that was not influenced by any compost treatment, and essentially terminated the experiment for that species (Fig. 3). Plant stand of the delphinium continued to be good until the end of the season.

Table 3. Effect of compost treatments before and at transplanting on plant stand, yield and stem length of Delphinium and Limonium under field conditions in 2008.

Species	Plant stand on Aug. 14	Stems per plant	Stem length, cm
Delphinium	89	2.1	49
Limonium	94	17.2	51
Stat. signif.	ns	***	ns
Composts:			
Control	95	9.8	51
Endicott	90	8.9	50
Vermicompost	92	10.1	50
Field of Dreams	90	9.9	48
Stat. signif.	ns	ns	*
Interact. signif.	ns	ns	***

As would be expected, the delphinium produced only 2 stems per plant during this first season, whereas the statice was much more productive. The compost treatments had no effect on stem yield, and both species reacted similarly to compost (Table 3). Both species had similar stem lengths. The effect of the compost treatments was different for the two species however, in that delphinium stem length was generally depressed by compost addition, whereas Limonium stem length was stimulated (Fig. 4). It was noticed that shortly before and after transplanting, the delphinium seedlings grown in compost had pale green leaves and lacked the vigor of the control seedlings. This was particularly evident in the vermicompost plots, and may account for the lack of response by this species to the compost treatment. Researchers working with this compost on Brassica vegetables also encountered such stunting, and attributed it to high salts and a high pH of the medium.

The results of this experiment indicate that the composts used had little influence on the senescence-causing factors influencing *Limonium*. The results with delphinium were inconclusive due to the unexpectedly good stand in these plants..

Fig. 3. *Limonium suworowii* in the plant stand trial, pictured at end of August, 2008.

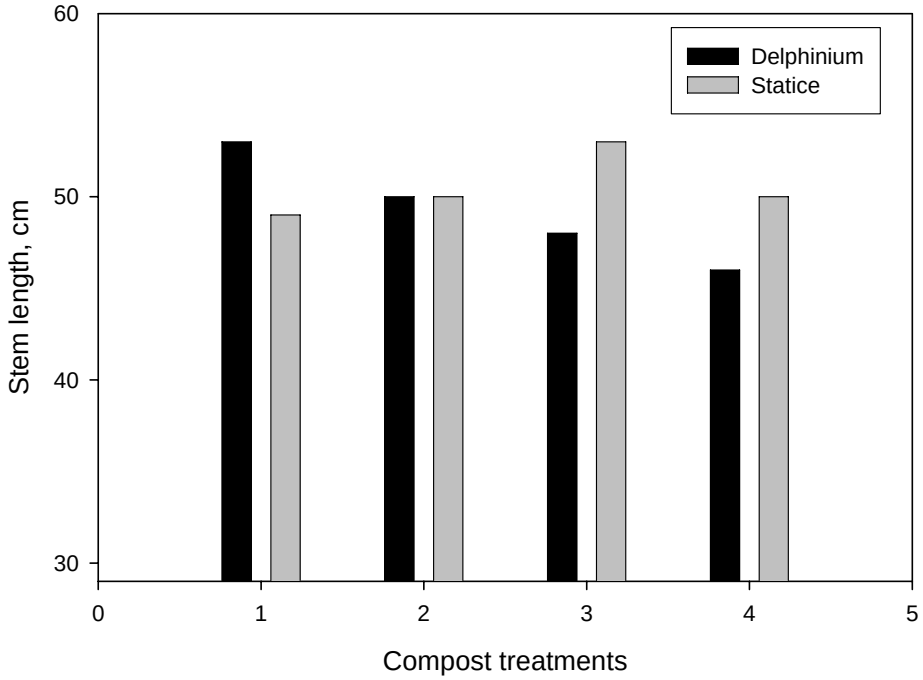

Fig. 4. Influence of compost treatment on stem length of Delphinium and *Limonium* (statice). Compost treatments were 1= Control, 2= Endicott, 3= Vermicompost and 4= Field of Dreams composts.

PEPPER TOPPING EXPERIMENT:

In previous years we have conducted variety trials of ornamental peppers (*Capsicum annuum*) that are grown to maturity, and harvested as stems with colored fruits attached. Some of these varieties produce a relatively early first flower low on the plant, followed by simultaneous flowering on several branches. The first flowers are borne relatively low on the main stem, and thus have little value as a cut stem, since to harvest them, one would have to harvest the whole plant at an early stage. Accordingly, removal of the first flower cluster by pinching before anthesis was thought to stimulate production of additional branches and increase yield.

Another species useful as a fruiting stem for fall harvest is 'Pumpkin-on-a-Stick' abbreviated here PoaS (*Solanum integrifolium*). As the name implies, this species produces pumpkin-shaped orange or red fruits attached by a short pedicel to the main stem and to the branches. Since the species we tested has long main stem and relatively short branches, it was thought that a higher yield of longer branches could be obtained by pinching out the main stem.

The objective of the current experiment was to determine if yield of desirable long branches could be increased by pinching out the main stem on each species.

Materials and Methods: The pinching treatments were conducted on ornamental pepper variety Nippon Taka (Johnny's) and PoaS (Harris Seed), having red fruit and green stem and devoid of spines. Topping consisted of pinching out the growing point after 6 leaves had developed on the main stem.

Plants were spaced 12 x 12 in. apart in 3 rows per bed, with 15 plants per plot. There were 3 replications, and the experiment was conducted in the high tunnel, with sowing date of April 1 and transplanting on May 8. The pepper plants were pinched on _May 23, and the PoaS on June 6.

Results and Discussion: The two fruiting ornamentals produced ripe fruit after about 178 days from sowing. Maturity was similar among all 4 treatments, with little delay noticed as a result of the pinching treatment. Pumpkin-on-a-Stick produced only half as many stems as the pepper variety, but these were considerably longer (Table 4).

Pinching of the growing point stimulated branch production in both species by about 15%, and there was no significant interaction between species and topping treatment. The pinching treatment did not significantly affect the stem length of either species. The results indicate that the increased labor required for the pinching may not be justified by the relatively small increase in stem numbers that result from the operation. However, the operation took little time, and removed the early fruit cluster borne on a useless short stem.

Table 4. Effect of pinching out the main growing point of the plant at node 6 on stem yield, stem length and date of harvest of 'Nippon Taka' pepper and Pumpkin-on-a-Stick grown in the high tunnel in 2008.

Treatments	Stems per plant	Stem length, cm
Pumpkin-on-a-Stick	3.5	76
Pepper	6.3	56
Stat. signif.	**	**
Control	4.6	67
Topped	5.3	64
Stat. signif.	**	ns
Interact. signif.	ns	ns

SUNFLOWER TOPPING:

While topping is a common practice for cut flower species that form branches readily, on sunflowers grown for cut flowers, that normally form only a single stem, removing the growing point to force branches to form may not be worth while. In previous experiments, conducted at a 9 x 9 in. spacing on a 4-row bed, we found that topped sunflowers form about 4 branches of adequate stem length, but the flowers tend to be small and less attractive than those on untopped plants. The present experiment was

conducted to determine if a wider spacing would allow the topped plants to produce larger flowers on more robust stems, and is a repetition of a trial conducted in 2007.

Materials and Methods: As in previous years, we compared two varieties: Procut Orange and Sunrich Orange. Treatments included two spacings on the bed: 9 x 9 in. with 4 rows per bed, and 12 x 12 in. with 3 rows per bed. Topping treatments were an untopped control and a soft pinch leaving 4 nodes. Experimental design was a split-split plot, with varieties as main plot, topping treatments as subplots, and plant spacing as sub-subplots. There were three replications. Seeds were sown on June 4, and transplanted on June 18. Plants were topped on July 7.

Results and Discussion: The results were similar to those obtained in the previous year. Topping increased stem number from 1 to 2.6, delayed flowering by 5 days and reduced stem length and flower diameter (Table 5). At the wider spacing, stem number and flower diameter increased. When the two factors were combined, topped plants grown at wide spacing had more stems and slightly increased flower diameter than was expected.

Table 5. Effect of spacing and topping of sunflowers on stem yield, earliness of flowering, stem length and size of flower in a field experiment on Procut Orange and Sunrich Orange sunflower.

Treatments	Stems/plant	Days to first flower, DAS	Stem length, cm	Flower diameter, cm
Spacing: 9x9	1.7	66	125	7.1
12x12	1.9	65	122	7.9
Stat. sign.	*	*	*	***
Topping: None	1.0	63	150	9.3
Topped	2.6	68	97	5.8
Stat. sign.	***	***	***	***
9x9, none	1.0	63	155	8.8
9x9, topped	2.5	63	96	5.4
12x12, none	1.0	69	145	9.8
12x12, topped	2.8	68	98	6.1
Interact. sign.	*	ns	**	ns (0.056)

Table 6. The influence of variety and topping and their interactions, on yield and components in the sunflower topping experiment.

Treatments	Stems/plant	Days to first flower, DAS	Stem length, cm	Flower diameter, cm
Procut Orange	2.0	60	111	7.2
Sunrich Orange	1.6	72	136	7.9
Stat. sign.	*	***	*	**
Procut control	1.0	58	136	9.2
Procut topped	3.1	61	87	5.2
Sunrich control	1.0	68	164	9.4

Sunrich topped	2.2	76	107	6.4
Interact. sign.	**	***	ns	**

Sunrich Orange flowered 12 days later than Procut Orange, had greater stem length and larger flowers (Table 6). Procut Orange produced more stems when topped than Sunrich Orange, and was relatively less delayed in flowering, but showed a greater reduction in flower diameter than Sunrich Orange. The lower leaf necrosis apparent in topped Sunrich Orange plants that occurred in 2007 was again present in 2008 and could have contributed to the depressed yield.

Table 7. Yield of stems per 100 ft. of bed and flower diameter for two sunflower varieties grown at two spacings, and subjected to two topping treatments.

	9 x 9 in.		12 x 12 in.	
Variety	Control	Topped	Control	Topped
	Stems per 100 ft. of bed			
Procut Orange	533	1547	300	990
Sunrich Orange	533	1120	300	660
	Flower diameter, cm			
Procut Orange	8.8	4.8	9.5	5.5
Sunrich Orange	8.8	6.1	10.0	6.7

When calculated on an area basis, the stem yield of the topped plants exceeded those of the controls by 2 to 3-fold (Table 7). The larger flower diameter of Sunrich Orange was maintained in the topped plants so that in spite of fewer stems per plant, it produced more flowers of 6 cm or larger diameter when topped at the 9 in. spacing than Procut Orange.

Fig. 5. ‘Procut Orange’ stems from topped plants, grown either at 12 in. (left) or at 9 in. spacing on the bed.

SUNFLOWER PHOTOPERIOD EXPERIMENT

Previous experiments have shown that many sunflower varieties are sensitive to daylength, and flower much earlier if they were exposed to 12 hr daylengths for the first 3 weeks after emergence than if that early emergence was under 16 hr daylength. Some of the most sensitive varieties already show flower buds ca. 19 days after emergence. Two experiments in 2007 gave the sensitive period as beginning around one week after emergence, and lasting about a week. The present experiment was designed to pinpoint more exactly when enough short days have been received, and to determine if the time period is the same for two sensitive varieties.

Materials and Methods: Seeds of ‘Sunrich Orange’ and ‘Solara’ sunflower were sown in 72-cell trays in soil-less mix on June 13, and subjected to one week durations of either 12 or 16 hr daylength on the photoperiod bench in Guterman greenhouse. There were all combinations of short and long days for a duration of three weeks total. There were eight treatments, as shown in Table 8. After completion of the daylength treatments, plants were transplanted to the field at 9 x 9 in. spacing, with three replications. In the field, a split plot experimental design was used, with varieties as main plots. Plants were harvested at anthesis, and stem lenth, leaf no. and flower characteristics measured. Axillary bud production was evaluated by counting the number of flower buds in the upper 4 leaf axles.

Results and Discussion: Plants of both varieties subjected to 12 hr photoperiod in the first three weeks flowered early on short plants, with small flowers (Tables 8, 9). The more long days were included in the treatments, the taller and later flowering the plants became, and the larger the flower diameter. Plants which had been given at least two weeks of short days had a significant level of adventitious flower bud formation (Table 9). Prevention of adventitious bud formation required long days in week 2, or for two weeks during the first three weeks (Table 9).

In agreement with the previous year’s trial, the daylength in week 2 after emergence was most influential in producing the effects typical for the specific daylength. For instance, treatments giving 2 periods of short days and one of long, the delay in days to flower was longest if the long photoperiod was given in week 2.

For plantings of daylength-sensitive sunflowers made during periods of short daylength, the results of this experiment suggest that adequate plant height and flower size could be gained by a single week of long days, starting at 1 week after the plants have emerged. This theory will be tested in 2009.

Table 8. Effect of various combinations of short and long days for the first three weeks after emergence on plant height, date of flowering and main stem leaf no. for two varieties of sunflower. "S" = 12 hrs daylength, "L" = 16 hrs.

	Stem length, cm		Days to flower		Leaf no.	
Treatment	Sunrich	Solara	Sunrich	Solara	Sunrich	Solara
3 SSS	73	66	51	49	12.3	12.7
2 SSL	85	75	55	52	12.0	11.7
4 SLS	94	92	59	56	14.7	14.7
6 LSS	82	92	55	56	13.0	13.7
1 SLL	122	102	63	60	18.7	15.0
7 LLS	110	113	62	61	16.7	16.3
8 LSL	103	108	59	61	13.7	13.7
5 LLL	139	134	69	69	21.3	21.3
Interact. signif.	**		**		**	

Table 9. Effect of week-long photoperiod treatments on flower diameter and degree of adventitious bud formation on 'Sunrich Orange' and 'Solara' sunflower.

	Flower diameter, cm		Bud count[z]	
Treatment	Sunrich	Solara	Sunrich	Solara
3 SSS	4.2	3.9	1.2	1.5
2 SSL	4.6	3.9	0.6	1.1
4 SLS	5.4	4.8	0.2	0.2
6 LSS	4.9	4.3	0.9	0.9
1 SLL	7.0	5.3	0	0
7 LLS	5.7	5.3	0	0.2
8 LSL	5.6	5.4	0	0.1
5 LLL	8.2	7.9	0	0
Interact. signif.	***			

[z]Bud count: No. in the uppermost 4 leaf axles

SUNFLOWER PHOTOPERIOD VARIETY SCREEN:

Many sunflower varieties react strongly to the daylength in which they spend the first three weeks after emergence. Most commonly, short days (12 h or less) will lead to hastened flowering on short stems, producing small flowers. Some varieties are day-neutral, and it is important for growers of sunflowers to know which varieties react in which way. This year we tested 11 varieties.

Materials and Methods: The photoperiod screen was conducted by sowing seeds in 72-cell trays, and exposing the trays as the seedlings emerged to either 12 h or 16 h photoperiod on a greenhouse bench that could be covered to black out all light. The seedlings were left under the specific photoperiod for 3 weeks, and then transplanted in the field at 9 x 9 in. spacing, with 24 plants per plot. The experimental design was a split plot, with daylength as the main plot, and varieties as the subplots. The experiment was

conducted twice, with a sowing date of May 14 and July 17, and transplanting June 9 and August 14, respectively. Unfortunately, the shading frame malfunctioned in the first trial, so only the results of the second planting will be reported here.

Varieties included in the test, and their sources were:

1. Sun4U Bicolor (Kieft)
2. Sun4U Lemon Yellow
3. Sun4U Orange
4. Sunflower 565 (Gloeckner)
5. Sunflower 460 Galilee Adami
6. Sunflower 1252 Tavor Joy
7. Sunflower 717 Arbel
8. Sunflower 337 Carmel
9. Cherry Rose (Johnny's)
10. Sunrich Orange
11. Procut Lemon (Seed Sense)

Results and Discussion: Overall, the growth of the sunflower varieties in this planting was not as vigorous as in previous years, with plant height of the long-day plants averaging 92 cm, compared to 113 cm for those screened in 2007. The same trend occurred for the two control varieties common to both trials. There are two possible reasons for this decline in vigor: the fertility level of the field may have declined by the Aug. 14 transplanting date, and/or the moisture conditions were less optimal.

As in previous trials, there was a range of reactions to the daylength treatments imposed on the 11 varieties. Two varieties, Sunflower 337 (Carmel) and Sunrich Orange, showed a delay of 2 weeks or more in long days (Table 10). Sunrich Orange is our standard sensitive variety. The majority of lines tested fell into the 'moderately sensitive' category, and only 3 could be classed insensitive: Sunflower 717 Arbel, Sunflower 460 Galilee Adami; and Procut Lemon, the insensitive control variety.

Table 10. Effect of exposure of 11 sunflower varieties during first three weeks after emergence to 12 or 16 h daylength in a greenhouse on main stem leaf number and days to first flower.

Variety	Leaf no. on stem		Days to flower		
no.	Short day	Long	SD	LD	Difference
1	13	16	50	60	10
2	12	15	50	60	10
3	15	17	55	62	7
4	14	16	53	62	9
5	13	16	57	62	5
6	14	17	50	62	12
7	13	19	60	64	4
8	12	21	53	69	16

9	8	11	39	50	11
10	13	18	53	67	14
11	13	15	55	60	5

Table 11. Influence of daylength on plant height, flower diameter and appearance of axillary buds in the upper nodes in the 2008 daylength trial with 11 sunflower varieties.

Variety	Plant height, cm		Flower diameter, cm		Axillary bud count[z]	
no.	SD	LD	SD	LD	SD	LD
1	65	98	5.0	5.1	2.3	0.4
2	56	86	3.7	5.5	2.1	0
3	84	105	4.1	6.1	1.3	0
4	72	101	3.5	5.7	1.6	0.3
5	80	98	3.8	6.0	0.9	0
6	53	78	3.7	6.0	2.6	0.5
7	85	102	4.6	7.3	0.1	0
8	57	93	3.6	6.9	1.7	0
9	33	70	2.2	3.5	1.8	2.3
10	57	96	3.8	6.5	2.3	0
11	68	81	4.6	5.8	0.1	0

[z]Bud count: no. of buds in uppermost 4 leaf axles

A description of the individual varieties follows:
1. Sun4U Bicolor: Medium height and flower size, dark center less pronounced than Procut Bicolor. Stems relatively thin, with strong branching tendency.
2. Sun4U Lemon: Pale yellow petals, small heads, little branching.
3. Sun4u Orange: Standard orange flower with dark center.
4. Sunflower 565: LIZA, ANY COMMENT ON FLOWER COLOR, ETC.?
5. Sunflower 460: Standard orange flower with large dark center.
6. Sunflower 1252: Yellow petal color, thin branches after main stem harvested.
7. Sunflower 717: Standard orange sunflower, day-neutral (Fig. 6).
8. Sunflower 337: Standard orange sunflower, strongly day-length sensitive.
9. Cherry Rose: Dwarf, very early flowering with small flower heads and profuse axillary branching. Even shorter and earlier under short days.
10. Sunrich Orange: Industry standard orange sunflower, very daylength sensitive.
11. Procut Lemon: Day-neutral standard, light yellow petals, early flowering.

Fig. 6. Sunflower 717 Arbel in the photoperiod screen planting in 2008.

STOCK (*MATTHIOLA INCANA*) VARIETY AND DATE OF PLANTING TRIAL:

Stock is a desirable cold-hardy cut flower species that has been grown successfully in temperature-controlled greenhouses. Our experience in the high tunnel has been less successful, with some varieties producing nothing but leaves, and others flowering early, but with rather short stems. Some varieties require a cold period to induce flowering, others do not. The present experiment seeks to gain a better understanding of the effect of earliness of planting on stock growth and flowering, using four varieties.

Materials and Methods: Four varieties with contrasting cold requirements for flowering were sown on three dates in seedboxes, grown in a greenhouse at relatively cool temperatures and transplanted to the tunnel at about a month later. Varieties used were Cheerful Yellow (Gloeckner), Katz White (PanAmerican), Lucinda Cream and Prouesse Deep Blue (both from Gloeckner). They were sown on Feb. 20, March 5 and April 1, and transplanted to the tunnel on March 31, April 11 and May 2, respectively.

Seedlings were grown in 72-cell trays, and transplanted to a 6 x 6 in. spacing with 5 rows per bed and 30 plants per plot. There were 2 replications per sowing date.

Results and Discussion: The two early varieties Cheerful Yellow and Katz White showed full flowering in all trials (Table 12), whereas 'Lucinda Cream'showed a decline in flowering in the two later plantings, and 'Prouesse' had only 70% of the last planting produce harvestable flowers. The results indicate that the first two varieties have a small or no cold requirement for flowering, whereas the latter two do require cold. The early growing season in the high tunnel was relatively cool in 2008, with temperatures during the first three weeks after transplanting averaging 57, 60 and 58° F in the three plantings, respectively. It is not clear from these temperature records why 'Lucinda Cream' and 'Prouesse' were inhibited from flowering, but the trials emphasize the need for early planting of late stock varieties in high tunnels. Given that the early varieties produced plants of similar stem length and appearance to the later ones, we recommend the early ones for that environment.

Table 12. Flowering date, stem length, plant leaf number and percentage of plants flowering in a stock variety trial transplanted into the high tunnel on March 31, April 11 and May 2, 2008.

Treatments	Planting date	Cheerful Yellow	Katz White	Lucinda Cream	Prouesse Deep Blue	Interact. signif.
Flowering date, DAS	1	57	59	78	73	
	2	48	40	74	62	ns
	3	72	69	93[z]	84	
Stem length, cm	1	57	62	53	60	
	2	68	57	50	61	**
	3	58	55	43[z]	53[y]	
Leaf no. per plant	1	32	33	77	53	
	2	38	29	72	59	**
	3	38	30	58[z]	45[y]	
Plants flowering, %	1	90	85	80	90	
	2	95	100	65	95	
	3	100	85	40	70	

[z]Fewer than 50% of plants flowered, and data taken only on those that flowered
[y]Data only from the flowering plants

LARKSPUR (*Consolida*) VARIETY AND DATE OF PLANTING TRIAL:

Larkspur, an attractive cut flower that blooms in early summer when transplanted into the high tunnel in late April, is often difficult to transplant. When sown directly in the tunnel, emergence may not be high due to soil crusting and low soil temperatures. In the current trial, we will test the effect of an early and later transplant date for seedlings started in a greenhouse.

Materials and Methods: Larkspur varieties Stiletta Indigo Blue (Gloeckner), Cannes Rose Stripe (Harris), Cannes Deep Blue and Sublime White were sown on Feb. 20 and March 5, and transplanted into the high tunnel on April 7 and April 21, respectively. Plants were spaced 6 x 6 in. in 5 rows in the tunnel, and two replications. There were 25 plants per plot. Flowering stems were harvested at anthesis, both for the main stem, and for the side branches.

Results and Discussion: Growth and yield of stems was impressive in these two trials. The main stems averaged more than a meter for three varieties, and branches also made acceptable cut flowers, with greater than 50 cm length (Table 13). Plants in the later sowing took about a week less to come to flower, but had significantly shorter main stems and branches. The results confirm the adaptation of larkspur to cool growing conditions, and its attractiveness as an early cut flower well suited for high tunnel production.

Table 13. Effect of planting date on date of first flower, main stem and branch length and the no. of branches per plant of four varieties of larkspur grown in the high tunnel.

Treatments	Planting date	Stiletta	Cannes Rose	Cannes Blue	Sublime White
Flowering	1	63	66	64	67
date, DAS	2	57	61	58	56
Main stem	1	83	116	118	121
length, cm	2	69	87	91	105
Branch length,	1	52	61	55	59
cm	2	49	56	52	57
Branches/plant	1	3.9	5.6	4.0	3.1
	2	3.5	3.8	4.4	3.2

Fig. 7. ‘Sublime White’ larkspur in the second planting of the trial.

VARIETY TRIALS (in alphabetical order):

CALENDULA VARIETY TRIAL:

In the middle of summer, after the first crops have been harvested from the high tunnel, there is need for additional crops that can be marketed in fall. Several new varieties of calendula have been released recently, and we wanted to test these in a high tunnel.

Materials and Methods: Five varieties of calendula were sown on July 10 and transplanted to the tunnel on August 12 at 9 x 9 in. spacing, with 24 plants per plot. Shortage of seed restricted ‘Pink Surprise’ to 20 plants per plot. There were 2 replications. To control aphid infestation in the trial, lady bird beetles were released on a couple of occasions. For powdery mildew control, foliar sprays of ‘Cease’ were applied twice.

Results and Discussion: Calendula is well suited to fall production in a high tunnel, since it withstands light frosts and can grow in cool conditions. It is however somewhat susceptible to powdery mildew, and preventative measures need to be in place to prevent it from building up.

‘Art Shades’ and ‘Kablouna’ were significantly taller than the rest of the varieties (Table 14). “Art Shades Mix’ featured colors from lemon to deep orange, with serrated, dark petal edges, semi-double with dark centers. ‘Kablouna Mix’ also had dark petal edges, and was fully double, so that the centers looked dark as the flower was opening. ‘Pink Surprise’ was a relatively short-stemmed line with orange color and a pink blush. Petals were fully double, but productivity lowest in the trial. ‘Flashback Mix’ was also short, but earlier and better productivity (Fig. 8). Petals were dark on the lower side and petals ranged in color on the upper side from lemon to dark orange. ‘Déjà Vu’ was of intermediate height, with dark streaks on the backs of the petals, with colors from orange to pink.

Table 14. Calendula variety trial results, giving stem length, yield and first harvest dates for 5 varieties grown in the high tunnel.

Variety	Stem length, cm	Stems per plant	First Harvest Date
Art Shade Mix (Thompson and Morgan)	51	10.9	73
Kablouna Mix	52	9.8	70
Pink Surprise	33	7.8	71
Flashback Mix (Johnny’s)	32	12.1	67
Deja Vu	39	13.8	67

Fig. 8. ‘Flashback Mix’ calendula grown in the high tunnel in the fall.

CAMPANULA VARIETY TRIALS:

Plant breeding has transformed campanula (Canterbury Bells) from a biennial to an annual flower that does not require cold to flower. The Champion series represent these improved types, and we wanted to compare their performance in the high tunnel and outside.

Materials and Methods: The same four varieties, Champion Blue, Lavender, White and Pink, were obtained from Harris Seed Co., sown in the greenhouse and transplanted to either field or high tunnel. Sowing dates were Feb. 8 and Feb. 28 for the high tunnel and field trial, respectively, and they were transplanted April 21 and May 5. There were two replications, and a spacing of 9 x 9 in., with 24 plants per plot. At harvest, the initial stems tended to be long, and subsequent ones considerably shorter, so harvest samples were separated into tall and short, to calculate a tall and combined average.

Results and Discussion: Growth of the trial in the high tunnel was not as vigorous as we had wished, because of excess compost application to the bed caused early plant stunting and poor growth. Many plants recovered well, and then made vigorous growth (Table 15). Differences among the varieties in this trial were not large, with similar stem lengths and yields. Champion Lavender tended to be about a week earlier in flowering than the other colors.

Growth and yield were not as high in the field (Table 16), with stem lengths about 20% shorter, and yield 35% less. In the field trial, Champion Blue had the highest stem yield, and Ch. Lavender was again the earliest flowering.

Given the earlier sowing and transplanting dates, it is not surprising that plants in the tunnel trial came to flower on June 19, compared to July 1 for the field trial. Thus the high tunnel is the preferred location for campanula production. This species also suffered in flower quality after a rain in the field

Table 15. Stem length, yield of stems and first flower date for four varieties of campanula, grown in the high tunnel in 2008. Yield was divided between the main stem (tall) and the shorter branches, with "All" being a total of the two.

	Stem length, cm		Stems/plant		Days to
Variety	Tall	All	Tall	All	flower
Champion Blue	46	43	7.8	9.0	135
Ch. Lavender	46	43	6.7	8.2	124
Ch. White	45	42	5.6	7.0	131
Ch. Pink	44	41	7.1	8.5	134

Table 16. Stem length, yield of stems and first flower date for four varieties of campanula, grown in the field in 2008. Yield was divided between the main stem (tall) and the shorter branches, with "All" being a total of the two.

	Stem length, cm		Stems/plant		Days to
Variety	Tall	All	Tall	All	flower
Champion Blue	39	34	5.8	8.8	124
Ch. Lavender	35	30	2.8	5.3	112
Ch. White	38	33	2.7	4.4	129
Ch. Pink	38	32	3.6	5.6	126

Fig. 9. Campanula ‘Champion Blue’ growing in the high tunnel in 2008.

LISIANTHUS VARIETY TRIALS:

Several new lisianthus varieties were released for trial in the ASCFG trial list for 2008, and we included them in field and high tunnel trials, both planted in spring.

Materials and Methods: Both trials were sown on Feb. 8 in 128-cell trays and transplanted to the high tunnel on May 15, and the field on May 19. Spacing was 9 x 9 in. with 20 plants per plot in two replications.

Varieties tested in the trials, and their sources, are:

1. Advantage Cherry Sorbet (Gloeckner)
2. Cadence Yellow (Goldsmith)
3. Twinkle Pink Improved
4. Twinkle Violet
5. Arena 1 Green (Takii)

6. Arena 2 White
7. Arena 3 Yellow
8. Arena 3 Pink
9. Arena 4 Rose
10. Vulcan 2 White
11. Vulcan 2 Yellow
12. Vulcan 2 Pink Picotee
13. Echo Champagne (Johnny's)

Results and Discussion: Climatic conditions for the field trial were good, and the varieties performed well (Table 17). The tunnel trial showed its usual earliness, but yields were significantly lower than in the field. This is primarily due to the lack of support netting, and the high incidence of lodging in the trial. In previous years, the lack of support allowed us to identify varieties with weak stems, but the high rate of compost used in the tunnel in fall 2007 contributed to lush growth of all varieties so that they lodged by the time of first harvest. Stem length was similar in both trials.

Table 17. Stem length, yield and earliness of 13 lisianthus varieties grown in the field and the high tunnel in 2008.

	Stem length, cm		Stems/plant		Days to flower	
Variety	Field	Tunnel	Field	Tunnel	Field	Tunnel
Advantage Cherry Sorbet	53	52	5.0	6.7	181	170
Cadence Yellow	41	43	5.2	5.4	184	161
Twinkle Pink Improved	50	54	3.8	3.8	177	162
Twinkle Violet	45	46	4.1	4.0	178	170
Arena 1 Green	53	53	6.8	3.0	184	176
Arena 2 White	55	52	4.5	3.0	185	176
Arena 3 Yellow	53	52	4.5	2.4	186	175
Arena 3 Pink	59	61	5.3	3.2	189	178
Arena 4 Rose	70	90	2.8	1.0	201	189
Vulcan 2 White	63	61	5.1	2.2	180	174
Vulcan 2 Yellow	52	52	4.8	2.6	180	171
Vulcan 2 Pink Picotee	54	62	3.0	1.5	187	178
Echo Champagne	48	44	4.4	3.8	177	173

Several varieties showed promise in both trials. Advantage Cherry Sorbet (Fig. 10) produced a large double deep pink flower with ruffled edges. It was relatively early, and had good productivity. In the Arena series, Arena 1 Green stood out with attractive ruffled deep green petal edges (Fig. 11). 'Arena 4 Rose' was the tallest variety in the trials, but achieved that height by being significantly later than all others. Its productivity suffered as a result. The Vulcan series features single flowers. The Pink Picotee of this series is attractive (Fig. 12), but was not productive.

Fig. 10. ‘Advantage Cherry Sorbet’ in the field trial in 2008.

Fig. 11. ‘Arena 1 Green’ flowers, showing ruffled petal edges.

Fig. 12. Vulcan 2 Pink Picotee lisianthus.

STATICE VARIETY TRIALS:

Statice is a productive and useful filler in mixed bouquets, and is grown by most cut flower producers. The present trial was conducted to compare productivity in tunnel and field. The varieties available in statice have not changed much in recent years. The most common belong to the *Limonium sinuatum* group and are grown as annuals. *L. perezii* is a late-flowering perennial that produces attractive blue flowers

Materials and Methods: Plants for Rep 2 of the field and L. perezii for the tunnel trial were sown on March 21, and the other entries on April 7. Transplants were set in the tunnel on May 8, and May 23 in the field. There were 15 plants per plot, spaced 12 x 12 in. apart in 3 rows on the bed.

Results and Discussion: The warm conditions of the high tunnel show statice production to good advantage (Table 18, Fig.13). Consistent increase in stem length, a 65% increase in stem yield, a 18-day earlier harvest and much higher flower quality are compelling reasons to produce statice in a high tunnel.

As predicted, *L. perezii* was the latest of the varieties to flower, and in the field only managed to produce one stem per plant. Among *the L. sinuatum* varieties in the trial, stem length was best for Qis White, but this variety was also somewhat late. 'Sunset

Mix' produced a profusion of stems, in colors ranging from pink to orange. The colors of this varietal mix seemed rather drab to me, but was liked by some of my staff. 'Turbo Mix' was especially productive in the high tunnel, with purple, pink, yellow and pale yellow plants in the mix. Fortress mix showed bright colors with sturdy stems, and held up better in the field than lighter-colored, thin-stemmed varieties. Splendor Supreme Mix had more subtle colors than Fortress, and was quite attractive. *L. perezii* was too late to be qrown here, although an attractive dark blue.

Table 18. Stem length, yield and first flower date of six varieties of statice when grown in the field and in a high tunnel.

Variety	Stem length, cm		Stems/plant		Days to flower	
	Field	Tunnel	Field	Tunnel	Field	Tunnel
Fortress Mix (Harris)	56	71	13	18	108	95
L. perezii (Gloeckner)	55	65	1.2	4.6	160	134
Qis White	66	72	11	17	130	102
Sunset Mix (Johnny's)	51	62	26	32	108	93
Splendor Supreme Mix (Geo)	54	65	9	17	110	100
Turbo Mix	54	62	18	39	108	90

Fig. 13. Comparison of *Limonium perezii* grown outside (left) and in the high tunnel in 2009. Picture was taken on August 4, when the field-grown plants had not reached anthesis yet.

SWEET PEA VARIETY TRIAL:

The trial was conducted to assess the performance of four sweet pea varieties when planted very early in the high tunnel.

Materials and Methods: Seeds were sown in 72-cell trays in the greenhouse on March 5, 2008. They were transplanted into the high tunnel on March 31 in double rows about 12 in. apart, and hills spaced 6 in. in each row. A vertical trellis of plastic netting (Hortanova with 6 in. grid) was attached to metal poles about 6 ft. high, supported by horizontal wires at the 3 ft. and 6 ft. level that were anchored to the ground at the ends. There were two replications.

The varieties tested included:

1. Winter Sunshine Rose (Gloeckner)
2. Cuthbertson Mix (Johnny's)
3. Mammoth Choice Mix
4. Elegance White

Results and Discussion: A severe frost on April 19 killed many plants, or froze them to the ground, allowing branches to grow from basal nodes. There were sufficient extra plants to fill in some missing hills, but plant stand and subsequent growth was not uniform, and the date of first harvest only occurred three months from sowing. Nevertheless, plants made vigorous growth, and produced considerable yield (Table 19). The best performer was Mammoth Choice Mix, which produced the longest flower racemes, and sprays, and had more of each than the other varieties. Three varieties were about 10 days earlier than Cuthbertson Mix in the trial. Individual racemes and sprays had a similar vase life of about 5 days. Fragrance and appearance of all varieties tested was satisfactory. An aphid infestation late in the harvest period ultimately spelt the end of the trial. Elegance white put out the straightest stems. In other varieties stems were more often crooked. Cuthbertson Mix had a very nice balanced mix of colors. The stems tended to be thin and crooked. Winter Sunshine Rose had a lovely shade of dark pink, somewhat shorter than others but strong stems.

Table 19. Stem length, yield per plant and first harvest date of four sweet pea varieties grown in the tunnel in 2008. Sowing date March 5, transplanted March 31.

Variety	Stem length, cm		Stems per plant		First harvest date, DAS
	Raceme	Spray	Raceme	Spray	
Winter Sunshine Rose	24.9	46.2	22.2	3.4	94
Cuthbertson Mix	26.8	54.5	19.8	5.1	106
Mammoth Choice Mix	28.6	56.4	34.4	7.4	95
Elegance White	25.4	44.8	28.1	5.3	93

Fig. 14. ‘Elegance White’ sweet pea growing on a trellis in the high tunnel; picture taken June 12, 2008.

TRACHELIUM VARIETY TRIALS:

A small variety trial was conducted to check on performance of three locally-available early varieties in both tunnel and the field.

Materials and Methods: The trial for the tunnel was sown on Feb. 20 and transplanted on May 12; the field trial was sown March 12 and transplanted May 28. Plants were spaced 9 x 9 in. apart in 4 rows, with 20 plants per plot. There were two replications in both locations.

Results and Discussion: In contrast to previous years, plants in the tunnel were not as productive as in the field (Table 20), although they exhibited increased stem length. The

earlier sowing and transplanting date conferred no advantage to the tunnel-grown plants; these were 19 days later than those grown outside.

Quality of the flowers from the tunnel was much higher than from the field (Fig.15), with larger florets and brighter color. 'Summer Pandora' is slightly earlier and has a shorter stem and has dark purple florets. 'Helios' is white with slightly taller stems. Productivity was comparable among the varieties.

Table 20. Stem length, yield and days to first harvest for 3 Trachelium varieties grown in the high tunnel and outside in 2008.

Variety	Stem length, cm		Stems/plant		Days to flower	
	Field	Tunnel	Field	Tunnel	Field	Tunnel
Summer Pandora (Harris)	40	47	15	11	131	156
Dafne Summer (Gloeckner)	45	48	16	15	145	160
Helios	49	60	16	11	145	160

Fig. 15. Trachelium 'Helios' grown outdoors (left) and in the high tunnel in 2008.

ZINNIA VARIETY TRIALS:

The recent release of several new cut flower zinnia varieties prompted us to test these in the field and in the high tunnel.

Materials and Methods: The field trial was sown in the greenhouse in 72-cell trays on April 29, and transplanted May 30 at 9 x 9 in. spacing with two replications. The high tunnel trial was sown on July 10 and transplanted on Aug. 7 at the same spacing. Plants

in the first replication of the latter were pinched to retain 5 nodes on Aug. 20. The varieties tested and their sources were:

1. Giant Carmine Rose (Benary)
2. Giant Lime
3. Giant Scarlet
4. Oklahoma Pink
5. Oklahoma Scarlet
6. Uproar Rose (Goldsmith)
7. Zowie Yellow Flame
8. Peppermint Stick (Johnny's) (Fall trial only)

Results and Discussion: The field trial grew well and gave good yields (Table 15). Stems were on average 12% shorter than in the tunnel, but stem yields were more than double. Yields in the high tunnel were cut short by increasing pressure from powdery mildew and botrytis, which did not respond to organic fungicides. Reduced light and lower temperatures in early October also contributed to the yield reduction

Varietal differences in productivity and appearance were marked in these trials. The Oklahoma lines were most productive, although their flowers were the smallest (Table 21, Fig. 18). Lowest yields were obtained from the 'Giant' lines, but the large, attractive flowers of these lines made up for the lower productivity (Fig. 16, 17). 'Uproar Pink' was particularly showy with large flowers, high yield and relatively lower susceptibility to leaf disease (Fig. 17). The bright colors of 'Zowie' compensated for the relatively shorter stems. 'Peppermint Stick' has good stem length and productivity, with interesting flower color patterns, and is worth growing again.

Table 21. Stem length, yield and date of first flower (from sowing) of eight zinnia varieties grown in the field and in the high tunnel in 2008.

	Stem length, cm		Stems/plant		Days to flower	
Variety	Field	Tunnel	Field	Tunnel	Field	Tunnel[z]
Giant Carmine Rose	68	77	7.3	3.6	79	69
Giant Lime	66	69	9.4	3.8	79	81
Giant Scarlet	69	78	8.4	4.4	75	67
Oklahoma Pink	52	61	17.6	8.3	70	67
Oklahoma Scarlet	54	66	17	8.1	70	60
Uproar Pink	62	72	9.8	5.2	77	67
Zowie Yellow Flame	45	52	11.8	5.2	71	74
Peppermint Stick	--	65	--	6.3	--	71

[z]Days to flower on controls only

Fig. 16. Giant Carmine Rose zinnia in the field trial.

Fig. 17. Giant Lime (left) and Uproar Pink zinnias in the field trial.

Fig. 18. Oklahoma Pink zinnia in the summer field trial.