Peony Research 2009

Patricia S. Holloway, Shannon Pearce, and Janice Hanscom

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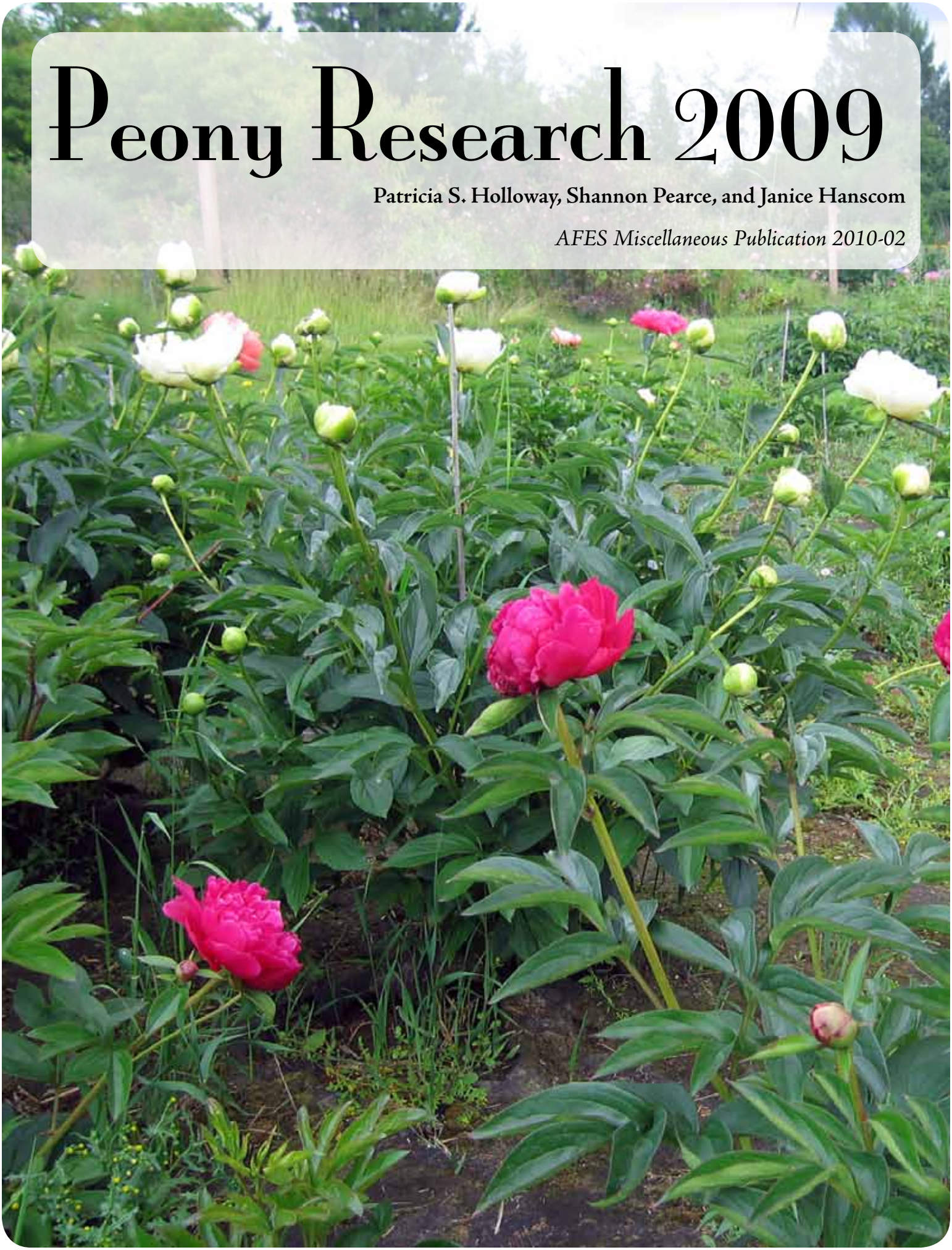


Shannon Pearce gathers peonies at the Georgeson Botanical Garden. Pearce, a student employee, assisted in conducting research on methods of cutting and shipping peonies in the summer of 2009. AFES photo by Nancy Tarnai.

Summary

Research has been conducted since 2001 to assist growers in identifying components of peony field cut flower production and distribution from field selection and planting to post harvest handling and packaging for export. This experiment addressed three components of the production cycle: field planting dates, root quality and plant productivity, and post harvest handling of cut stems. In a comparison of planting times (autumn, spring or as containerized plants in mid summer), 'Sarah Bernhardt' and 'Felix Crouse' showed no difference in shoot number and growth one full year after planting. 'Duchess de Nemours' and 'Alexander Fleming' showed significant reductions in growth compared to the other cultivars, and we suspect disease rather than planting time as the problem. All treatments where bud break had occurred in storage with 'Duchess de Nemours' and 'Alexander Fleming,' new shoots rotted, and recovery was slow. A treatment of elemental sulfur was not sufficient to protect roots from storage rot.

'Sarah Bernhardt' roots and crown buds were weighed, counted and measured prior to planting in order to learn if a correlation exists between root quality and subsequent growth and flowering. Three root attributes were correlated with the total number of stems produced: total number of eyes per plant, total number of roots per plant, and root fresh weight. Characteristics such as root length and maximum diameter were not correlated with subsequent growth. We found no relationship between any root characteristics and the number of flowering stems and foliage height in the first year. The attributes that showed correlation could not be fitted to a linear or curvilinear model explaining the nature of the correlation. Larger sample sizes will be necessary to clarify these relationships.

The best method for handling peony cut flowers for greatest vase life is to cut peonies dry and store them dry in a cooler (34°F) at 80+% relative humidity until shipping. Use of water in buckets in the field or pulsing flowers with water in the cooler does not improve vase life of peonies. Under optimum conditions, 'Sarah Bernhardt' peonies lasted up to 15 days in a vase, 8-9 days from bud break to full bloom, and an additional 5-6 days in full bloom. Chilling in a cooler is the most important attribute to long vase life.

Introduction

Cultivation of peonies as field-grown cut flowers was begun in 2001 at the Agricultural and Forestry Experiment Station Fairbanks Experiment Farm with a trial of 30 cultivars recommended as cut flowers (Holloway et al. 2003). Subsequent research was designed to identify methods of cultivation, potential management issues such as weeds, disease and insect problems, and to work with growers to develop best management practices for commercial peony production (Holloway et al. 2004, 2005, 2007). We have also explored markets for fresh cut flowers (Klingman 2002), identified processes for cold chain management between Alaska and export markets, and examined world demand for fresh cut peonies (Auer 2008, Auer and Greenberg 2008). The long-term goal of this project is to assist growers in identifying components of crop production and distribution, from field selection and planting to post harvest handling and packaging for export. Our current study emphasized experiments in three areas: field planting dates, root quality, and fresh-cut stem harvesting methods.

I. Field planting dates

Peony roots for commercial sale are harvested from late August through October in the northern United States and Canada. Nearly all publications on peony cultivation recommend fall planting to allow time for roots to become established prior to freeze-up. (i.e. Hubber 1996, Nehrling and Nehrling 1960, Rogers 1995, Stevens 1997). Depending upon the commercial source, it is not always possible for Alaska growers to obtain peony roots in autumn, and many have resorted to purchasing roots in autumn or spring and direct planting in spring. Others who have received roots too late in the autumn pot them into containers, then transplant them outdoors in midsummer. The purpose of this experiment was to compare fall, spring, and containerized stock planting to learn if differences occur in long-term productivity as cut flowers. This experiment is year one of a five-year project.

Fifteen roots of four peony cultivars were purchased in late summer 2007 from one commercial source. Five roots of each cultivar were planted immediately into prepared Fairbanks silt loam soil, pH6.2, and covered with black landscape fabric for weed control at the Georgeson Botanical Garden. No fertilizer was applied at planting, but plots were irrigated once to help establish the roots. The remaining roots were stored in plastic bags containing a slightly moistened wood chip/sawdust mixture following treatment with elemental dusting sulfur and maintained at 34°F (1°C) + 2°F in a cold room.

Five roots of each cultivar were removed from cold storage on 4 April 2008 and potted into a peat-lite greenhouse mix (Promix BX) and grown in 3-gallon (11-liter) containers in the greenhouse until 1 June. The greenhouse was maintained at a minimum night temperature of 50°F (10°C) through April and May with natural daylight. Plants were watered as needed and fertilized weekly with 500 ppm liquid feed 15-16-17 peat-lite mix. Plants were hardened off in late May and remained in a cold frame and were fertilized and watered as needed until field planted 16 July. The third set of roots was removed from the cooler on 14 May and planted immediately into the same field as the fall-sown and containerized roots.

Field plot layout consisted of five single-plant replicates with four cultivars arranged in a completely randomized design.*

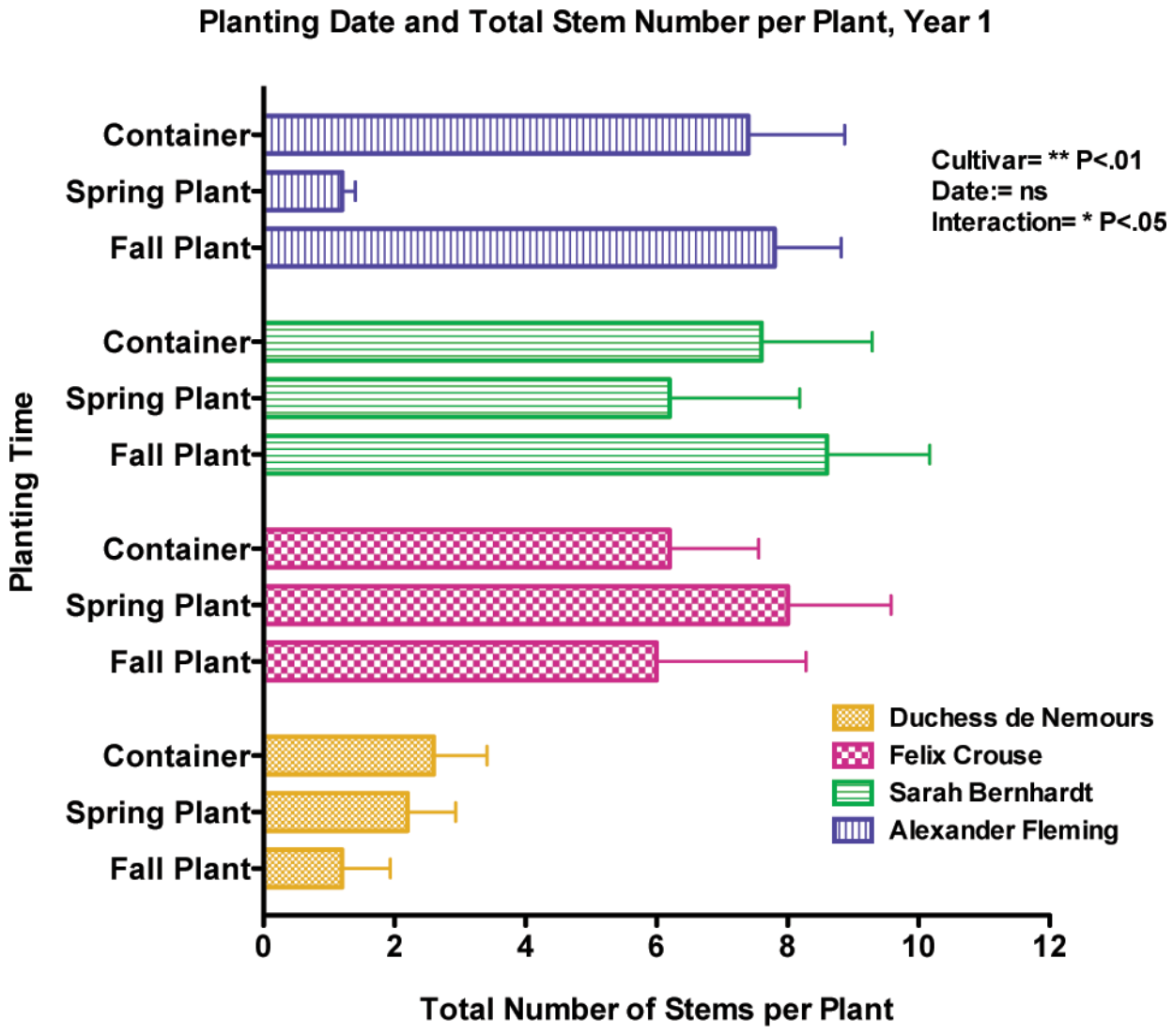
* While the best experiment would have had at least five cultivars with ten plants per replicate, funding and space constraints prevented this.

Within-row spacing was 24 inches (61 cm), with 36 inches (91 cm) between rows. The plot was surrounded on all sides with a guard row of peonies. Plots were fertilized in June 2009, with 10-20-20s (4 lb per 100 sq ft; 195g per sq meter), irrigated to maintain Irrometer readings of 30 centibars or less, and hand weeded as needed. Data collection commenced in June 2009, one full season after planting, and consisted of non-destructive counts of vegetative and reproductive stems and stem height. Counts were repeated in July after new growth was observed on some plants. Data were analyzed by two-way analysis of variance for cultivar and planting date effects and interaction.

The response of peony growth to planting date differed significantly (P<.01) among cultivars. 'Duchess de Nemours' roots produced the fewest total stems (Fig 1). The only cultivar to show a difference in stem number by planting date was 'Alexander Fleming,' in which spring-planted roots showed a more than 75% reduction in stems over fall and containerized roots. All other cultivars had similar stem production regardless of planting time.

Although there is probably a genetic component to the variations in plant growth, both 'Alexander Fleming' and 'Duchess de Nemours' showed stem rot from storage disease even with a treatment of dusting sulfur. The 'Duchess de Nemours' roots showed blackening of the emerging stems (suspected *Botrytis* sp.) in both container and spring planting. There was no new growth on fall-planted roots. With 'Alexander Fleming,' the roots planted in containers showed no new growth before planting in April, but one month later, bud break had occurred, and many new shoots were black. Both 'Felix Crouse' and 'Sarah Bernhardt' showed no bud break in storage, at most slight bud swelling for containerized and spring planting, and none of the resulting growth showed blackened stems.

Figure 1. Total number of stems per plant produced on roots planted in autumn, spring, and midsummer (containerized stock) one year following planting.

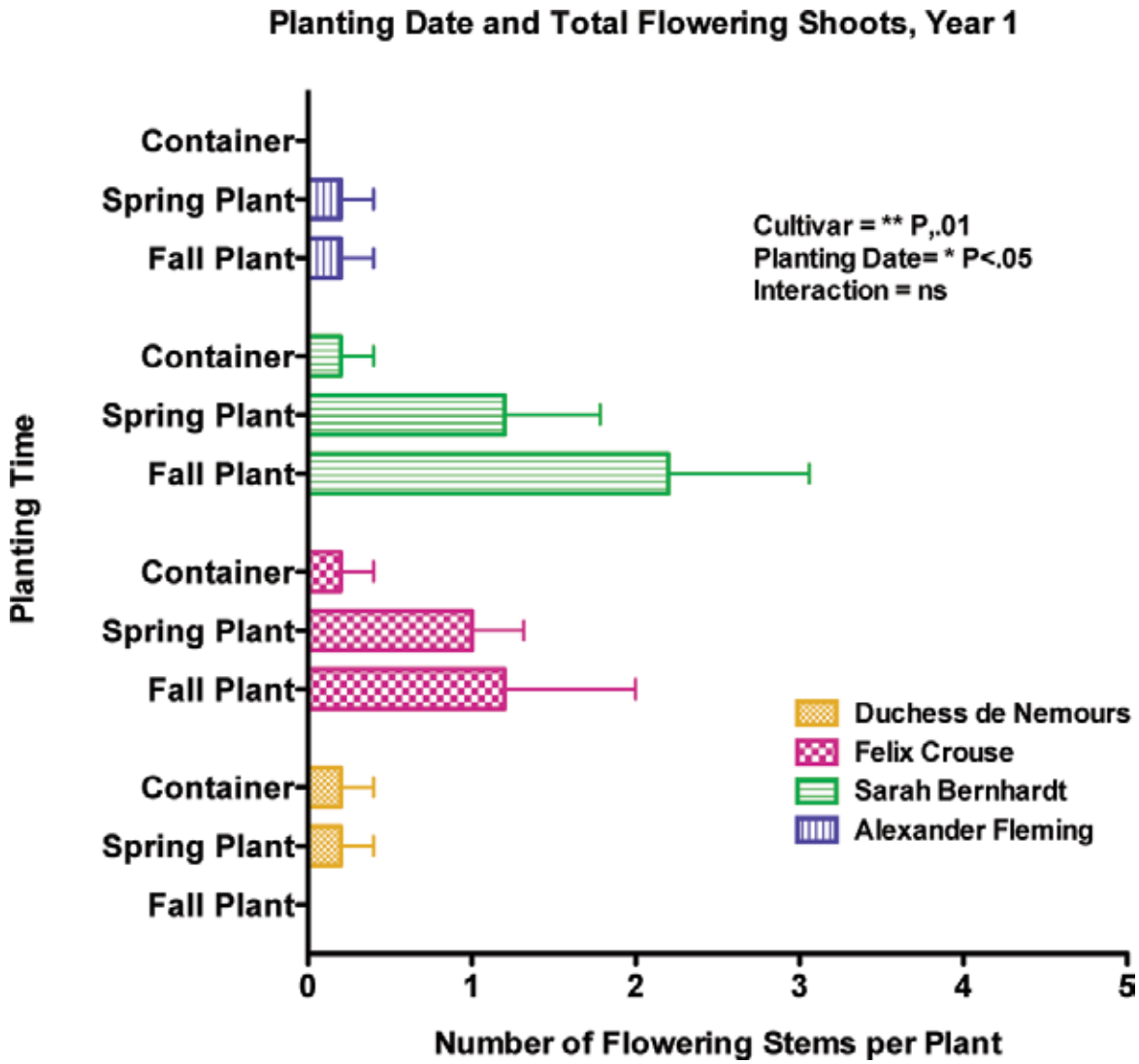


Most plants did not produce blooms the first year, but 'Felix Crouse' and 'Sarah Bernhardt' produced significantly (P<.01) more than the other cultivars, and fall-planted roots were more productive than spring or containerized plants for these cultivars (Fig 2). During the first two years of development, the presence of flowers is not considered desirable, and many growers recommend removing flowers to allow more plant resources to go toward greater root production. Although these data might favor 'Alexander Fleming' and 'Duchess de Nemours,' these two cultivars also showed susceptibility to disease. Lack of flowers is probably related to disease rather than cultivar. Plants differed significantly in vegetative stem height only in relation to cultivar and not planting time for each cultivar (Fig 3).

Data on shoot growth and survival were collected originally on 9 June, 2009. However, we noticed that some plants emerged very late, and the data were repeated on 18 July. One or two plants of each cultivar showed signs of life very late in the season, and growth consisted of one very short vegetative stem. We observed this late growth in other peony experiments and speculate that the primary "eyes" or crown buds had died, forcing the development of secondary buds. Commercial nurseries usually sell roots with two to five well-developed eyes. However, there are also numerous tiny buds located on the storage roots near the primary eyes. Perhaps, when the primary eyes die, the tiny secondary buds develop but are delayed in maturation the first season.

Generic statements recommending autumn rather than spring planting do not hold for all cultivars, disease to roots in storage being a significant factor determining success in the first year. We found no differences in vegetative and reproductive stem growth and plant height, at least for roots that did not break bud in storage. Cultivars that broke bud before planting

Figure 2. Total number of flowering stems per plant produced on roots planted in autumn, spring, and midsummer (containerized stock) one year following planting.



had significantly fewer vegetative stems, and in some instances were late to emerge. Dusting sulfur alone is not sufficient to prevent disease on emerging stems. Temperatures must remain cold enough (as close to 32°F as possible) to prevent bud break, especially for cultivars with short dormancy periods such as 'Duchess de Nemours.' Otherwise a stronger fungicide dip must be used to reduce disease in unplanted roots.

II. Root quality and plant growth

Peony roots are sold primarily by the number of crown buds or eyes that occur on the top of the root. Eye number is easy to sort by harvesters, and roots can be graded into quality classes, three to five eyes being optimum (Stimart 1988, Rogers 1995). Other sources recommend purchasing roots that are 4-8 inches in length, longer roots having delayed growth at least in the first season (Rogers 1995). Others claim longer roots are not detrimental to growth but simply are more difficult to plant (Nehrling and Nehrling 1960). Considering peonies remain in the ground and productive for more than 20 years, root quality at planting may be important in subsequent growth and survival, and perhaps flowering. The purpose of this project was to compare root attributes such as number of eyes and root length to learn if any root attributes may be correlated with optimum growth and flowering in peonies.

Roots of 'Sarah Bernhardt' peonies were purchased in September 2008, and data were collected immediately on each root: number of eyes, length of longest root, maximum diameter of root, number of individual roots per crown, and root fresh weight. Roots were stored at 34°F (1°C)+ 2°F cooler until 21

Figure 3. Maximum vegetative stem height of plants from roots planted in autumn, spring, and midsummer (containerized stock) one year following planting.

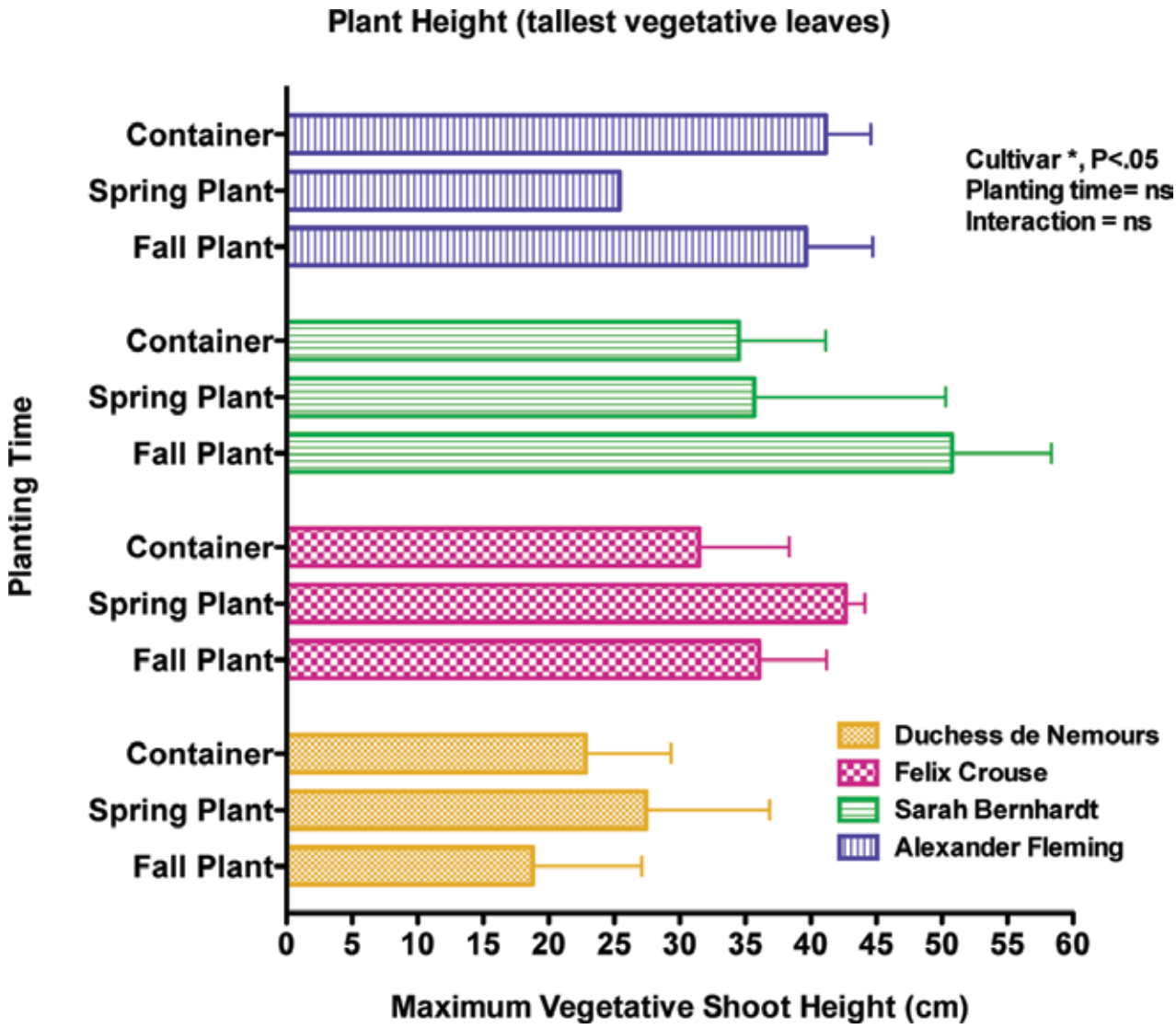
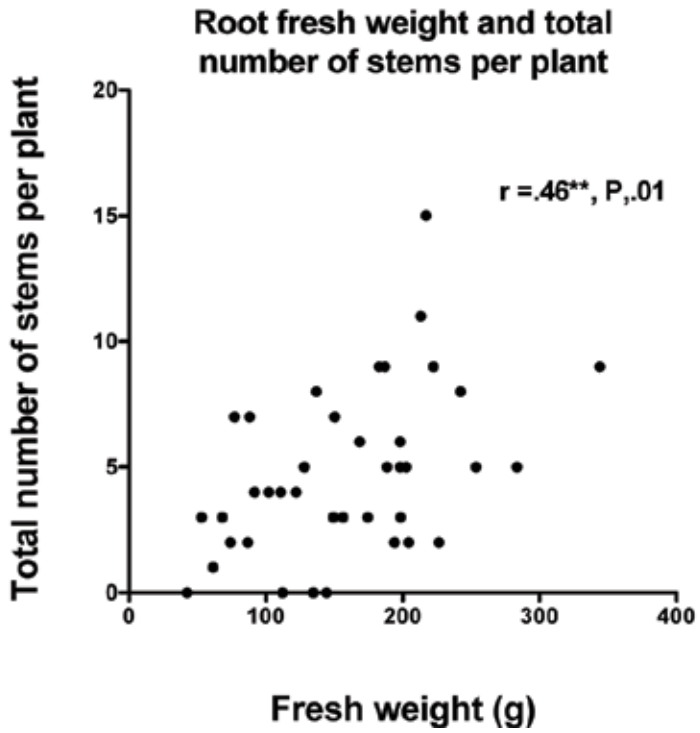
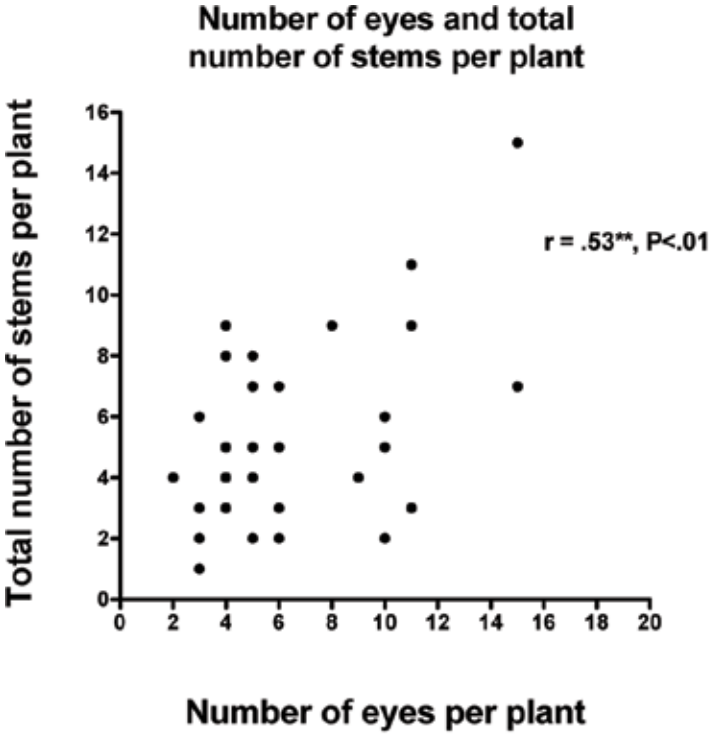
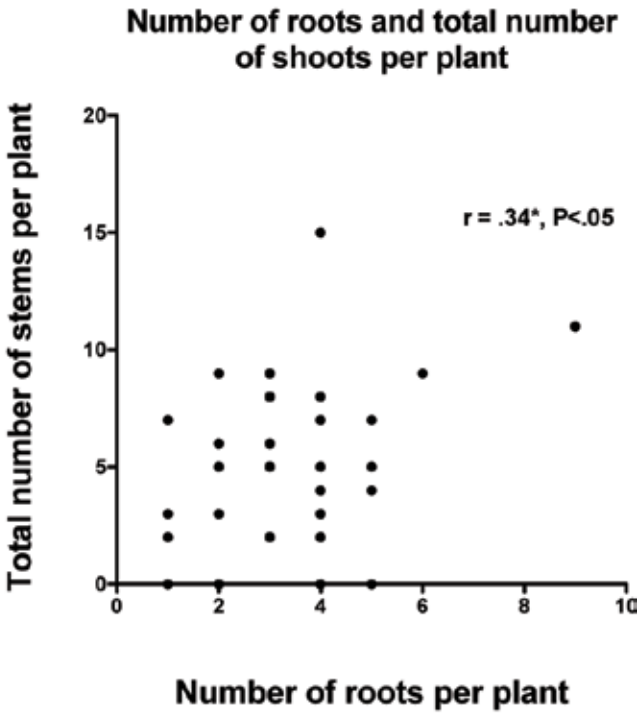


Figure 4. Scatter plots of significantly correlated attributes between root characteristics and plant growth in peonies.







May, 2009 when they were field planted, at random, in the Georgeson Botanical Garden, Fairbanks silt loam soil, pH 6.2. Trenches were hand dug and roots were planted diagonally with primary buds facing upward. They were buried with at least 2 inches (5 cm) of topsoil over the eyes, and the entire bed was covered with spun-bonded landscape fabric for weed control. Plots were irrigated through T-tape trickle irrigation immediately after planting and throughout the season when Irrometer readings reached 30 centibars.

Plots were fertilized in June with 100 lb/acre 10-20-20s granular fertilizer broadcast in an 18-inch (46 cm) circle around the roots. Plots were hand weeded all summer as needed around the crown. Non-destructive data were recorded on 15 July including total number of stems, number of flowering stems per plant and foliage height. Data were analyzed using correlation coefficients, and scatter plots and logistic regression analysis were employed to identify best fit response models between significant data sets.

A highly significant correlation existed between the data pairs of number of eyes/total stems per plant (P<.01) and total root fresh weight/total stems per plant (Table 1). A weaker correlation was detected between number of roots/total stems per plant(P<.05) Root length and maximum root diameter showed no correlation with subsequent plant growth, and all root attributes showed no correlation with number of flowering stems and foliage height in the first year.

Examination of scatter plots and logistic regression analysis did not show a clear relationship in any of the three significant correlations (Fig 4). Models fitted to each data pair were weak (maximum r2= .27). A larger sample size will be required to clarify the relationship between root characteristics and plant growth.

This project eliminated 12 characteristics as not being correlated with root attributes, at least in first-year growth. This study suggests that number of eyes, number of roots, and total fresh weight are correlated with the subsequent growth of first-year peony plants, but just how they are related is not clear.

Table 1. Correlations existing between root attributes and peony growth following one full year of growth.

Plant characteristics Root characteristics	Total stem number vegetative+ flowering	Stem number flowering	Max height of foliage
Number of crown buds (eyes)	Yes*	No	No
Number of roots	Yes†	No	No
Root length	No	No	No
Maximum root diameter	No	No	No
Total root fresh weight	Yes*	No	No

* Correlation significant, P<.01, n=40
† Correlation significant, P<.05, n=40

III. Harvesting and Handling of Peony Cut Flowers.

There are no published uniform standards for handling peonies immediately after harvest. Interviews with growers in New Zealand, Oregon, and Washington revealed different methods of flower handling depending on their equipment, amount of labor, and expertise in harvesting. All growers have cold storage facilities in which to hold flowers until sold, but the handling method between the field and the cooler varies. Some growers recommend dry harvest while others put stems directly into water immediately in the field. Some growers recommend cold water, others, warm. A pulse of water, one to three hours long either before or after stem grading is common, although Gast (1997) and Stimart (1988) reported little value in such practices. The timing between field cutting and cold storage may range from less than one hour to several hours. There is no clear directive for a method that promotes the longest vase life. The purpose of this experiment was to evaluate methods of post harvest handling of peony cut flowers to identify best practices for maximum vase life of fresh cut peonies.

'Sarah Bernhardt' peony cut stems were harvested three times (replicates) during the bloom season: 30 June, 2 July, and 5 July. On each date, 120 stems were harvested and randomly assigned to one of 20 combinations of field and cold storage treatments. Treatment combinations were numbered for easier comparison (Table 2).

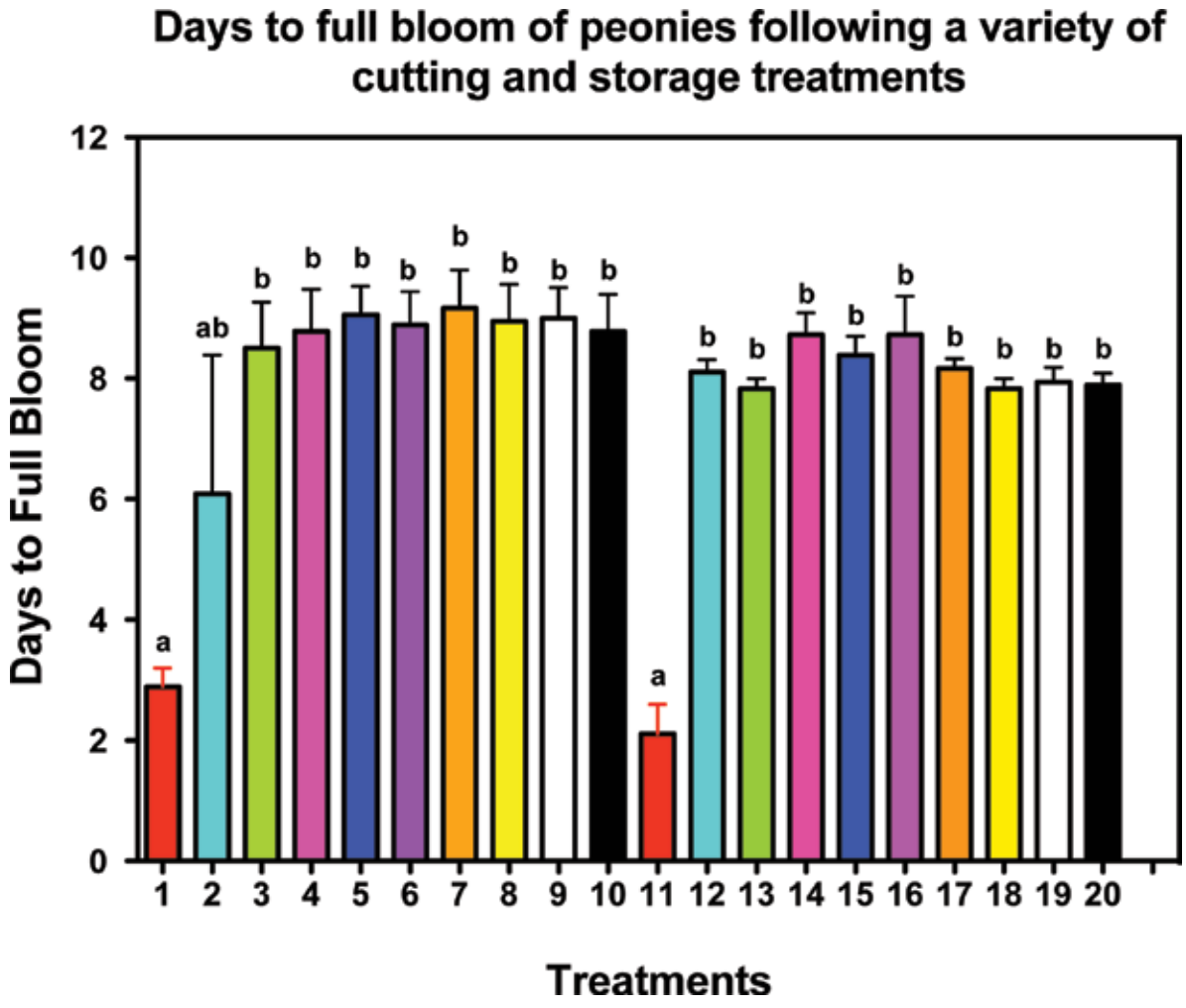
Table 2. Treatment combinations for post harvest handling of peony cut stems, 2009.*

Treatments in field	Control: stems directly into vase, no chill	Cold water immediately in field[1]	1 hr dry outdoors in full sun[2]	3 hr dry outdoors in full sun[2]
Treatments in cooler				
Control: stems directly into vase,[3] no chill	1 (11)			
1 week cold water[1] in cooler[3]		8 (18)	2 (12)	5 (15)
1 hour cold water[1] pulse, 1 week dry in cooler[3]		9 (19)	3 (13)	6 (16)
1 hour cold water pulse,[1] 1 week dry in cooler,[3] 1 hour cold water[1] pulse		10 (20)	4 (14)	7 (17)

1. Initial cold water temperature, 34+1°F
2. Air temperature range during field drying (first temperature is 1 hour treatment, rep 1: 64- 68 + 3°F, rep 2, 68- 71 + 2°F, rep 3 65- 68 + 2°F
3. Cooler temperature, 34 + 2°F; room temperature for vase life 67 + 2°F

* Treatment numbers reflect a combination of field (right header) and cooler treatments (left column). For instance, treatment 8 consisted of stems that were placed immediately into buckets of cold water in the field then were moved to the cooler where they remained in cold water for one week. Treatment 18 (in parentheses) was the exact same regime but the stems were freshly cut (1 inch, 2.5 cm) every time they were moved to another water treatment.

Figure 5. Average number of days following storage and handling treatments for peony buds to reach full bloom (refer to Table 2 for treatment number descriptions).



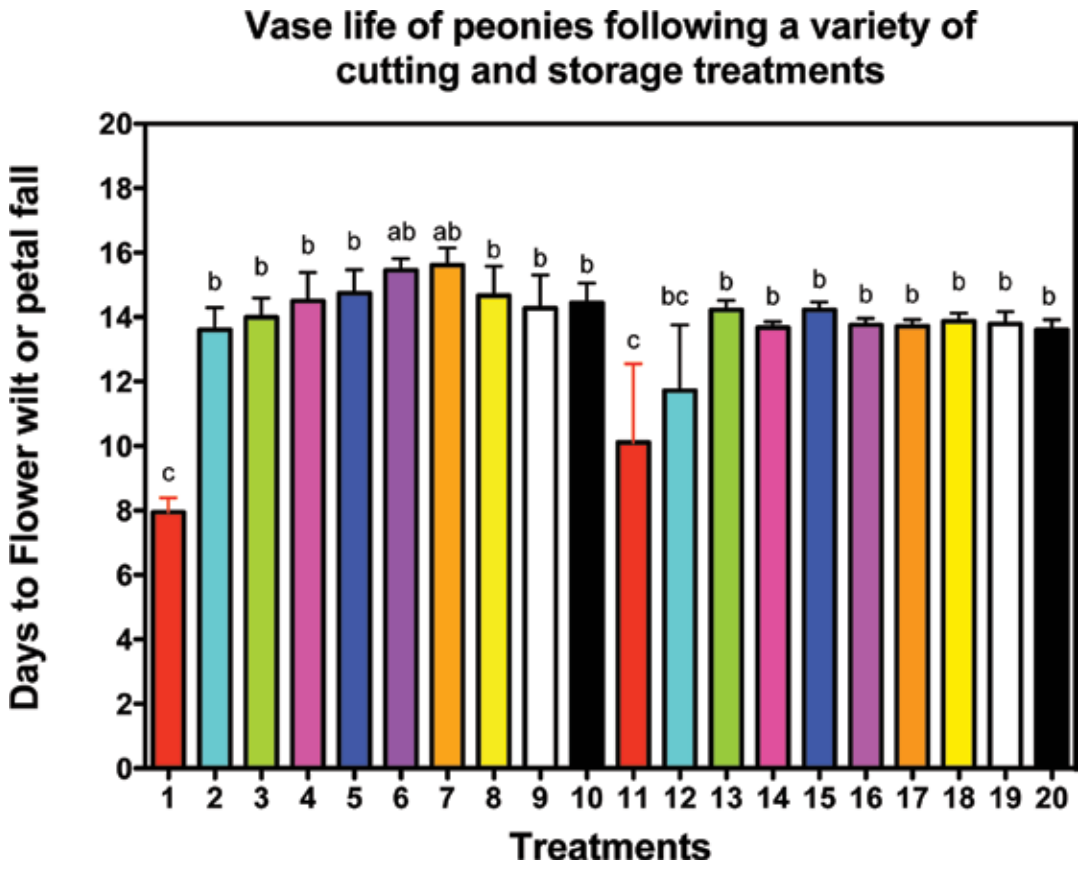
Following treatment, stems were transferred to Mason jars full of water and placed in a room with 24-hour fluorescent ceiling lights and an average room temperature of 67+3°F. Relative humidity averaged 65+ 5%. Each stem was tagged with treatment information, and the number of days to full bloom, petal fall, and total vase life were recorded. Water was added to the jars nearly every day to prevent drying. Full bloom was defined as the stage at which the large guard petals became perpendicular to the stem. Vase life was terminated when petals dropped with a gentle shake of the stem or wilted. Data were analyzed using analysis of variance for a completely randomized design with six stems per treatment and three replicates.

Control stems that received no chilling reached full bloom in two to three days after stems were put into the jars of water (Fig 5). Cutting stems prior to water treatment did not change the days to full bloom Treatments 1 and 11). Flowers in every other treatment reached full bloom in six to nine days—at least double the time of the controls. No combination of field and cooler treatments was significantly different from all others in the days to full bloom. For instance, stems held outdoors in full sun for three hours and those inserted directly into cold water showed the same number of days to full bloom.

The same trend occurred in total vase life. Stems lasted 8-10 days for the control stems (unchilled) and 11-16 days for all other treatments (Fig 6). The number of days from full bloom to petal fall was the same for all treatments regardless of handling and both chilled and unchilled (Fig 7). Peonies lasted 5-7 days in all treatments.

Unchilled control stems opened faster than all other treatments, but full bloom lasted the same amount of time for all treatments. Chilling is the most important factor in extending vase life of peonies. Field handling methods do not seem to be a critical influence in total vase life. Growers may cut stems without taking buckets of water into the field, and up to a three-hour delay between cutting and storage did not seem to harm vase life. Water storage or pulsing in the cooler is not necessary. Our results mirror those of Gast (1997) and recommendations by Stimart (1988).

Figure 6. Total vase life (average days from bud break to petal fall or wilt) of peonies following storage and handling treatments (refer to Table 2 for treatment number descriptions).



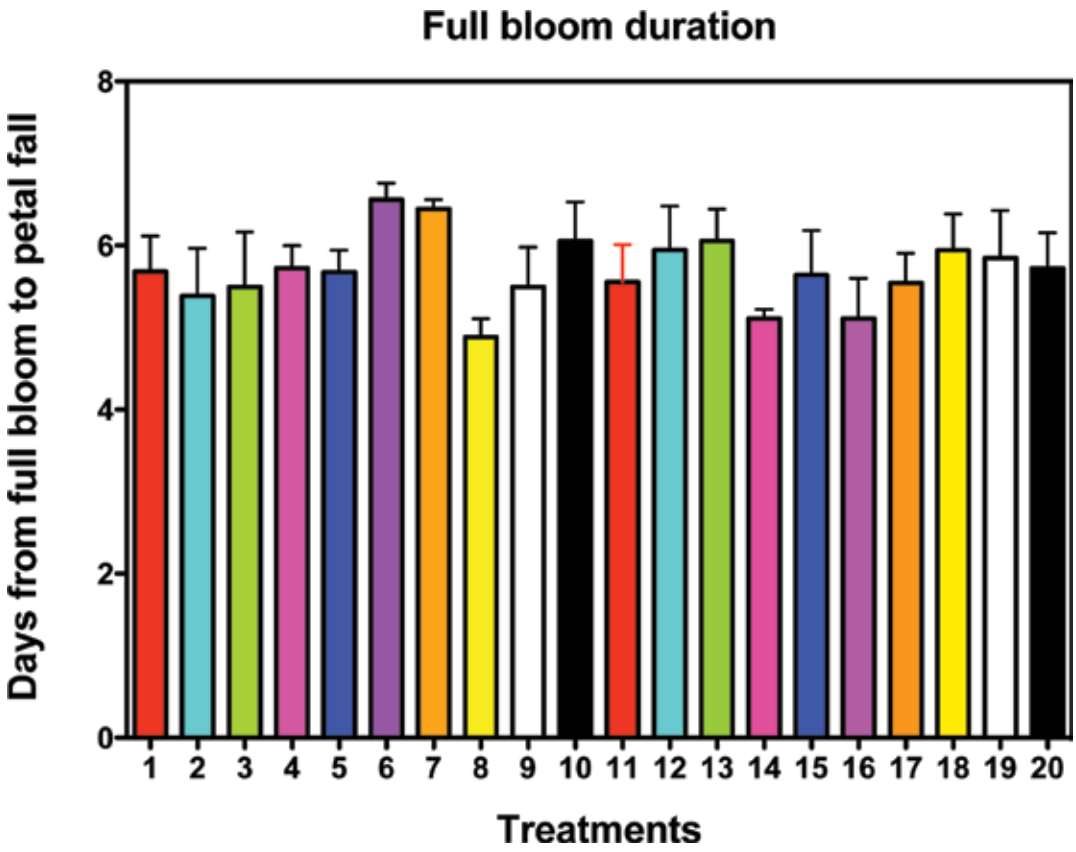


Figure 7. Average number of days following storage and handling treatments for peony buds to remain at full bloom until petal wilt or fall (refer to Table 2 for treatment number descriptions).

Above: cut peonies from the Georgeson Botanical Garden.

Left and below: Shannon Pearce snips peony stems in a test of storage and cuttng treatments to determine which methods are best for shipping peonies. She and the buckets of flowers are in a cooler room.

AFES photos by Nancy Tarnai.

Bumblebee approaching a peony at the Georgeson Botanical Garden. AFES photo by Nancy Tarnai.

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