CUT FLOWER CULTURAL PRACTICE STUDIES AND VARIETY TRIALS 2015

H. C. Wien, Horticulture Section, School of Integrative Plant Science, Cornell University, Ithaca, NY

EXECUTIVE SUMMARY:

Another cold winter severely inhibited anemone and ranunculus in the tunnel and killed the youngest *Eucomis* lily plants, but overwintered snapdragons came through well. In the field plants got off to a slow start in the wet weather, but then thrived. In all we had a mix of results, with lots of interesting data, as you will see below.

Anemone/Ranunculus Pre-sprouting trial 2014/15: (Page 6). The small trial planted near the outside wall of the tunnel suffered from cold damage. Covering with a low tunnel did not improve survival, but slightly increased yield. Pre-sprouting the planting materials for 3 weeks increased winter survival, but variability was high.

Lisianthus Spacing and Topping trial: (Page 7). In a repetition of the previous year's experiment, two varieties of lisianthus were grown at 6 x 6 in. or 9 x 9 in. spacing, and either topped or left alone. Plants showed increased yield by spacing and topping in both the field and the high tunnel, with more than a doubling of yield when the two conditions were combined. Topping resulted in no decrease of stem length, so is clearly a worthwhile practice. If stems are elongating at transplanting, plants can be pinched then, facilitating the process.

Sunflower Topping trial: (Page 8). Four sunflower varieties were topped at either the six or the 10-leaf stage. Stem numbers increased more with the early than the later treatment, with some varieties, notably Procut Gold and Sunrich Orange producing barely more than one small flower per plant with the late topping treatment. The branching variety Goldrush produced more than 4 stems per plant in both topping times, and is best suited for this treatment.

Sunflower Photoperiod Experiment: (Page 10). Eleven sunflower varieties were exposed in the seedling stage to either 12 hours (short days) or 16 hours (long days) for three weeks and then transplanted to the field. Only one new variety, Helios Flame showed a short-day reaction, flowering nine days earlier, while Starburst Greenburst flowered eight days later after short day rather than long day pre-treatment. Neither responses were severe enough to affect productivity. Of the varieties trialed, Procut Gold, Procut Brilliance and Procut Red have become standards, while Starburst Panache, Helios Flame, Starburst Greenburst and Jade look promising as cut flower varieties.

Snapdragon Overwinter Experiment: (Page 13). Two varieties of snapdragon were transplanted in July and early August 2014 in the high tunnel, harvested in the fall and then were allowed to overwinter with low tunnel protection or not. The low tunnel significantly improved survival. 'Supreme Light Lavender' also had better stands in spring than 'Maryland White'. Combined yields exceeded 30 stems per plant on a 9 in. spacing, and highlight the promise of overwintering snapdragons in high tunnels.

Compost trials: (Page 15). Conditions in our cut flower field in 2014, after yearly additions of compost, had resulted in a high pH that adversely affected plant growth that year. We conducted a series of six greenhouse pot and field experiments to trace the cause of the poor growth in 2015. The results were not definitive, but showed that high levels of compost reduced plant growth in pots of snapdragon,

dianthus, campanula, larkspur and delphinium. Field experiments in areas of our field that had contrasting amounts of compost added showed little effect, largely because soil pH and soil organic matter levels did not vary significantly among plots.

Ornamental Cabbage Seedling Management trial: (Page 22). The trial was conducted to avoid the poor establishment of ornamental cabbage seedlings when planted in June or July in the field. We compared direct-seeding with use of transplants sown in small cells and transplanted relatively early. All treatments resulted in good yields of plants with long straight stems and desirable "flower" diameters. Thus the direct seeding of this species may be an easy way to establish this crop.

Ornamental Pepper: (Page 23). Eight *Capsicum baccatum* PI lines and the *C. annuum* variety Black Pearl were grown in the field and tested for maintenance of turgidity and leaf loss after harvest. Three PI lines stayed well hydrated for two weeks in the vase, and their leaves could be easily removed: PI 441542, 441575 and 441430-1. 'Black Pearl' also had good postharvest properties but stem length was inadequate as a cut stem.

Variety Trials:

Ageratum: (Page 27). After initial poor growth in the cool June conditions in the field, the plants recovered and yielded well. Of the six varieties tested, Dondo White was promising with long, sturdy stems, Everest Blue was superior to Blue Horizon in stem length and yield and Timeless Rose had attractive flowers with strong stems. The two red-flowered varieties yielded well but had excessively thin stems.

Allium: (Page 29). Of the eleven Allium species planted in fall 2013, only nine have survived, and several show further signs of decline. Only *A. amplectens* Graceful Beauty is producing increasing stem numbers. The trial points out a need to investigate the conditions needed to improve plant stand and productivity over time.

Ammi: (Page 29). Five Ammi varieties and *Trachimene* (Blue Lace Flower) were compared in a field experiment. The *Daucus* variety Dara looked promising with its long, straight stems and umbels varying in color from black to white to gradients in between. 'Graceland' is an early traditional Ammi variety with branching, short stems. 'Green Mist' and 'Casablanca' follow it with longer stems and large umbels, but again are hard to use because of their branching nature. *Trachimene* is very susceptible to root rot, and can't be recommended.

Anemone/Ranunculus: (Page 31). The trial was planted in December and thus was exposed to the harsh winter conditions. In spite of a low tunnel covering, stands of ranunculus were low, and few of the eleven accessions produced more than one stem per plant. 'Ponpon Aurora' stood out, both in winter survival and yield, but its color may limit its appeal. Among the five anemone lines, stands were nearly complete after winter, but again yields were low. 'Mistral Plus Vianco Centro Negro' was noteworthy with its attractive white flowers and dark centers, and strong stem.

Centaurea: (Page 33). In this trial of six varieties the traditional blue 'Emperor William' produced more than twice as many stems than the other entries, but a short vase life and short stems reduced its appeal. 'Black Gem' and 'Red Boy' were attractive and worth another look.

***Eucomis* (Pineapple Lily): (Page 36).** The seven varieties in this trial were planted in 2012 and 2013, and have overwintered successfully in the high tunnel. A 2014 planting, situated near the outside wall, did not survive the winter. Yields in 2015 were 4 to 5 stems per plant, but the harvest duration of only 7 to 10 days limits the appeal of this crop for tunnel planting.

Marigold: **(Page 37).** The number of tall, attractive marigold varieties with long vase life has continued to increase in recent years. Among the 7 varieties tested in our trial, Oriental Deep Gold, Garland Orange and Giant Orange stood out with long stems and uniform flowers.

Matricaria: (Page 39). Six varieties were tested and grew well. They produced two flushes of flowers, in early summer and early fall. 'Magic Lime Green' had attractive double flowers and led the others with more stems.

Scabiosa: (Page 41). Productive plants with attractive flowers, scabiosa is worth considering as a cut flower. In our 4-variety trial, Black Knight stood out with its black petals and blue stamens. A vase life of less than a week requires harvest at early opening stage.

Statice: (Page 43). The seven varieties in the trial produced flowers throughout the summer and the fall. Blue and purple varieties tended to be later and with leafier stem ribs than the other colors, and the yellow varieties, though showy, suffered from a stem necrosis in the fall that ended their harvest season. 'Seeker Mix' was early, productive and with an attractive assortment of colors, and is worth further attention.

ACKNOWLEDGEMENTS: I am grateful for the expert assistance of Priscilla Thompson and Emily Burrister in the conduct of these trials. The farm manager Tim Dodge and his staff installed drainage tile, fertilized and laid plastic mulch and maintained the area of our plots, and the high tunnel to a high standard. Thanks also go to the Association of Specialty Cut Flower Growers, and the following seed companies, who provided technical assistance and donated seed samples used in these trials: Geo, Fred C. Gloeckner, Harris, Johnny's Seeds and Takii. Additional support came from Federal Formula Funds, and the Walmart Foundation.

WEATHER CONDITIONS:

Temperatures at the flower farm were near normal for most of the season, except for unusually cold conditions in January through March (Fig. 1). February average temperatures were 15 F lower than the

long-term average, and this adversely affected some crops overwintering in the high tunnel.

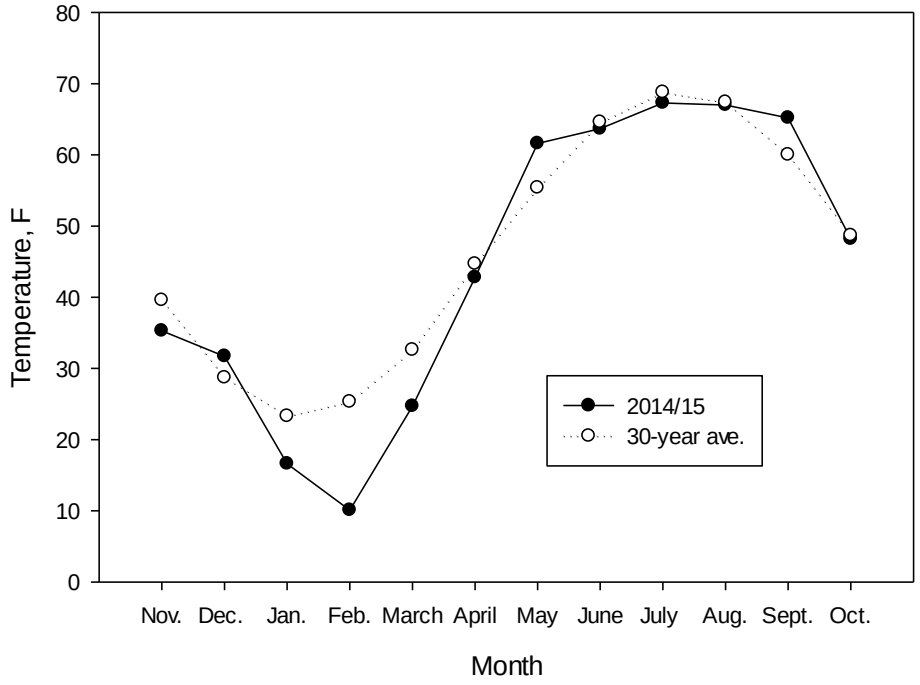


Fig. 1. Monthly air temperatures for Ithaca for the 2014-2015 growing season, compared to 30-year averages. Data obtained from the Northeast Regional Climate Center, and were recorded at their station located ca. one mile from the farm. (www.nrcc.cornell.edu/climate /ithaca/)

Rainfall for the season was more variable than normal, with lower totals in January, March and August, and excessive moisture in June and July. We avoided moisture problems in the high tunnel with regular irrigation, and in the field with our sandy, well-drained soil. The poor drainage at the north end of our

outdoor plots was remedied by installation of drainage tile before the field plantings were put in.

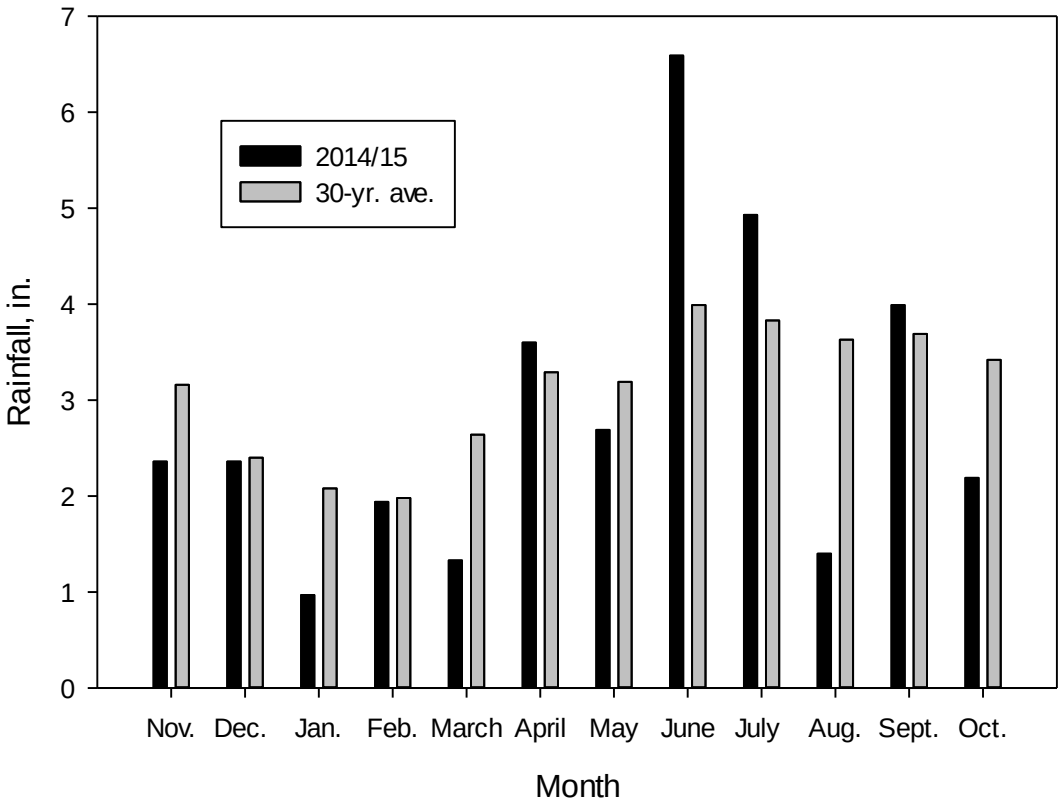


Fig. 2. Monthly average rainfall totals for Ithaca for the 2014-15 growing season, and their 30-year averages. Data from the Northeast Regional Climate Center website.

GENERAL MATERIALS AND METHODS:

The 2014/15 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, respectively.

Yearly addition of compost to the field was not continued in 2015, because the soil pH had exceeded 7.5. To correct this situation, 200 lbs/A of 90% sulfur was broadcast on the field in spring. A broadcast application of 30 lbs N per acre of ammonium sulfate fertilizer was applied before disking and harrowing of the field. We applied no basal fertilizer in the high tunnel, but provided 20 lbs./A of a soluble 21-5-20 fertilizer through the trickle irrigation system on July 10.

Pest and disease pressure in the field were low in the 2015 season, so no pesticide sprays were made. In the tunnel, a buildup of spider mites on the snapdragon experiment was controlled by releasing natural enemies supplied by IPM Labs in Locke NY.

Plants for most trials were started in greenhouses from seed in seedling trays in Cornell 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 plot, and 2 replications in both the tunnel and outdoor variety trials.

Plots in the tunnel were irrigated weekly during most of the season 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.

CULTURAL PRACTICE TRIALS:

ANEMONE RANUNCULUS PRE-SPROUTING TRIAL 2014/15

Anemone and ranunculus are cold-tolerant crops that grow well in cool greenhouses. The current trial will test if the 2 crops can be successfully grown in a high tunnel if emerging plants are protected from freezing by use of a secondary cover. In last year's trial, the recommended pre-sprouting did not appear to be needed, but low tunnel covers hastened flowering. We repeated the trial to confirm the results of last year.

Materials and Methods: The trial was conducted using anemone 'Galilee Red' and ranunculus 'Amadine Orange Picotee'. Planting materials were soaked in aerated water at room temperature overnight, followed by either pre-sprouting for 3 weeks on Dec. 3, 2014, or planting directly in the high tunnel. Half the plots were covered with a low tunnel of medium-weight Covertan spun-bonded fabric, or left uncovered. The trial was situated in a bed nearest to the wall of the high tunnel. Plots consisted of 25 corms, spaced 6 x 6 in. apart, in two replications.

Results and Discussion: The severe winter made this experiment into a near-disaster, especially because the plot was located in the bed closest to the outside wall of the high tunnel. Variability from plot to plot was high, and with only two replications and small plots, few effects could be shown to be significant. Nevertheless, some conclusions can be drawn.

The capacity to produce foliage after the hard winter, termed 'survival', was much higher for pre-sprouted corms, and slightly higher for anemone than ranunculus (Table 1). Yield of flowering stems was abnormally low compared to previous seasons, when 3 to 5 stems per plant were the norm. Yield was increased slightly by the low tunnel covers. Stem length was increased by the pre-sprouting treatment. Days to flowering varied widely and was not significantly affected by the treatments applied.

Overall, the experiment confirms the need to pre-sprout the planting material, and to provide low tunnel protection for these over-wintered crops, but it also shows the limits of winter hardiness of these species.

Table 1. Effect of pre-sprouting of corms, protection in the high tunnel by erecting a low tunnel and species on survival, yield and plant characteristics of overwintered anemone and ranunculus in the 2014/15 season.

Treatments	Survival %	Stems/plant	Days to flo.	Stem length, cm
Pre-sprout no	14	1.0	144	17
yes	72	1.1	152	27
Stat. signif.	ns (.06)	ns	ns	*
Cover no	37	0.6	152	21
yes	50	1.48	146	23
Stat. signif.	ns	*	ns	ns
Species Anemone	55	0.6	157	18
Ranunculus	32	1.4	144	26
Stat. signif.	*	ns	ns	ns

LISIANTHUS SPACING AND TOPPING TRIAL

In a repetition of trials conducted in 2014, the purpose of this work was to test if the significant yield increase produced by combining close spacing and topping could be confirmed.

Materials and Methods: Seedlings of lisianthus were purchased from the commercial plant propagator 'Grow-N-Sell'. The seedling plugs were in 216-count trays, arrived on May 6, and were transplanted into 72-count trays in Cornell mix artificial soil. These were allowed to grow until June 8 in the greenhouse, and were then transplanted to the field and the high tunnel in three replications in each location. Treatments in both locations consisted of the varieties 'ABC 1-3 Purple' and 'Mariachi 3 Grande White', spacing of the plants in the field/tunnel at either 9 x 9 in. spacing with 4 rows per bed, or 6 x 6 in. with 6 rows per bed. When the transplants reached the 6 extended leaves stage, they were pinched leaving about 4 nodes, or not pinched. The experimental design in both field and tunnel was a split split plot, with spacing as main plots, and pinching treatments as subplots and varieties as sub-subplots. Statistical analysis of the date was done using Statistix software.

Results and Discussion: Trials in field and tunnel grew well, and produced first flowers about 2 months after transplanting, with the field planting about 4 days later than that in the tunnel (Table 2).. Topping delayed flowering about a week, and 'Mariachi' was about a week later than 'ABC'. Stem length was not affected by the spacings used, nor by topping, but 'ABC' was consistently taller than 'Mariachi', and stem length was also consistently enhanced by growing in the tunnel. The yield of stems was enhanced by the closer spacing in both field and tunnel. By 64 and 79 percent, respectively. Topping doubled yield in the field, and less markedly in the tunnel. The ABC variety was significantly lower yielding that Mariachi in the field, but the yield order was reversed in the tunnel.

Table 2: Effect of spacing, topping in the seedling stage and variety on the time of flowering, stem length and the number of stems produced per unit area, in two trials conducted in the field and in the high tunnel in 2015.

Treatments	Flower date, DATP		Stem length, cm		Stems/ft^2	
Spacing	Field	Tunnel	Field	Tunnel	Field	Tunnel
9 x 9 in.	70	66	49	56	5.0	5.4
6 x 6 in.	71	67	50	61	8.2	9.5
Stat. sig.	ns	ns	ns	*	*	*
Topping						
None	67	62	50	58	4.4	6.3
Topped	74	70	50	60	8.8	8.6
Stat. sig.	***	***	ns	ns	***	***
Variety						
ABC	67	60	52	60	5.7	8.1
Mariachi	74	72	48	57	7.4	6.9
Stat. sig.	***	***	***	**	***	**

In both field and tunnel, topping of plants grown at close spacing gave an additional boost in yield compared to the un-topped plants (Table 3). Unlike in 2014, the incidence of stems with only one flower was low, and not increased by the combination of close spacing and topping.

Table 3. Influence of spacing and removal of the main growing point in the seedling stage (topping) on yield of flowering stems per unit area in both field and high tunnel.

Treatments	Stems per ft^2	
Spacing x topping	Field	Tunnel
9 x 9, control	3.8	4.9
6 x 6, control	6.2	6.0
9 x 9, topped	5.0	7.7
6 x 6, topped	11.4	11.4
Interaction significance	**	**

The results of these trials confirm the findings of 2014, that close spacing and plant topping can be combined to more than double yields, without adversely affecting stem length. These stems from crowded, topped plants bore fewer flowers than those produced by growing at wide spacing, but were still of acceptable market quality.

SUNFLOWER TOPPING TRIAL

Removal of the apical meristem from sunflowers in the seedling stage forces production of lower branches, and doubles or triples stem yield. Early topping is difficult to do because the stem nodes are close together, so later topping would be easier. The current trial was conducted to determine the influence of late topping on yield and stem length, comparing four varieties.

Materials and Methods: Treatments consisted of pruning at either the 6 or the 10-leaf stage, compared to a control that was not topped. Four varieties were used: Procut Lemon, Procut Gold and Sunrich Orange, all with a strong tendency to produce single stems, and Goldrush, a branching variety. Plots consisted of 24 plants spaced 9 x 9 in. apart in four rows, and three replications. Treatment design was

a split plot, with topping treatments as main plots and varieties as subplots. Seeds were sown in the greenhouse in 72-cell trays on May 20, and transplanted June 10. The early pinching treatment was done on June 19 and 22; the late one on June 27, using hand pruners.

Results and Discussion: The overall effects of topping were similar to those found in previous years, but varied reactions of the varieties used produced significant topping by variety interactions. In general, topping reduced stem length, and late topping resulted in shortest stems (Table 4). Similarly, flower diameter also was incrementally reduced by topping. Topping delayed flowering about a week no matter when it was done.

'Sunrich Orange' was about 10 days later in flowering date than the other 3 varieties, and also had longer stems and larger flowers. The reaction to topping with regard to stem yield differed among the varieties (Table 5). The branching variety Goldrush produced significantly more stems when topped at both times than the other three varieties, which showed a decrease in stem numbers after the late topping. This was paralleled with the decrease in flower diameter, which was less marked for 'Goldrush' than the single-stem varieties. Late topping was detrimental to yield of stems and to flower size in the single-stem varieties and should be avoided.

Table 4. The reaction of four sunflower varieties to removal of the stem apex at either the 6- or 10-leaf stage on stem length, flower size and days to flowering.

Treatments		Stem length, cm	Flower diameter, cm	Days to flower
Topping	None	142	7.8	63
	6-leaf	86	4.8	69
	10-leaf	59	4.0	71
Statistical significance		***	***	***
Varieties	Procut Lemon	83	5.3	65
	Procut Gold	97	5.5	67
	Sunrich Orange	107	6.5	76
	Goldrush	95	4.8	64
Statistical significance		***	***	***
Interaction significance		***	***	**

Table 5. The interaction of the time of topping and variety on yield of stems and flower diameter.

	Yield, stems/plant			Flower dia., cm		
Topping	None	6-leaf	10-leaf	None	6-leaf	10-leaf
Procut Lemon	1.0	2.8	2.3	8.0	4.4	3.5
Procut Gold	1.0	3.3	1.0	8.1	4.4	3.9
Sunrich Orange	1.0	3.2	1.7	9.2	5.9	4.5
Goldrush	1.0	4.7	5.6	5.9	4.3	4.1
Interact. sign.		***			***	

SUNFLOWER PHOTOPERIOD REACTION TRIAL

Some sunflower varieties used as cut flowers are sensitive to the daylength they experience in the seedling stage. This can significantly influence the flowering date, height and flower size produced by these varieties. Since 2006, we have tested new varieties for reaction to daylength, and in 2015, we similarly tested nine more.

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 in a greenhouse, either at a 12-hour daylength as controlled by a mechanical blackout curtain, or in another part of the same bench in which daylength was extended with artificial light to 16 hrs. 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. Due to space restrictions on the greenhouse daylength bench, the two reps of the 19-variety trial were planted sequentially. The first planting was sown on May 15 and transplanted to the field on June 8; the second replication was sown June 10 and transplanted July 6. As in previous trials, 'Procut Lemon' was planted as a daylength neutral control, and 'Sunrich Orange' as a short-day sensitive standard variety. Data on plant and main stem flower head characteristics were taken at anthesis of each flower.

Results and Discussion: This year's tested varieties were mostly daylength neutral, with only two short day lines, and one classed as long-day. The varieties contributed by Seedsense had all been tested in previous years, and were classed as day-neutral, except for Procut Red, which in 2014 had a slight long-day reaction, and was classed as day-neutral in 2011.

Table 6. Daylength reaction of sunflower varieties as indicated by time to flowering and plant height at flowering. Short (12 hours) and long (16 hours) daylength were imposed on seedlings during the first 3 weeks after emergence in seedling trays in a greenhouse, and plants were then transplanted to the field.

Name (Source)	Daylength reaction	Days to first flower		Plant height	
		Short day	Long day	Short day	Long day
Helios Flame (Harris)	Short-day	55	64	122	153
Procut Brilliance (SeedSense)	Neutral	60	60	117	112
Procut Gold	Neutral	61	59	128	122
Procut Red	Neutral	68	70	164	157
Starburst Greenburst	Long-day	72	64	163	125
Starburst Panache	Neutral	65	64	142	126
Red Hedge (Johnny's)	Neutral	61	60	101	99
Jade	Neutral	66	60	126	109
Zebulon	Neutral	68	66	100	96
Procut Lemon	Neutral	60	58	95	101
Sunrich Orange	Short-day	52	70	73	138

As in previous years, daylength sensitivity affected not only the time of flowering, but also other plant attributes (Table 7). When given the seedling daylength treatment to which they were susceptible, the plants had a shorter stature at flowering, had smaller flowers, and showed an increased number of flower buds. Daylength reaction of sunflower varieties is thus an important characteristic to know, especially if the seedling growth period falls outside 'normal' periods, such as an early production in spring, or under winter conditions in lower latitudes such as Florida.

Table 7. Summary table of three 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	No. of varieties	Days to first flower		Flower diameter, cm		Bud no.	
		Short day	Long day	Short day	Long day	Short day	Long day
Short day	2	54	67	4.1	7.8	2.4	0.2
Day-neutral	8	64	62	6.0	6.1	0.7	0.8
Long day	1	72	64	8.7	7.3	0.3	2.0

A summary table on the reaction to daylength of all the varieties tested since we started to screen in 2006 can be found at my research page of the Horticulture Section faculty pages: (http://hort.cals.cornell.edu/sites/hort.cals.cornell.edu/files/shared/documents/Daylength-response-of-sunflowers.pdf). More details of the screening program's results through 2012 have recently been published in: HortTech. 24(5):575-579, 2014.

The description and images of the new varieties is taken from plants given the long-day treatment, a condition closest to that faced by plants grown in our summer season.

Helios Flame: A moderately branching variety with bicolor flowers and dark disk. With short days pretreatment, plants flowered 9 days earlier, and had increased branching. Variety shows promise, but needs to be checked for petal loss susceptibility common to other varieties with similar flower color.

Procut Brilliance: A standard midseason orange single stem cultivar, productive and uniform, and insensitive to daylength.

Procut Gold: Single stem cultivar with orange petals and greenish-yellow disk. Daylength-insensitive.

Procut Red: A tall, late, single stem variety with dark red petals and disk. Petals tend to drop after 5 to 6 days in the vase.

Starburst Greenburst: A branching variety with sturdy stem, flowering earlier under long day conditions. Semi-double flower with light orange pointed petals, merging to a green center. Attractive.

Starburst Panache: Similar in stature and size to 'Starburst Greenburst' except for a lack of daylength sensitivity. Flower has innermost petals dark. Attractive.

Red Hedge: A short, heavily branched variety with small dark red flowers. Branches precocious and obscuring the main flower. Very susceptible to lower leaf spot disease (likely *Septoria helianthi*)). Not promising.

Jade: A relatively short, thin-stemmed branching variety with small flowers and striking light green petals and disks. Attractive in the vase but may be too delicate to ship.

Zebulon: A short branchless variety with long yellow petals and a yellow-green disk. Long petals susceptible to bruising.


HELIOS FLAME


PROCUT GOLD


STARBURST
GREENBURST


STARBURST PANACHE


RED HEDGE


JADE

SNAPDRAGON OVERWINTER EXPERIMENT

A preliminary report of this experiment was published in the Summer 2015 issue of the ASCFG Cut Flower Quarterly:

SNAPS AGAIN

H. Chris Wien, Horticulture Section, Cornell University, Ithaca, NY 14853

A year ago, I reported the successful overwintering of snapdragon varieties in our high tunnel (Zone 5b). To make sure that this was not a peculiarity of our winter season, we did it again, and after a tougher winter (January through March temperatures averaged 17 F, 10 degrees below the long-term average for this site), I feel confident that this is a good way of getting a jump on the spring cut flower season with this crop, thus getting two crops from one planting.

We sowed the seed of two varieties Supreme Light Lavender and Maryland White in the greenhouse on June 3 and July 3, 2014, and transplanted them to the tunnel about 5 weeks later. The plants were spaced 9 x 9 in. in 4 rows per bed, and pinched at transplanting. They produced a good harvest in the fall, and were then either left unprotected in the tunnel over winter, or covered with a low cover of spun-bonded material. The covers were removed in late April, and we started harvesting in mid-May, about a month before new transplants in the tunnel would come into flower.

The results, after 3 weeks of spring harvest, are interesting and encouraging. As indicated in the table, winter survival depended most on having a low cover over the plants. There were also significant varietal differences in survival, with Supreme Light Lavender having nearly twice as many plants re-sprout in spring than Maryland White.

Table 1. Winter survival and early yield per unit area in spring of two snapdragon varieties sown in early June and July, 2014. Plants were either left uncovered over winter, or protected by a low tunnel cover from November to April.

Low tunnel cover	Variety	Winter survival, %	Yield of stems per ft^2
None	Maryland White	22	0.2
None	Supreme Light Lavender	69	2.0
Covered	Maryland White	60	4.8
Covered	Supreme Light Lavender	90	6.8
Stat. sign.	Cover	**	**
	Variety	***	**
	Interaction	ns	ns

Yields in the fall were 12 and 15 stems per ft^2 for Maryland White and Supreme L.L., respectively. Early yields in spring depended on survival, obviously, and are shown in the table. If they follow the pattern of the previous year's trial, we expect them to be about two-thirds of fall yields.

There was a trend for winter survival and yield to be better for the later planting, but neither were statistically significant. Taken together, the results of the 2013 and 2014 trials encourage summer planting of snapdragons in high tunnels, and with protection by low tunnels over winter, taking advantage of the additional early yield the following spring. Give it a try! For the results of last year's overwinter trial, see the summer 2014 issue of the Quarterly, or look for my annual report in the Cornell Horticulture website.

Acknowledgements: I am grateful for the excellent help of my assistants, Priscilla Thompson, Anna Enockson and Emily Burrister. Financial assistance by Federal Hatch funds made possible this work.

Fig. 1. 'Maryland White' (in foreground) and 'Supreme Light Lavender' snapdragon, in fall 2014. Picture taken Sept. 29, 2014.

Additional Results: Harvest in 2015 was concluded on July 13, not because the plants had stopped growing and producing flowering stems, but because the pressure of work from other trials forced the termination. Yields in the 2015 season depended largely on the survival of plants over the winter (Table 8). Survival was markedly improved by the additional protection afforded by the low tunnel. 'Supreme Light Lavender' proved to be more winter-hardy than 'Maryland White'. Yield per plant was only improved with low tunnel protection, but since yield per unit area also depended on

winter survival, slightly higher yield was obtained from the later planting date and with 'Supreme Light Lavender'. Low tunnel protection resulted in a doubling of yield per ft^2.

Table 8. Survival and yield of two snapdragon varieties planted in the high tunnel in summer 2014. Yield shown only for the 2015 harvests.

Treatment		Survival, %	Stems/plant	Stems/ft^2	Stem length, cm
Planting date	June 3	53	15.0	13.8	47
	July 3	68	13.9	17.9	46
	Stat. signif.	ns	ns	*	ns
Low tunnel	No	46	12.7	10.5	47
	Yes	75	16.2	21.3	46
	Stat. signif.	**	**	**	ns
Variety	Maryland	40	14.6	11.3	48
	Supreme LL	80	14.3	20.5	45
	Stat. signif.	**	ns	**	*

A comparison of the 2014 and 2015 harvest seasons showed that stem length was slightly longer in the fall (Table 9), and 'Maryland White' had consistently longer stems in both seasons. 'Maryland White' yielded more per unit area than 'Supreme Light Lavender' in the fall, but the trend was reversed due to better winter survival of 'Supreme' in the spring, resulting in better overall yield for the latter. The results confirm those of the previous snapdragon overwinter experiment that summer planting of this crop in a high tunnel can result in productive fall and early spring harvest seasons. Protecting the plants over winter with a low tunnel aids plant survival and boosts spring yields.

Table 9. Stem length and yield of two snapdragon varieties in 2014 and after overwintering, in 2015.

Planting date	Variety	Stem length, cm		Stems/ft^2		
		2014	2015	2014	2015	Total
June 3	Maryland	55	48	18.5	8.4	26.9
	Supreme LL	49	45	14.9	19.4	34.3
July 3	Maryland	57	48	11.0	14.2	25.2
	Supreme LL	52	44	8.6	21.7	30.3
Stat. signif.	Date	ns	ns	ns	*	
	Variety	***	*	***	**	
Interact. signif.		ns	ns	ns	ns	

COMPOST TRIALS

The problems encountered with high pH conditions in our field in 2014 due to yearly use of alkaline dairy manure compost generated a series of experiments to determine the impact of high pH and of the compost in growth of several cut flowers. Initially, we attempted to increase medium pH by addition of varying levels of powdered limestone to Cornell artificial soil mix in a greenhouse experiment. Despite addition of four times the normal lime level, the medium pH did not rise beyond pH 7 in a month. We

abandoned that approach and then conducted pot experiments using various levels of the high pH compost, and monitoring growth of flower seedlings in the greenhouse. This was followed by several field experiments in areas of our cut flower field where compost had been applied, or not. The results of these efforts point out the stability of the soil system.

1. FOUR SPECIES POT EXPERIMENT

Materials and Methods: Seeds were started in 128-cell trays in the greenhouse on March 9, and placed in a 55 F greenhouse for germination and emergence. The plants included were snapdragon Maryland Red, Larkspur Cannes Mix, Campanula Champion Pro White and Dianthus Amazon Neon Duo. There were 5 pots per treatment. On May 1, plants were transplanted to 4 in. pots, which had been filled with Cornell mix, or Cornell mix and 10, 25, 50 or 100% compost that had been sieved to pass a ¼ in. mesh screen. Plants were grown in a 60 F greenhouse, and their height measured at weekly intervals until flowering.

Results and Discussion: Addition of compost to the Cornell mix had significant effects on medium pH, but not on conductivity (Table 10). Plant growth was negatively affected only at the higher compost levels in the medium (Figs. 3 and 4). The four species reacted similarly to the treatments, with none showing a greater growth reduction with increased compost levels. At the highest compost levels, seedlings exhibited chlorotic upper leaves and discolored, paler flowers.

Table 10. Soil acidity and conductivity of soil media containing artificial soil mix containing various levels of compost, used in a greenhouse pot study. Measurements made on June 3 using a pour-through method, with 10 samples per measurement.

Compost %	Medium pH	Conductivity, mS
0	7.03	0.82
10	7.00	1.22
25	7.52	1.47
50	7.78	1.31
100	8.18	1.54

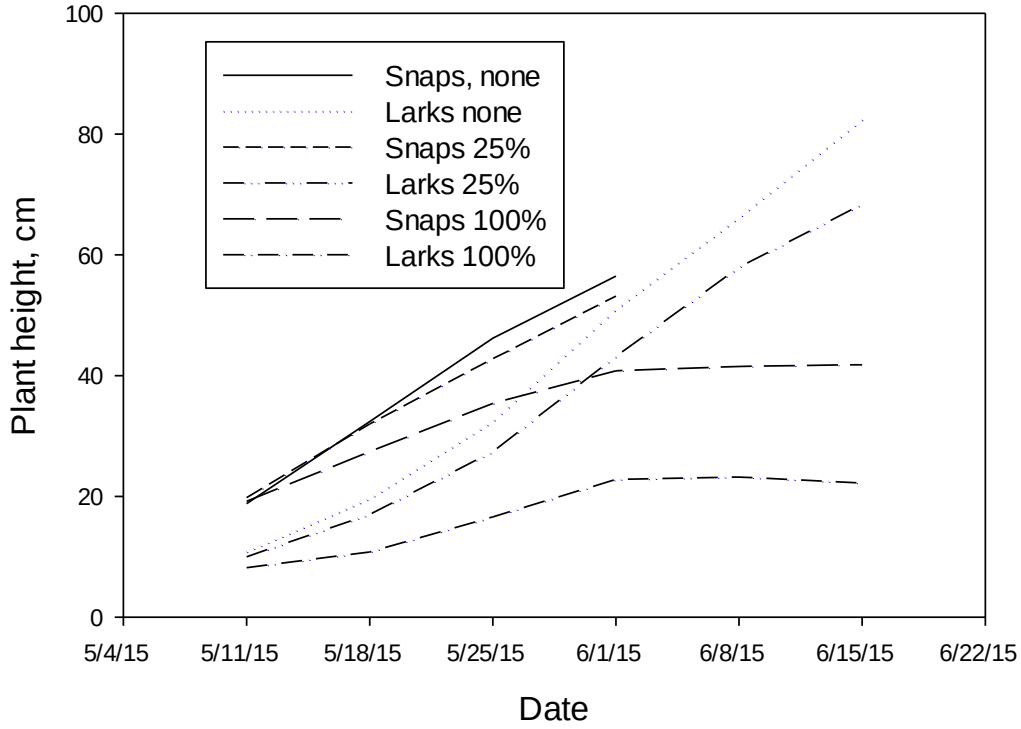


Fig. 3. Increase in plant height over time for snapdragon and larkspur grown in 4 in. pots in the greenhouse in 0, 25% or 100% compost.

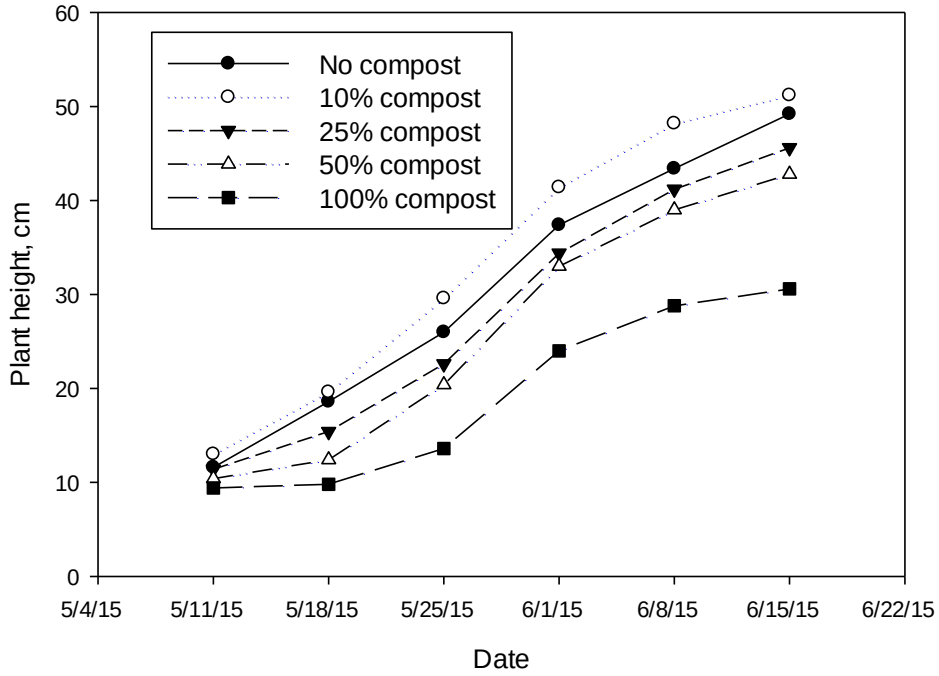


Fig. 4. Plant height increase of potted Campanula seedlings growing in the greenhouse in various levels of compost.

2. FOUR SPECIES FIELD EXPERIMENT

The reduction in plant growth by the four species grown in pots suggested that a field experiment in the area where problems occurred last year was advisable. Areas in the field existed which had had differential compost additions over the years.

Materials and Methods: For the differential compost treatments we chose one bed that had had no compost additions, one in which compost had been added yearly except in 2015, and which had been treated with sulfur (see General Materials and Methods), and one in which compost was applied yearly and in 2015, and that had not been treated with sulfur. Surplus seedlings from the species pot experiment described above were transplanted to these blocks, with a 9 in. spacing and 16 plants per subplot. In each block there were 3 replications. Plants were harvested at anthesis, and stem length was measured at that time.

Results and Discussion: The soil pH in the beds used in this comparison showed very little difference (Table 11). Given the finding that compost levels of 50% or higher were needed to influence growth significantly in the pot experiment, it is not surprising that few differences in growth and yield were apparent in this field trial (Table 12). Stem lengths hardly varied among the beds. Stem yields of larkspur, campanula and dianthus were better for the bed that had received compost in every year except in 2015, perhaps in part due to the soil's higher organic matter content.

Table 11. Soil reaction in the three beds used in the field experiments, varying in amount and frequency of compost addition. Soil pH was measured in July 1, 2015.

Compost	Soil pH	Organic matter, %
None	6.9	4.3
Up to 2015	6.6	5.4
Yearly	6.9	5.0

Table 12. Growth, yield and flowering date of four cut flower species growing in three area differing in the amount and frequency of compost application in the field.

Species	Stem length, cm			Stems/plant			First flower date		
Compost	None	Not this year	Yearly	None	Not this year	Yearly	None	Not the year	Yearly
Snaps	52	51	50	31	24	20	6/11	6/5	6/10
Larks.	42	42	34	6	14	4	6/29	6/21	6/26
Campan.	21	24	22	3	8	2	6/15	6/15	6/16
Dianthus	37	43	38	13	16	12	7/12	7/10	7/16

3. DELPHINIUM POT TRIAL 1

Over several years, we have been investigating the reason for the poor longevity of the perennial cut flower, delphinium, and the varietal differences in plant duration in the field. Aside from strong varietal differences, no soil or plant treatments tried seemed to affect this trait. The symptoms of the early die-back resembled an iron deficiency, with light green leaves appearing at the top of the canopy, and since iron is known to be unavailable to plants at high pH, it seemed logical to link the delphinium die-back to the high pH problem. We thus conducted a pot trial with different levels of compost.

Materials and Methods: Seeds of delphinium varieties Guardian Blue, Candles Blue Shades and Centurion Gentian Blue were sown in the greenhouse March 9 in 98-cell trays. In mid-April, the seedlings were transplanted to 4 in. pots in Cornell mix, or mix containing 10, 25, 50 or 100% compost. Pots were placed in the 60 F house and heights measured weekly until flowering.

Results and Discussion: As with the species pot trial described above, increasing proportions of compost in the mix reduced growth at the highest rates (Fig. 5). The growth rates of 'Candles' were similar to 'Guardian', but 'Centurion' grew more slowly, and flowered significantly later than the other 2 varieties (Fig. 6). It was difficult to determine a difference in varietal reaction to the compost rates, aside from the differences in stem extension rate that accompany flowering. Soil pH and conductivity readings were taken in late June and showed a decrease in pH compared to that measured in early June in the species pot experiment (Table 13). As in the previous sampling, conductivity did not vary with the proportion of compost in the mix.

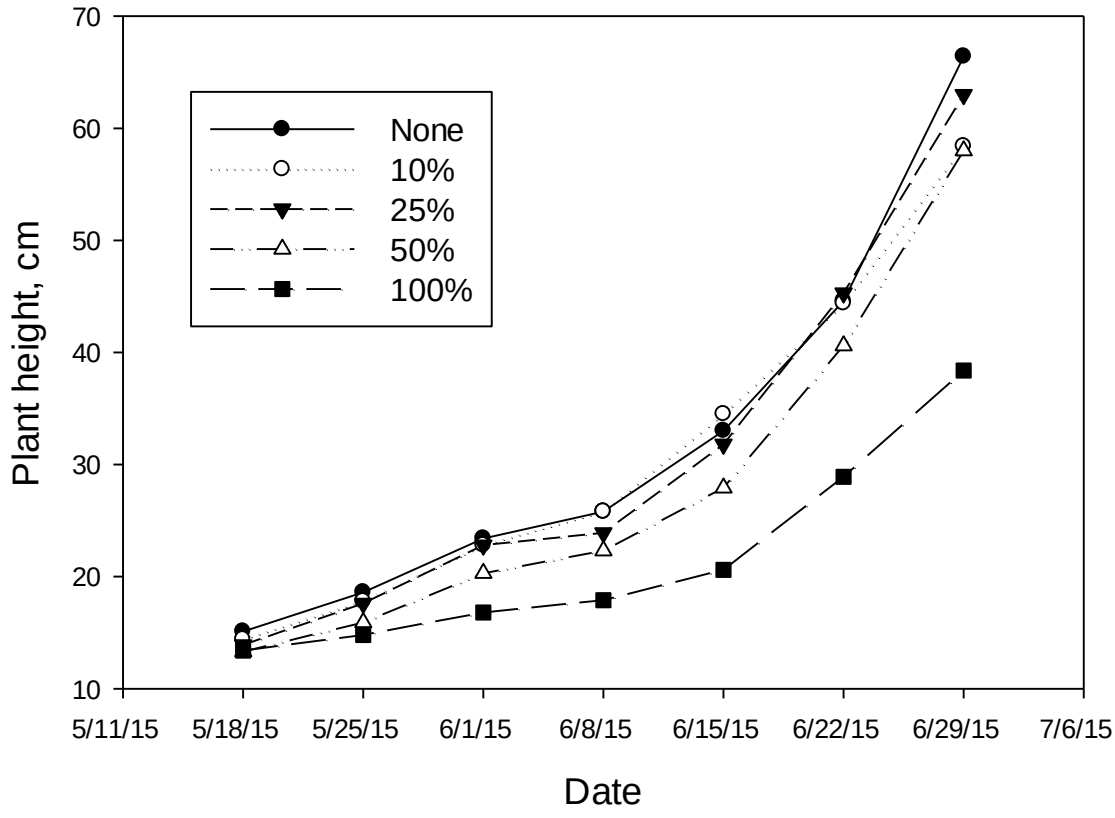


Fig. 5. Height growth of 'Guardian Blue' delphinium seedlings in pots with various levels of compost

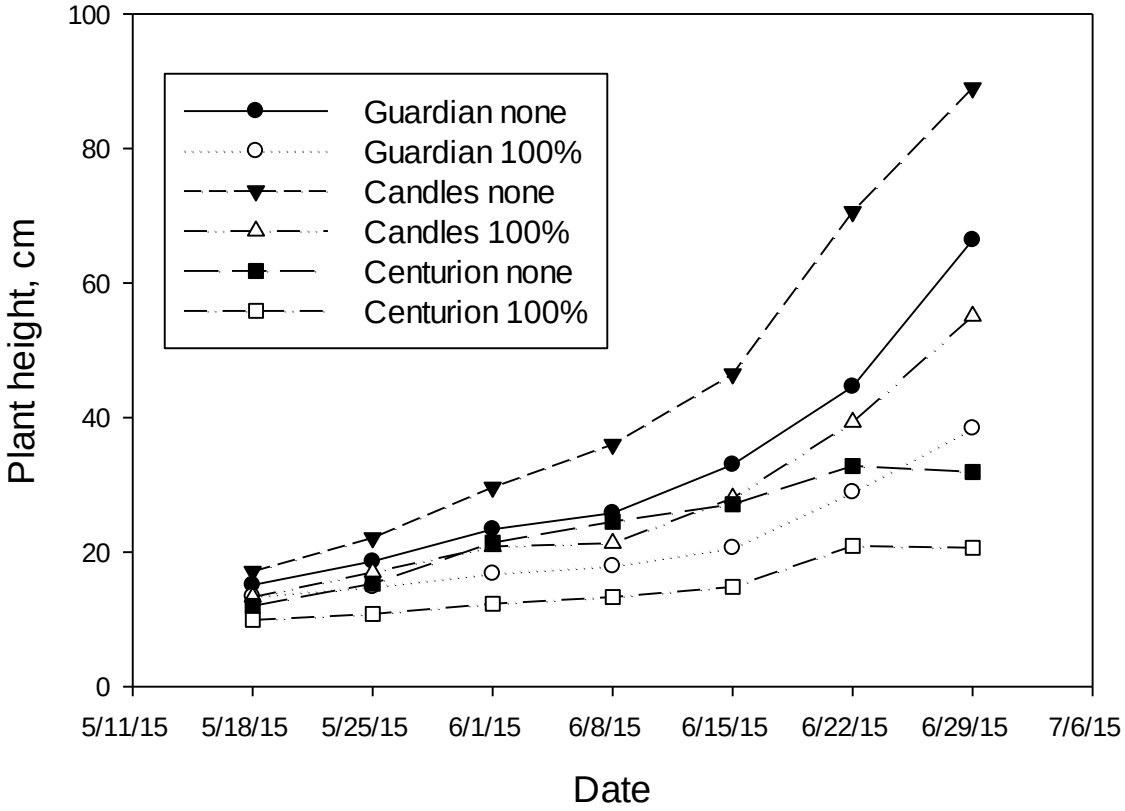


Fig. 6. Growth in height of three varieties of delphinium seedlings grown in pots in the greenhouse without compost or in 100% compost.

Table 13. Soil acidity and conductivity of soil media containing various levels of compost, used in a greenhouse pot study with delphinium. Measurements made on June 29 using a pour-through method, with 8 samples per measurement.

Compost %	Medium pH	Conductivity, mS
0	6.30	1.63
10	6.66	0.74
25	6.60	1.13
50	6.73	1.07
100	7.72	1.46

4. DELPHINIUM POT TRIAL 2

A repetition of the first experiment was conducted with the same three varieties, and an additional one: Magic Fountain Lavender White Bee. Surplus seedlings from the field experiment described below were

planted in 4 in. pots on June 25 and placed in the 60 F greenhouse. The same compost treatments were used, with 6 plants per treatment.

Results and Discussion: The growth of delphinium was similar to that in the previous experiment, and to growth of the four species (Table 14). Again, growth of 'Centurion' lagged behind while 'Magic Fountain' had growth rates similar to 'Guardian'. Again, no obvious varietal differences in reaction to the compost occurred.

Table 14. Height of delphinium seedlings in a greenhouse pot experiment growing in various levels of compost. Height measurements were taken on Aug. 7, and are averages of 6 plants.

	Varieties			
Compost level, %	Guardian	Candles	Centurion	Magic Fountain
0	37	52	15	29
10	29	47	24	34
25	36	45	23	32
50	40	48	20	26
100	24	35	9	13

5. DELPHINIUM FIELD TRIALS

Using the same field beds as for the Four Species Field Trial, we planted seedlings of the three varieties used in the pot experiments and observed growth, yield and plant survival. In the first planting, 'Guardian', 'Candles' and 'Centurion' were transplanted in 2 replications at a 12 x 12 in. spacing using 6 seedlings per plot for 'Guardian', and 9 seedlings for the other 2 varieties. The trial was transplanted May 27, and flower harvests continued until the end of the season. In the second trial, surplus seedlings from the 4-variety pot experiment conducted in the greenhouse were planted to the field beds on June 15, using 9 plants per plot and 3 replications. Flower harvest was continued until the end of the season.

Results and Discussion: Varietal differences were significant in stem length and in survival in the two experiments (Tables 15, 16). 'Guardian' and 'Candles' had significantly shorter stems at flowering in both experiments than the later-flowering 'Centurion'. The latter also showed a higher survival rate in both experiments than the other varieties.

Since the effects of the compost additions were unreplicated, differences in stem length, yield and survival would have to be dramatic to be convincing. None of the results suggest that there was an effect of compost levels. Given the small difference in pH and organic matter in the three blocks, as indicated by the soil tests (Table 11), such lack of difference in plant performance is not surprising.

Table 15. Effect of frequency and timing of compost addition to flower yield and survival of three delphinium varieties in a field experiment transplanted May 27.

Varieties	Stem length, cm			Stems/plant			Survival, %		
Compost	None	Not this year	Yearly	None	Not this year	Yearly	None	Not the year	Yearly
Guardian	49	50	45	5.6	5.8	4.5	83	100	83
Candles	48	51	48	4.2	6.4	6.3	89	89	44
Centurion	77	72	66	3.6	4.4	3.8	100	94	94

Table 16. Effect of frequency and timing of compost addition to flower yield and survival of four delphinium varieties in a field experiment transplanted June 15.

Varieties	Stem length, cm			Stems/plant			Survival, %		
Compost	None	Not this year	Yearly	None	Not this year	Yearly	None	Not the year	Yearly
Guardian	40	35	42	2.1	2.6	3.5	74	63	60
Candles	44	48	45	2.6	3.1	3.0	71	74	82
Centurion	69	69	64	2.7	3.9	3.3	93	89	96
Magic Fountain	41	39	44	2.2	2.3	2.9	67	70	67
Stat. sign.	**	***	***	ns	ns	ns	ns	ns	**

Taken together, the results of the pot and field experiments carried out with the five species of cut flowers all indicate that the addition of compost to the field is only detrimental to plant growth at high levels of compost. At more moderate levels, compost has beneficial effects on plant performance.

The differences in longevity of delphinium cultivars that we have noted over the years were again evident in the field experiments, but the lack of differences among soil conditions in the plots made it hard to ascribe a cause. It would be worthwhile to grow delphinium varieties contrasting in longevity at different soil pH's to test a possible link.

ORNAMENTAL CABBAGE SEEDLING MANAGEMENT TRIAL

The cut flower varieties of ornamental cabbage are normally grown in summer for a fall harvest, and are meant to produce stems of 30 to 50 cm length, and a head diameter of not more than 10 cm. This requires high density planting of the seedlings and support in the field by netting. In past variety trials it has been difficult to produce the seedlings in trays and to harden them off sufficiently so that they will have adequate stem strength. The current trial experimented with direct seeding in the field, and raising the seedlings in small cells for early transplanting with multiple seedlings per stand. Our objective was to produce two good seedlings per stand at a 6 x 6 in. spacing in the field.

Materials and Methods: Treatments consisted of either sowing seed directly in the field, or sowing in transplant trays of either 288-cell or 98-cell count in the greenhouse and later transplanting. Spacing for all treatments was 6 x 6 in. with 5 rows per bed. In the 288-cell tray, one seed was sown per cell; in the

98-cell tray, 2 seedlings per cell were left at transplanting. All treatments resulted in a final density of 2 plants in every 6 in. square. Seeds were sown in field and greenhouse on June 24, and the transplants put in the field July 13. There were two replications of 30 hills per plot. The varieties Lucir Rose and Crane Bicolor were compared, as subplots in the split plot experiment. Plots were netted with Horta Nova netting of 6 in. cell size. Plants were harvested in early October, and stem length and the diameter of the colored area at the top of the plant measured (termed flower diameter).

Results and Discussion: Plants grew well and had good stands. The netting provided adequate support so that stems were straight at harvest. Differences among seedling treatments were slight, with similar stem lengths, yields and 'flower' diameters produced no matter if seedlings were direct-seeded or transplanted (Table 17). 'Lucir' produced consistently shorter stems but with a larger colored area than 'Crane'. With the relatively late advent of cool conditions, 'Crane' was delayed in coloring.

Table 17. Effect of seedling treatments and varieties on stem length, stem yield per unit area and the diameter of the colored area at the top of the plant at harvest for ornamental cabbage grown in the field.

Treatments	Varieties	Stem length, cm	Stems/ft^2	'Flower' dia., cm
Direct seeded	Lucir	68	6.8	8.7
	Crane	83	6.0	4.2
Small cell	Lucir	60	6.2	8.0
	Crane	78	5.8	4.4
Large cell	Lucir	63	6.6	8.2
	Crane	82	6.0	4.2

The results of this experiment indicate that ornamental cabbage can be successfully direct-seeded, thereby avoiding the use of soft transplants that wilt in the field and produce crooked stems. Additional work is needed to determine possible spacings and plant arrangements when direct-seeding that would produce the desirable small-headed plants at maturity. The trial also shows that raising the seedlings in trays of small cell size forces transplanting before the seedlings can get soft and leggy, and may thus be an alternative approach to the problem of ornamental cabbage establishment.

ORNAMENTAL PEPPER VARIETY TRIAL

Plant introductions of *Capsicum baccatum* have shown to be promising as ornamental cut stems for fall harvest with fruits attached. Some lines maintain leaf turgidity in the vase, and most grow tall and produce many stems. The current experiment was an additional look at this promising crop.

Materials and Methods: Seeds of eight C. baccatum lines and one C. annuum variety were sown in 98-cell trays on March 31 and transplanted to the field on May 25. Field spacing was 18 in. in both directions, with 2 rows per bed, and 18 plants per plot and 2 replications. Three plants per plot were harvested in mid-October when the pods had colored and were attractive, and the stem lengths measured. In early October a hydration test evaluated the degree to which leaves stayed turgid on harvested stems, using 3 stems per vase in two replications. Vase solutions were either tap water or a 30-min. hydration treatment in a commercial hydration solution, followed by water. The cut stems were

kept in fluctuating temperature averaging 60 F, with an 8-hour daylength treatment with low intensity tungsten bulb in the windowless storage room.

Results and Discussion: The results of this trial confirmed the findings of the previous years. The *C. baccatum* lines were productive and attractive, averaging from 9 to 23 stems of more than a meter length (Table 18). The postharvest storage of the cut stems showed similar results to the study conducted in 2014. PI's 441525, 441542, 441552,441575 and 441530-1 stayed well hydrated in the vase for two weeks (Table 19). Of these, PI's 441542, 441575 and 441530-1 were easy to defoliate at the end of the two week storage period. Overall, use of a hydration solution pretreatment reduced wilting of some lines, but had no effect on the degree of leaf loss. The single *C. annuum* line (Black Pearl) included in the trial also performed well in maintaining turgidity in the vase and having leaves that were easy to remove after 2 weeks. With its shorter branch length, it is tempting to attempt crosses between the two species to remedy that fault.

Table 18. Stem length and yield of eight *C. baccatum* accessions and one *C. annuum* variety, harvested in mid-October. Averages of 3 plants from each of 2 replications.

Line or variety	Stem length, cm	Stems per plant
PI 159252	92	23
PI 441525	108	16
PI 441542	106	18
PI 441552	116	14
PI 441572	97	16
PI 441575	101	18
PI 441530-1	133	15
PI 441530-2	103	9
Black Pearl	58	15

Table 19. The tendency of cut stems to wilt and the leaf removal ease after one and two weeks of storage in the vase at room temperature of 8 pepper lines and one variety. Stems were either kept in a hydration solution for 30 min. or only in water.

Line or variety	Wilt rating[Z]				Leaf removal rating[Y]			
Hydration?	Yes		No		Yes		No	
Storage, weeks	1	2	1	2	1	2	1	2
PI 159252	5	3	4	2	1	2.5	2	2.5
PI 441525	5	4	5	3	1	2.5	1	2.5
PI 441542	5	5	5	5	1	3.5	1	3.5
PI 441552	4	4	4	2	1	1	3	1
PI 441572	5	2	5	1.5	2.5	4	2.5	4
PI 441575	5	4.5	5	3	4.5	4.5	4.5	5
PI 441530-1	5	5	5	3	2.5	4	4.5	4.5
PI 441530-2	3	2	3	2.5	2	3	4	3.5
Black Pearl	5	3	5	3.5	1	4	1	3.5

[Z] Wilt rating: 1= completely wilted, 5= fully turgid [Y] Leaf removal rating: 1= leaves attached, 5= most leaves detached and removed easily


PI 159252


PI 441542


PI 441525


PI 441572


PI 441552


PI 441575


BLACK PEAR


PI 441530-1


PI 441530-2

CUT FLOWER VARIETY TRIALS

The trials conducted in 2015 were partly to take a fresh look at species we had not trialed in recent years, and in part to participate in the ASCFG variety trials. Unless otherwise stated, these were grown in two replications.

AGERATUM

Materials and Methods: Seeds were sown in 98-cell trays in Cornell mix on April 8, and transplanted to the field on May 27. A 12 in. spacing with 3 rows per bed was used.

Results and Discussion: Prolonged cool and rainy weather caused uneven and growth and stunting and yellowing of leaves in early June. As weather warmed, the plants recovered and went on to produce abundantly (Table 20).

Table 20. Stem length, stem yield and days to start of flowering for six ageratum varieties grown in the field in 2015.

Variety name (Source)	Stem length, cm	Stems/plant	First flower date, DAS
Blue Horizon (Geo)	36	26	77
Dondo White	48	44	73
Everest Blue	40	31	75
Red Flint	42	43	75
Red Sea	42	43	73
Timeless Rose	44	51	72

Blue Horizon: The industry standard, with sturdy, medium length stems but relatively low productivity. It has a striking bright medium blue flower color.
Dondo White: With longest stems in the trial, good stem strength and high productivity make this a promising variety.
Everest Blue: Somewhat taller than 'Blue Horizon', slightly higher yield but its flower color is not as bright.
Red Flint: Many thin stems with a tendency to sprawl. Flower color reddish-purple.
Red Sea: Similar to 'Red Flint' in all aspects.
Timeless Rose: Sturdy, erect stems, productive and promising.


BLUE HORIZON


DONDO WHITE


EVEREST BLUE


TIMELESS ROS


RED SEA


RED FLINT

ALLIUM

Materials and Methods: Six *Allium* species having large bulbs, and five with small bulbs were purchased from John Scheepers, Inc. and planted on Oct. 2, 2013. Those having large bulbs were spaced 12 x 12 in. apart, with 9 bulbs per plot; the small-bulb species were spaced 6 x 6 in. apart, with 24 bulbs in Rep. 1 and 12 in Rep.2, because of space restrictions. Harvest data from the 2014 season is in last year's annual report. The plot was kept weed-free and mulched with wood chips after the 2014 harvest, but no fertilizer was added.

Results and Discussion: After the second winter, 'A. Silver Spring' did not emerge, and *A. azureum* had harvestable stems in only one replication. Several other species also produced less than one stem per plant (Table 21). '*A. amplectens* Graceful Beauty' on the other hand showed increased productivity from 2 stems in 2014 to 3.2 this year. Work is needed on fertility management to assure continued productivity of perennial *Allium*.

Table 21. Stem length, stem yield and flowering dates of 9 Allium species planted in fall 2013 and harvested for the second time in 2015.

Variety name	Stem length, cm	Stems/plant	First flower date
A aflatunense	56	1.3	May 22
A albopilosum	28	0.4	June 6
A jesdianum	73	0.3	May 20
A multibulbosum	58	0.8	June 6
Mount Everest	84	1.4	May 25
Graceful Beauty	25	3.2	June 9
A azureum	41	0.4	June 17
Hair	58	0.8	June 16
A sphaerocephalon	54	1.0	July 8

AMMI

In the 2014 variety trial choice of early and later-flowering varieties made it possible to span most of the summer harvest season. The current trial was conducted to further test this assumption.

Materials and Methods: Five varieties of Ammi and a look-alike (*Trachimene coerulea*) were sown on April 8 and transplanted May 27 at a 12 x 12 in. spacing in the field with 18 plants per plot.

Results and Discussion: Growth was generally good, but the heavy rains in June resulted in a high incidence of root rot in *Trachimene*, especially in the less-well drained part of the field where Rep. 2 was located. 'White Queen Anne's Lace' flowered so early that plants had not made adequate vegetative growth to produce high yields (Table 22).

Table 22. Stem length, stem yield and first flower time for 5 Ammi varieties and for *Trachimene*, planted in the field.

Variety name (Source)	Stem length, cm	Stems/plant	First flower date, DAS
Dara (Johnny's)	50	27	100
Green Mist	46	13	117
Graceland (Gloeckner)	35	33	81
White Queen Anne's Lace	27	13	70
Casablanca	46	15	117
Trachimene (Blue Lace Flower)	35	22	97

Varietal Descriptions:

Dara: An annual line of *Daucus carota* (carrot), this variety produced tall, strong, straight stems and broad flat umbels. Umbel color varied from black to white, with others having black petals and green centers. Harvest duration was about 6 weeks, but later harvest were of short, small stems, so several plantings about a month apart would be advisable. A promising variety.

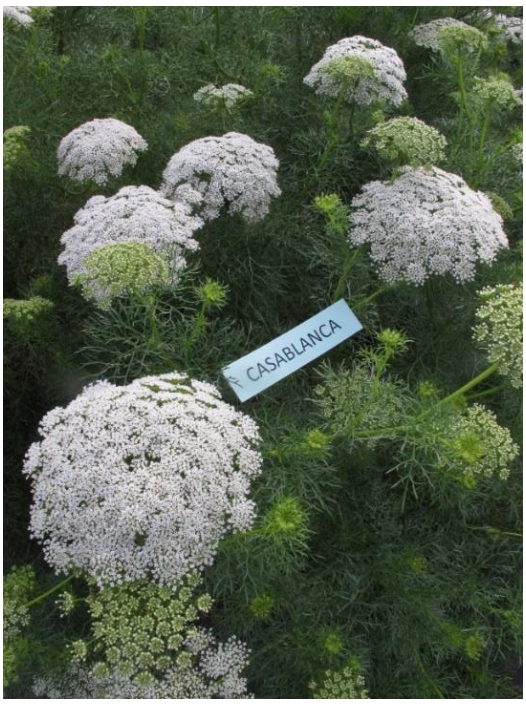
Green Mist: Plants nearly as tall as 'Dara', but stems more branched and angled, so that individual stems tangled easily. Umbels large, light green; late flowering.

Graceland: Medium height, medium early plants with open white umbels. Branched and angled stems make tangles likely. Most productive variety in the trial.

White Queen Anne's Lace: A very early line that began flowering in the seedling tray prior to transplanting. Will need earlier planting to develop its potential.

Casablanca: A twin of 'Green Mist'.

Trachimene (Blue Lace Flower): Although described as a blue Queen Anne's Lace, the flower more nearly resembles Scabiosa in size and appearance. Flower is attractive although stem length is inadequate. Susceptibility to root rot is a major constraint.



ANEMONE/RANUNCULUS

Two years of good results with anemone and ranunculus as an overwintered crop in the high tunnel encouraged us to try varieties from sources other than Gloeckner. Onings (Holland) advertised European lines, so accordingly, we included these in this trial.

Materials and Methods: Planting materials were soaked in room-temperature water overnight on Dec. 2, and then placed in moist vermiculite for 3 weeks in a dark 50 F storage room. Entries were planted in the high tunnel on Dec. 22, with individual plots of 25 seedlings at a 6 in. spacing, with 5 rows per bed. There were 2 replications, and the entire experiment was covered with a low tunnel of Covertan spun-bonded material held up by wire hoops. The low tunnel was kept in place until the end of March.

Results and Discussion: The pre-germination process gives an opportunity to see the health of the planting stock, since roots and shoots should have formed in that period. Anemone varieties 1, 4 and 5 had some non-sprouting corms, as did ranunculus varieties 2, 4 and 7. In the ranunculus, this was reflected in low survival numbers; in anemone low sprouting was not an indication of later stands (Table 23).

The severity of the winter was reflected in the low survival rate of the ranunculus, but also in the low yields, which were less than half those of the previous year (see 2014 annual report). Survival was normal for the anemone in this experiment, but yields were also much lower than in previous years.

Varietal Descriptions:

Ranunculus:

1. **Elegance Bianco 59-99:** Sparse foliage, low vigor, white flowers. Plants senesced early.
2. **Elegance Bianco Festival:** Crop failure.
3. **Elegance Bianco Striato:** Moderate stand. Flowers white, with black rim and stripes, attractive.
4. **Elegance Bianco Sfumato:** Crop failure.
5. **Elegance Giallo 99-1:** Low vigor, flowers yellow, small.
6. **Elegance Rosso 232-03:** Medium vigor, dark red flowers, some flecked with white.
7. **Elegance Viola 06:** Low vigor plants, dark violet flowers.
8. **Ponpon Aurora:** Best stand of Ranunculus varieties in trial; very vigorous and high yielding; unusual flower color, with older flowers looking bleached.
9. **Amadine Orange Picotee:** Standard line, moderate stand, flowers yellow to dark orange.

Anemone:

1. **Concerto Mix:** Delicate foliage, stems thin and short. Petals single, lanceolate shape, colors vary from tan to dark red. Tends to wilt in vase.
2. **Mistral Magenta/Viola:** Robust and vigorous plants but flower stems short, fat, with dark purple petals.
3. **Mistral Plus Vianco Centro Negro:** Robust, vigorous foliage with thick flower stems. Petals white inside, with purple blush on outside. Dark central disk. Attractive and promising.
4. **Mistral Vinato Wine Red:** Low, delicate foliage, flowers short, not promising.
5. **Galilee Red:** Standard, early, flowers bright red.

Table 23. Stem length at harvest, yield per plant and plant survival of nine ranunculus and five anemone varieties grown over winter of 2014/15 in the high tunnel. All varieties except for the last listed for each species were obtained from Onings (Holland).

Variety name (Source)	Stem length, cm	Stems/plant	Survival, %
RANUNCULUS			
1. Elegance Bianco 59-99	30	0.7	60
2. E. Bianco Festival	24	0.6	10
3. E. Bianco Striato	29	1.5	58
4. E. Bianco Sfumato	30	1.0	20
5. E. Giallo 99-1	30	1.2	62
6. E. Rosso 232-03	31	1.6	70
7. E. Viola 06	30	1.4	44
8. Ponpon Aurora	34	3.1	82
9. Amadine Orange Picotee (Gloeckner)	28	2.1	34
ANEMONE			
1. Concerto Mix	20	1.6	86
2. Mistral Magenta /Viola	19	1.5	100
3. Mistral Plus Vianco Centro Negro	22	2.4	92
4. Mistral Vinato Wine Red	16	1.1	84
5. Galilee Red (Gloeckner)	21	1.4	90

Fig. 7. A sample of cut ranunculus and anemone from the trial: Anemone varieties 1 (underneath the rest), 2 and 3; ranunculus varieties 3 and 8.

CENTAUREA

A traditional cut flower that is not grown much currently, *Centaurea* or cornflower has some new colors that deserve another look.

Materials and Methods: The crop was sown on April 15 in the greenhouse and transplanted May 18 in the field at 12 x 12 in. spacing and 18 plants per plot.

Results and Discussion: Plants grew vigorously in the field, producing mounds of foliage of about 30 in. height, and flowering over several months (Table 24). Cut stem harvest became so labor-intensive that we had to stop harvesting in early July because of the labor needs of our other crops. Despite our cessation of flower harvest, plants continued to produce flowers for at least another month.

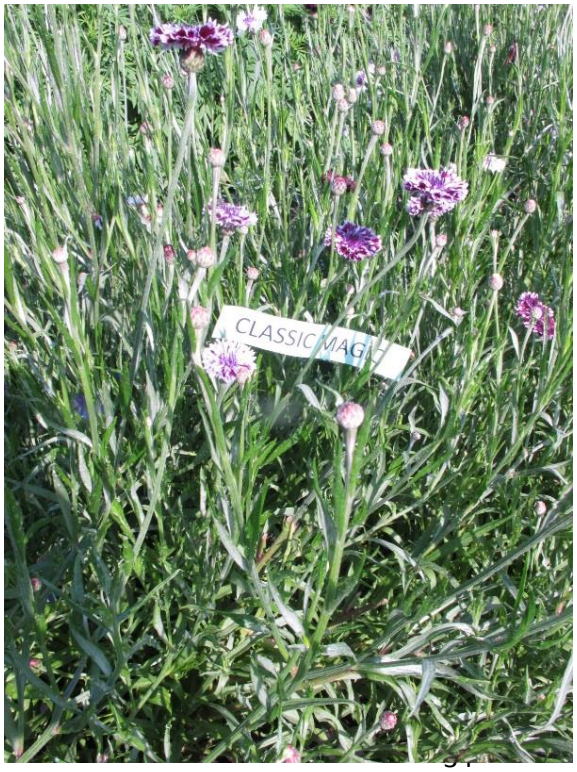
Varietal descriptions:

1. **Black Gem:** Plants erect with long lower branches, foliage gray-green. Flowers semi-double to double, petals black, attractive. Vase life at least one week. Promising.
2. **Classic Fantastic:** Plants open with long lower branches. Flowers semi-double, color varying from white to dark purple with dark centers.

3. **Classic Magic:** Plants more compact than var. 2, foliage medium green. Flowers smaller than var. 2, color varying from white to dark red, with some with dark rims. Flowers have dark centers.
4. **Emperor William:** Large, sprawling plants with thin stems. Flowers small, single, color blue with dark center. Very productive but difficult to harvest and untangle. Vase life about 5 days.
5. **Jubilee Gem:** Short, compact plants. Latest plant to flower in trial. Flowers semi-double, dark purple, but stems short. Variety more suitable as bedding plant than cut flower.
6. **Red Boy:** Erect plants growing up to waist height, but varying in height from plant to plant. Flowers double, dark pink, attractive in the vase. Promising.

Table 24. Stem length, yield and earliness of flowering of six *Centaurea* varieties grown in the field.

Variety name (Source)	Stem length, cm	Stems/plant	First flower date, DAS
Black Gem (Select Seeds)	38	12	96
Classic Fantastic	43	15	93
Classic Magic	42	9	98
Emperor William	31	50	88
Jubilee Gem	34	12	108
Red Boy	35	20	93




CLASSIC FANTASTIC


JUBILEE GEM


EMPEROR WILLIAM


RED BOY

PINEAPPLE LILY (*Eucomis*)

The crop was planted as a 4-variety trial in the high tunnel in April 1012, with another 3 varieties added in 2013, and daughter bulbs from Rep. 1 of the 2012 trial planted in spring 2014 in the same area. The severe winter of 2014/15 however decimated the plants in the last planting, with bulbs destroyed in the frozen ground. Plants of the older plantings were not reduced in numbers, and their performance is given below.

Materials and Methods: Plants were established from bulbs at a 12 x 12 in. spacing and two replications. To minimize stem bending in the vase after harvest, flowers were cut after nearly all florets were open on the stem.

Results and Discussion: The reason for the loss of the 2014 planting is not entirely clear, but may be partially due to its proximity to the end wall of the tunnel, where temperatures may have been lower than in the middle.

In spite of the cold stress, the plants of the 2012 and 2013 plantings grew well, and produced similar yields as in 2014 (see 2014 Annual Report) (Table 25). Flower harvest began on July 24, and only lasted a maximum of 10 days. The varieties varied little in flowering date. Plant and flower stem lodging occurred this season already during harvest, and is another indication that the plants would need to be replanted in 2016 to reduce crowding.

Table 25. Stem lengths, yields and harvest durations of seven Eucomis varieties grown in the high tunnel. The first four varieties were planted in spring 2012, and are unreplicated; the other three were planted in spring 2013 in two replications.

Variety name (Source)	Stem length, cm	Stems/plant	Harvest duration, days
Reuben	61	4.1	7
Innocence	70	4.7	7
Tugela Jade	62	4.6	10
Megaru	66	3.8	5
Tugela Gem	61	4.0	4
Tugela Jewel	65	4.8	6
Tugela Ruby	59	5.4	7

MARIGOLD

The development of new varieties of tall, large-flowered marigold varieties for the cut flower market is continuing, and has been accompanied by the recognition that other cultures use marigold blossoms for decorations in festivals, weddings and other ceremonies. Thus the demand for productive varieties is high.

Materials and Methods: The seven-variety trial was sown in the greenhouse in 98-cell trays on April 16. On May 18, the trial was planted in the field at 12 x 12 in. spacing, with 18 plants per plot.

Results and Discussion: Growth of the plants was uniform, and vigorous. Plants started flowering in early July, with all varieties starting to flower within 3 days of each other (Table 26). Except for the first two varieties all averaged half a meter in stem length and produced at least 20 stems per plant.

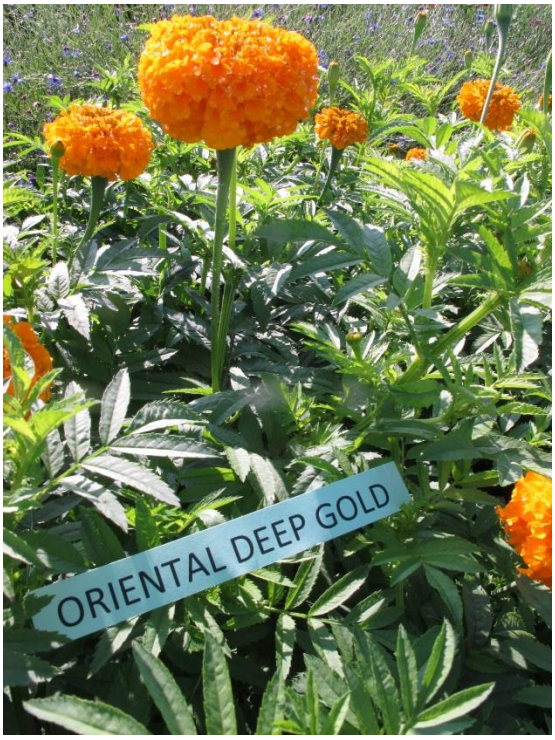
Table 26. Stem length, stem yield and first flower date for seven marigold varieties grown in the field.

Variety name (Source)	Stem length, cm	Stems/plant	First harvest, DAS
Eagle Yellow (Ameriseed)	36	20	78
Falcon Yellow	46	18	77
Jedi Orange Plus	52	24	78
Oriental Deep Gold	49	19	79
Storm Gold	50	21	79
Garland Orange (Harris)	51	28	77
Giant Orange (Johnny's)	51	27	79

Varietal descriptions:

1. **Eagle Yellow:** Shortest plants in the trial. Plants much branched with insufficient stem extension for quality cut flowers. Flowers large, bright yellow, attractive.
2. **Falcon Yellow:** Plants of intermediate height with flowers of similar size to 1 but slightly darker yellow.
3. **Jedi Orange Plus:** Plants 40 in. tall; flowers 2 to 3 in. diameter, with fewer petals than varieties 1 and 2; dark orange.
4. **Oriental Deep Gold:** Plants 3 ft. tall. Stems extending well, flowers similar in size to var. 3. Many petals, globe shape when open, color light orange, promising.
5. **Storm Gold:** Plants 3 ft. tall, flowers uneven shape, slightly lighter orange than var. 4.
6. **Garland Orange:** Plants 40 in. tall with finely cut leaves. Flowers 2 to 3 in. diameter, deep orange, productive, promising.
7. **Giant Orange:** similar in size of plant and flower to var. 6. Flower color deep orange, productive, promising.


LOW


ORIENTAL DEEP GOLD


STORM GOLD

MATRICARIA

We have not grown this promising filler flower previously and wanted to become familiar with its attributes and weaknesses.

Materials and Methods: Seeds were sown on March 30 in the greenhouse and transplanted to the field on May 11 at 9 x 9 in. spacing, with 4 rows per bed and 24 seedlings per plot.

Results and Discussion: Plants were vigorous and made uniform growth in the field. After a first flush of flowers that we began harvesting in late June, there was a lag in flower production from mid-July to mid-August, when stem production resumed until the end of the season (Table 27).

Table 27. Stem length, yield and earliness of six matricaria varieties grown in a field trial in 2015.

Variety name (Source)	Stem length, cm	Stems/plant	First harvest, DAS
Magic Lime Green (Johnny's)	38	24	85
Magic Single	40	22	84
Ball's Ultra Double (Geo)	36	17	88
Virgo	33	16	90
Snowball Extra (Gloeckner)	35	19	92
Sunny Ball Gold	37	16	92

Varietal descriptions:

1. **Magic Lime Green:** Plants slightly sprawling, flowers double with tiny petals, attractive yellow-green color, early, promising.
2. **Magic Single:** Erect plants with light green foliage. Flowers with white petals around yellow-green centers.

3. **Ball's Ultra Double:** dark green foliage, flowers double with relatively large petals and small yellow-green centers.
4. **Virgo:** Erect compact plants with relatively few branches; flowers densely double with tiny petals, white with small yellow-green centers. Shortest and least productive variety in trial.
5. **Snowball Extra:** Somewhat low growing with many branches; flowers densely double, petals white with green centers.
6. **Sunny Ball Gold:** medium height plants with few branches; flowers finely double, yellow green. Moderate productivity.

SCABIOSA

The annual species (*Scabiosa atropurpurea*) that we have not grown in recent years, scabiosa is a useful addition to mixed bouquets.

Materials and Methods: Seeds were sown in 98-cell trays on April 22 and transplanted to the field on June 1 at 12 in. spacing with 3 rows per bed and 18 plants per plot.

Results and Discussion: Plants began flowering in mid-July and produced a large number of stems until the end of August (Table 28). The varieties tested had nearly identical stem length. Scabiosa has a vase life of less than a week if the flowers are harvested when open.

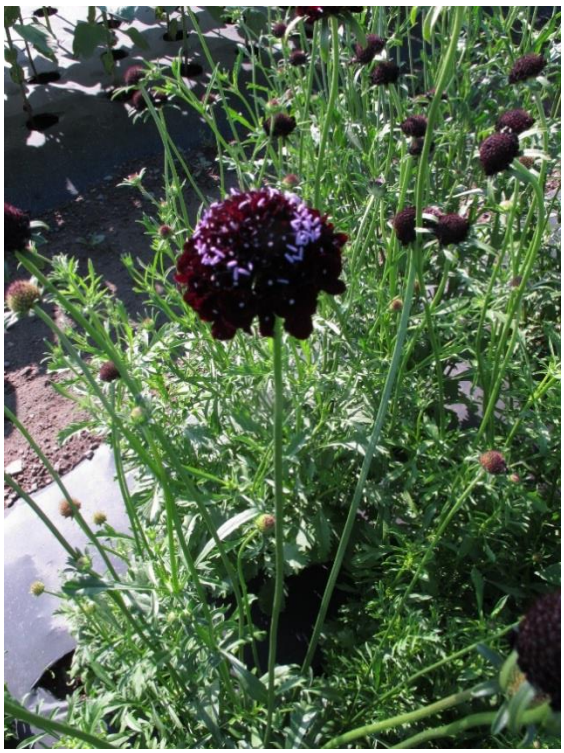
Table 28. Stem length, flower yield and earliness of flowering of four scabiosa varieties grown in the field.

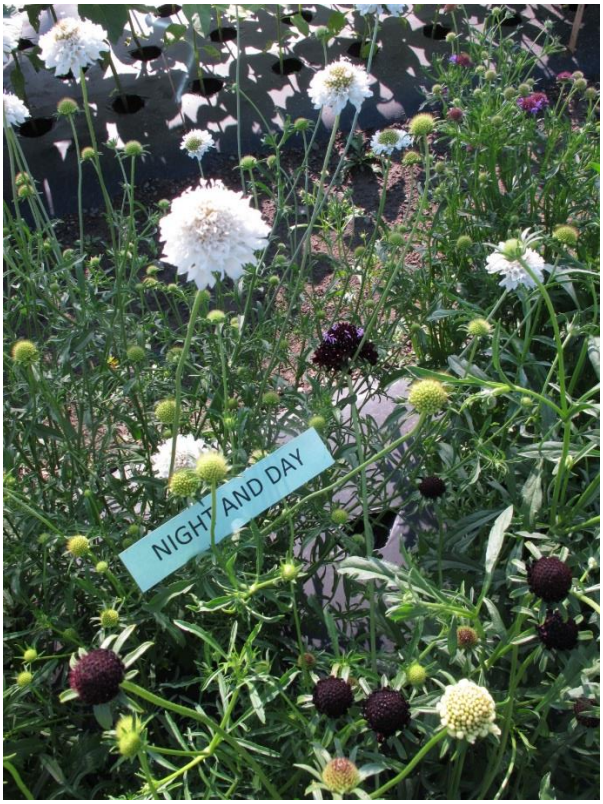
Variety name (Source)	Stem length, cm	Stems/plant	First harvest, DAS
Quis Mix (Harris)	45	53	89
Black Knight (Johnny's)	45	52	84
Blue Cockade (Geo)	47	48	91
Night and Day	46	60	84

Varietal descriptions:

1. **Qis Mix:** An interesting mixture of colors, ranging from black, dark red to pink. Plants relatively late in flowering.
2. **Black Knight:** Attractive velvety-black petals and blue stamens on strong stems. Promising.
3. **Blue Cockade:** Later-flowering sturdy plants with attractive medium-blue petals.
4. **Night and Day:** Productive mixture of black and white-flowering plants. The black part appears similar to var. 1; the white line has smaller, pointed umbels that tend to flower unevenly on the head. Not acceptable.


BLUE




NIGHT AND DAY

STATICE:

Statice (*Limonium sinuatum*) is an important component of a cut flower program. The crop produces colorful, attractive flowers that are long-lived in the vase, and can be used as a dried flower.

Materials and Methods: Seeds of the seven-variety trial were sown in Cornell artificial soil mix in 72-cell trays on April 6. Plants were transplanted to the field on May 25 at 12 x 12 in. spacing with 18 plants per plot.

Results and Discussion: Plants grew vigorously and flower harvests started in early July, continuing until mid-October (Table 29).

Table 29. Stem length, plant yield and earliness of flowering of seven statice varieties grown in the field.

Variety name (Source)	Stem length, cm	Stems/plant	First flower date, DAS
Seeker Mix (Johnny's)	56	32	86
Supreme Blue	64	16	126
Fortress Yellow (Harris)	63	32	98
Qis Yellow	61	27	93
Seeker White (Geo)	57	40	83
Purple Monarch	60	13	103
Forever Blue	55	21	91

Varietal descriptions:

1. **Seeker Mix:** A relatively early mix of white, pink, purple, and yellow flowers. Attractive and productive.
2. **Supreme Blue:** Latest-flowering in the trial. Erect, tall stems, bright blue flowers with stems prominently ribbed.
3. **Fortress Yellow:** Tall erect stems of medium yellow flowers. In early September, developed a disfiguring leaf blackening on stems and flower stalks that also spread to var. 4 in the first replication.
4. **Qis Yellow:** Similar to var. 3.

5. **Seeker White:** Early, productive plants with thick, alate stems.
6. **Purple Monarch:** late flowering plants of low productivity. Stem ribs prominent.
7. **Forever Blue:** Relatively short stems with prominent ribs. Moderate productivity.