STS Available Again

Cut flower growers welcome the registration of an STS-containing product, and NC State research shows its effects.

By John Dole, William Fonteno and Sylvia Blankenship

Cut flowers vary greatly in their sensitivity to ethylene, with symptoms such as flower, bud and leaf abscission; bud abortion; rapid flower senescence; epinasty; and decreased vase life. Concentrations as low as 100 ppb and exposure times as little as four hours can lead to damage of some species. The ethylene blocker, silver thiosulfate (STS), was developed as a pretreatment to prevent ethylene damage, and it gained widespread acceptance in the cut flower industry. Problems with registration, however, temporarily led to the lack of STS-containing products available to growers, wholesalers and retailers in the United States. Recently an STS-containing product (Chrysal AVB, Pokon & Chrysal USA) has been registered for use on cut flowers.

Researchers have also been working with a variety of other anti-ethylene agents. Work at North Carolina State University led to the development of 1-methylcyclopropene (1-MCP), and a product containing the active ingredient (Ethylbloc, Floralife Inc.) has been widely promoted in the floriculture industry.

With two products available, we set out to determine in which situations AVB and/or Ethylbloc is the optimum treatment. The effectiveness of AVB or Ethylbloc may vary with specific species or type of inflorescence. Treatments examining the effects of cold storage and water quality were also included because they might influence the effectiveness of the AVB and Ethylbloc.

EXPERIMENT DETAILS

Fourteen commonly grown cut flower species were tested, represented by 1-3 cultivars per species (Figure 1, page 44). Commercially grown cut stems were harvested, untreated and shipped overnight to Raleigh, N.C. Stems were unpacked, sorted into six bunches of 10 stems each based on criteria listed in Figure 1, recut and placed in either deionized water or deionized water plus STS for four hours. STS was used at either ½ ml per liter AVB for alstroemeria or 1 ml per liter AVB for all other species. With four species — bouvardia 'Royal Fancy', dianthus 'Tasman', delphinium 'Light Blue' and gypsophila 'Golan' — additional stems were placed in either tap water or tap water plus 1 ml per liter AVB. Stems placed in deionized water were either subjected to Ethylbloc at the label rate or ambient air for four hours. Our deionized water had a pH of 4.6 and an EC of 0.0; when STS at 1 ml per liter was added it had a pH of 5.8 and an EC of 0.44. The tap water had a pH of 6.1 and an EC of 0.21.

Storage. After treatment stems were removed, and bunches were put in polyethylene sleeves. One bunch from each treatment was placed in deionized water. The other bunch was packed dry in a floral box. All bunches were stored at 41° F in the dark for four days. At the end of cold storage bunches were removed, and stems were recut and placed in fresh vases with deionized water. Stems were then held at 68° F in a cooler for two days under 12 hours of light per day.

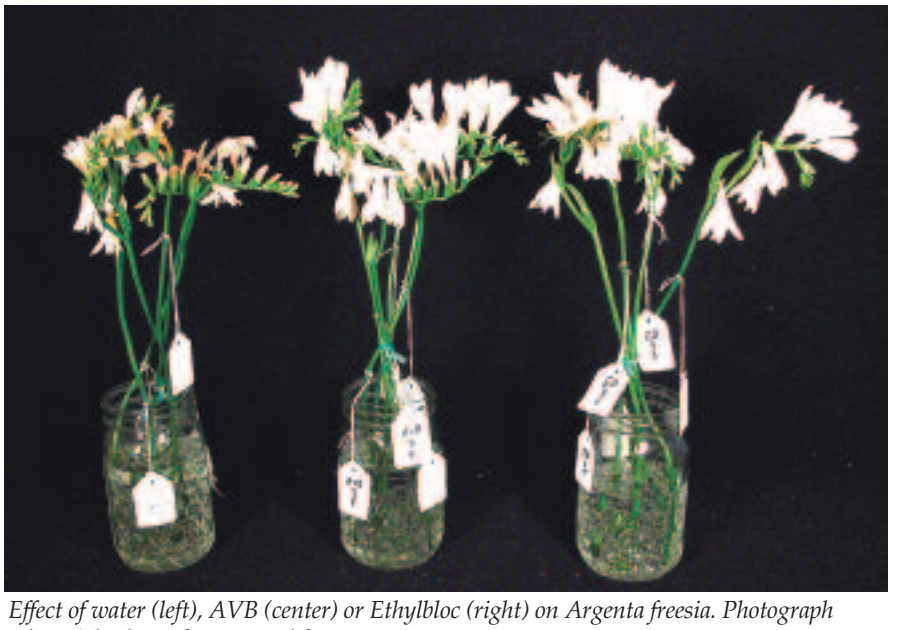
Vase life evaluation. Bunches were taken out of storage, sleeves were removed and bunches were split into two smaller bunches of five stems each. These bunches were placed in vases filled with deionized water under 12 hours of light per day, with one bunch of five stems per vase. Flowers were monitored daily to determine the end of wholesale/retail vase life, which was designated as the first day a change was noticed in the flower or inflorescence that would typically prevent the flower from being sold by a wholesaler or retailer (Figure 2, page 46). The consumer vase life was also recorded for each stem, and that was designated as the day a typical consumer would have disposed of the stem.

RESULTS

Alstroemeria. Stems treated with AVB and stored in water had a 2.8-day longer consumer vase life than all of the other treatments. Neither AVB or Ethylbloc had any effect on wholesale/retail vase life. No visual differences in the pattern of senescence were noted among the treatments.

Bouvardia. Stems treated with AVB or Ethylbloc generally had a longer consumer vase life than those treated only with water. However, ➧

Effect of water (left), AVB (center) or Ethylbloc (right) on Icardia carnation. Photograph taken eight days after removal from storage. (Photos courtesy of William Fonteno)



Effect of water (left), AVB (center) or Ethylbloc (right) on Argenta freesia. Photograph taken eight days after removal from storage.

AVB-treated stems had the longest vase life. A similar pattern was noted for wholesale/retail vase life. No visual differences in the pattern of senescence were noted among the treatments.

Carnation. Both AVB and Ethylbloc have been well documented as increasing the vase life of carnation. Similarly, in our work stems treated with AVB, regardless of storage method or water type, had the longest consumer vase life. Stems treated with Ethylbloc had a shorter vase life but lasted longer than stems treated only with water. In our work AVB increased consumer vase life by 123-152 percent and Ethylbloc by 35-110 percent compared to untreated controls. The ➧

Figure 1. Species, cultivars and sorting criteria. In addition to the sorting criteria listed below, stem thickness was considered for every species.

Species (scientific name)	Cultivars	Sorting criteria
Alstroemeria (Alstroemeria hybrids)	Rebecca	Number florets/stem
Bouvardia (Bouvardia hybrids)	Royal Fancy	Number of florets/stem
Carnation (*Dianthus caryophyllus*)	Icardia, Silk Road, Tasman	Degree of openness, head size
Delphinium (*Delphinium Hbelladonna*)	Light Blue	Degree of openness, inflorescence length
Freesia (Freesia hybrids)	Argenta, Flandria	Number of florets and number open
Gypsophila (*Gypsophila paniculata*)	Golan	Degree of openness, size of inflorescence
Larkspur (*Consolida ambigua*)	Imperial Light Blue	Degree of openness, inflorescence length
Lily, Asiatic (Lilium hybrids)	Polyanna	Number of buds
Lisianthus (*Eustoma grandiflorum*)	Echo White	Number of buds, number of open flowers
Ranunculus (*Ranunculus asiaticus*)	LaBelle Gold	Number of buds, number of open flowers
Snapdragon (*Antirrhinum majus*)	Maryland White Improved, Yosemite Pink	Number of buds, number of open flowers, length of inflorescence
Stock (*Matthiola incana*)	unknown white	Number of buds, number of open flowers, length of inflorescence
Sweet pea (*Lathyrus odorata*)	Winter Elegance	Number of buds, number of open flowers
Waxflower (*Chamelaucium uncinatum*)	Early Pink, University Red	Number of buds, number of open flowers

Effect of water (left), AVB (center) or Ethylbloc (right) on Light Blue delphinium. Photograph taken four days after removal from storage.

pattern of senescence varies with the treatment. The petals of untreated and Ethylbloc flowers curled towards the center of the flower ("sleepiness"), while the AVB-treated flowers stayed more open but exhibited discoloration and drying of the petals.

Delphinium. Stems treated with AVB and stored wet, regardless of water type, had the longest consumer vase life. Stems treated with AVB and stored dry had a slightly shorter vase life. All other treatments were similar. The pattern of senescence varied with the treatment. The petals of AVB-treated flowers generally did not abscise but wilted and dried. The petals of Ethylbloc and untreated flowers generally abscised. Wholesale/retail vase life was similar to consumer vase life.

Freesia. Both cultivars reacted similarly in that AVB and Ethylbloc greatly increased the consumer vase life of stems treated only with water and stored dry (Figure 3, below). All stems stored wet had a similar vase life regardless of treatment. Neither AVB or Ethylbloc had any effect on wholesale/retail vase life. No visual differences in the pattern of senescence were noted among the treatments.

Gypsophila. Stems generally had the longest vase life when treated with AVB. Recommendations call for pulsing with sucrose and either silver nitrate or AVB. Our work did not include sucrose, which may explain why AVB increased vase life by only 16-33 percent. Neither AVB or ➧

Figure 2. Criteria used to determine the end of wholesale/retail vase life and the end of consumer vase life.

Species	Wholesale/retail vase life	Consumer vase life
Alstroemeria	petal drop	no open flowers remaining
Bouvardia	leaves or florets wilted or discolored	all florets wilted or discolored
Carnation	petals discolored, oldest petals less than 90° from vertical	petals dry or flowers closed
Delphinium	petal drop	all petals dropped or dry
Freesia	first open flower wilted	no open flowers remaining
Gypsophila	florets discolored	no more fresh florets (all other florets dry)
Larkspur	petal drop	all petals dropped or dry
Lily	first open flower wilted	no open flowers remaining
Lisianthus	petal discoloration	no open flowers remaining, loss of turgidity
Ranunculus	petal drop, bent stem, discoloration of oldest petals	petal drop, bent neck, discoloration of oldest petals
Snapdragon	petal discoloration, bent stem	all florets discolored or stems bent
Stock	petal discoloration	all petals dropped or dry or stems bent
Sweet pea	floret drop	no open florets remaining, all florets dry
Waxflower	shattering	all florets dry

Figure 3. Effect of AVB and Ethylbloc on freesia stored either dry in floral boxes or wet in buckets of water.

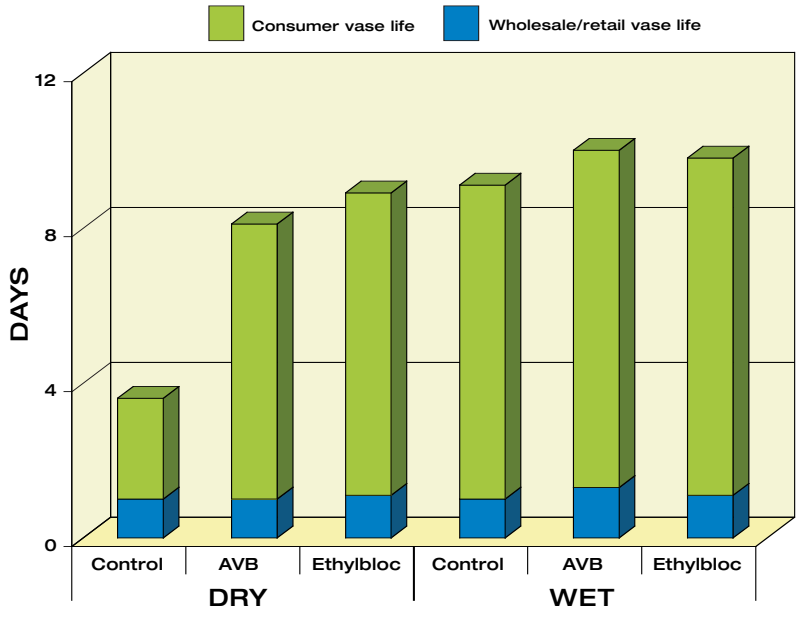
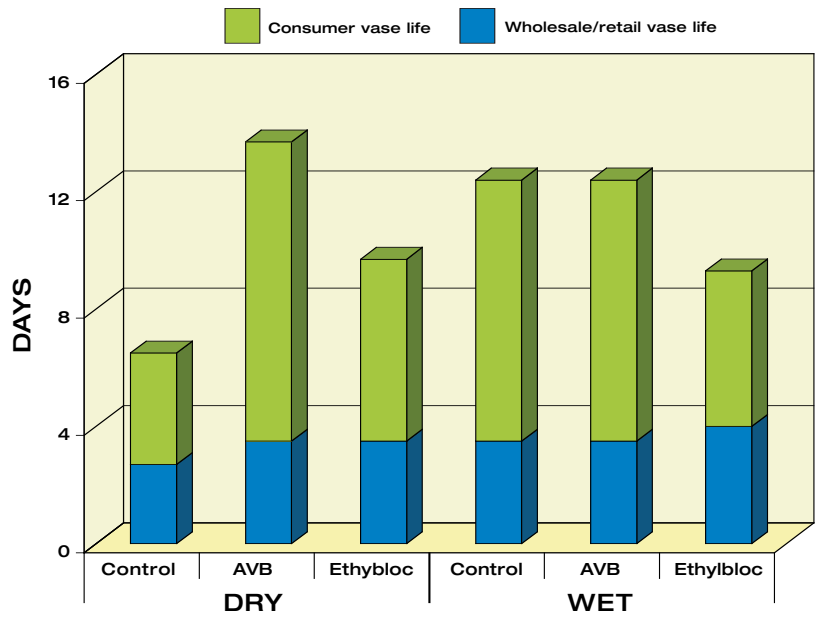


Figure 4. Effect of AVB and Ethylbloc on Asiatic lily stored either dry in floral boxes or wet in buckets of water.



Ethylbloc had any effect on wholesale/retail vase life. No visual differences in the pattern of senescence were noted among the treatments.

Stems treated with AVB had the longest consumer vase life regardless of storage method (Figure 4, above). Ethylbloc increased the vase life of stems stored dry but not of stems stored wet. Stems treated with AVB opened the most flower buds compared to those treated with Ethylbloc or water only. Stems treated only with water and stored dry had the fewest open flowers and the most buds (all of which were dead) at the end of consumer vase life. Ethylbloc (regardless of wet or dry storage) increased the number of flowers opening on stems compared to stems treated only with water and stored dry. None of the stems had open flowers at the time the experiment was started. Neither AVB or Ethylbloc had any effect on wholesale/retail vase life. AVB is a compulsory pretreatment for Asiatic lilies to be sold through The Netherlands flower auctions.

Stock. Stems treated with AVB and stored wet had the longest consumer vase life; however, all stems showed foliage damage within 48 hours of removing the stems from storage. Damage was not sufficient to cause termination of consumer vase life but was noticeable. Lower AVB rates should be investigated for stock. Regardless, it was also evident that Ethylbloc was not as effective in extending vase life as was AVB. No visual differences in the pattern of senescence were noted among the treatments, other than the untreated control flowers tended to drop more petals than the stems treated with AVB or Ethylbloc.

In our work the foliar damage did not influence wholesale/retail vase life, as all stems in all treatments had at least one floret showing discoloration or watersoaking at the end of storage and had a wholesale/retail vase life of 0 days. However, if it were not for the discoloration on the florets, the foliar damage from AVB would have resulted in a significantly lower wholesale/retail vase life.

Sweet pea. Stems treated with AVB, regardless of storage method or water type, had the longest consumer vase life (Figure 5, page 58). Stems treated with Ethylbloc had a shorter vase life but lasted longer than stems treated with water only. Stems treated only with water and stored dry had the shortest vase life of only 1.2 days.

All control stems dropped open flowers during storage and thus, had a wholesale/retail vase life of 0 days. AVB and Ethylbloc prevented floret drop during storage and had similar wholesale/retail vase lives. The flowers on the AVB-treated stems tended to remain attached and dry, while Ethylbloc flowers tended to abscise.

Waxflower. Dry storage slightly reduced the consumer vase life of both cultivars, but AVB and Ethylbloc had no effect. However, AVB and Ethylbloc greatly increased the wholesale vase life of 'Early Pink' stems treated only with water and stored dry. All stems stored wet had a similar vase life regardless of treatment. Other than the initial floret drop of ➧

untreated stems stored dry, no visual differences in the pattern of senescence were noted among the treatments.

STORAGE AND WATER

The vase life of several species was reduced by dry storage including delphinium (wholesale/retail only), freesia (consumer only), lily (consumer only), stock (consumer only) and waxflower (wholesale/retail and consumer). In the case of freesia, lily, stock and wax flower (wholesale/retail only) the use of AVB and Ethylbloc prevented the negative effects of dry storage and increased vase life. With delphinium and stock the negative effects of dry storage could not be ameliorated by AVB or Ethylbloc. Considering all 19 taxa, however, the species tested tolerated dry storage well, as no differences occurred due to dry storage of 12 of the taxa tested.

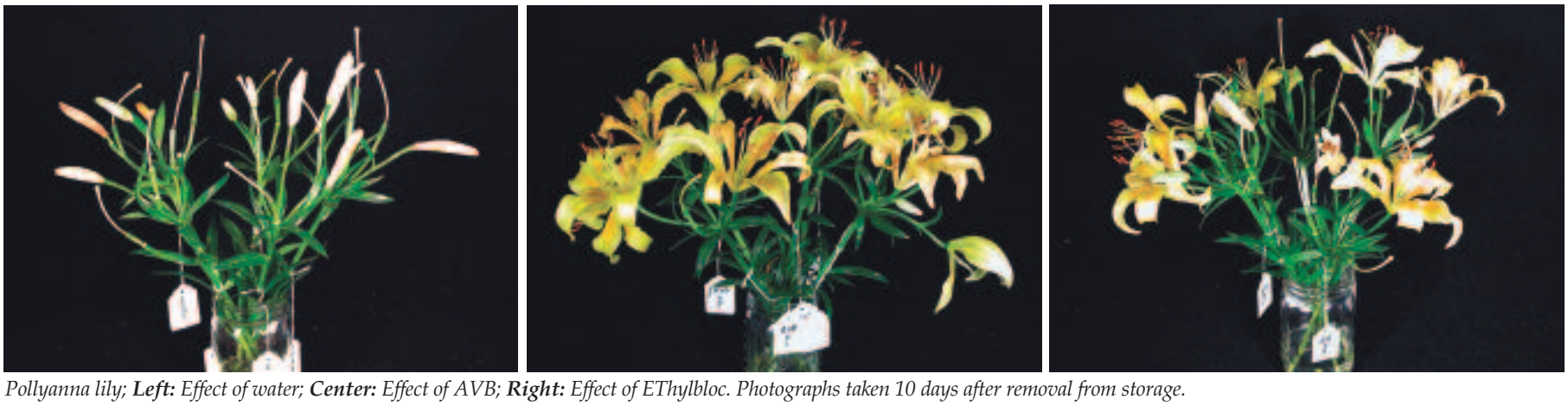
For carnation, delphinium and gypsophila tap water had no effect. Tap water did have an effect on bouvardia; however, the results were mixed in that tap water was best with stems subsequently stored dry, while deionized water was best with stems subsequently stored wet. Overall, it appears that either tap water or deionized water can be used with AVB. Note that our tap water is relatively high quality with a pH of 6.1 and an EC of 0.21.

TAKE HOME MESSAGE

The 19 cut flower taxa could be organized into four groups based on effectiveness of AVB and Ethylbloc.

1) Both AVB and Ethylbloc increased vaselife, but AVB was more effective: carnations (all three cultivars), bouvardia, lily and sweet pea. For all of these species the use of AVB would be recommended at all times, regardless of storage method.

2) Both AVB and Ethylbloc prevented the negative effects of dry storage: ➧



Pollyanna lily; ***Left:*** *Effect of water;* ***Center:*** *Effect of AVB;* ***Right:*** *Effect of EThylbloc. Photographs taken 10 days after removal from storage.*

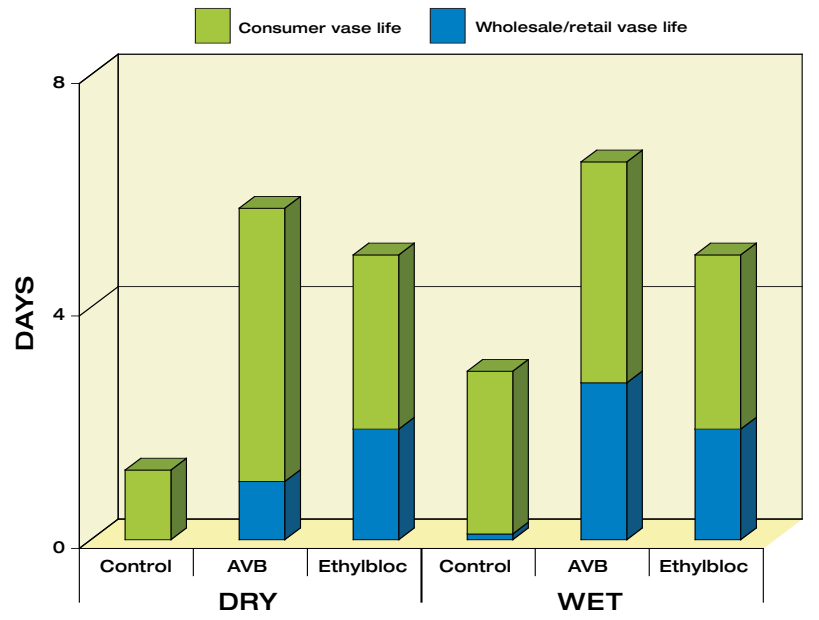
crop cultivation

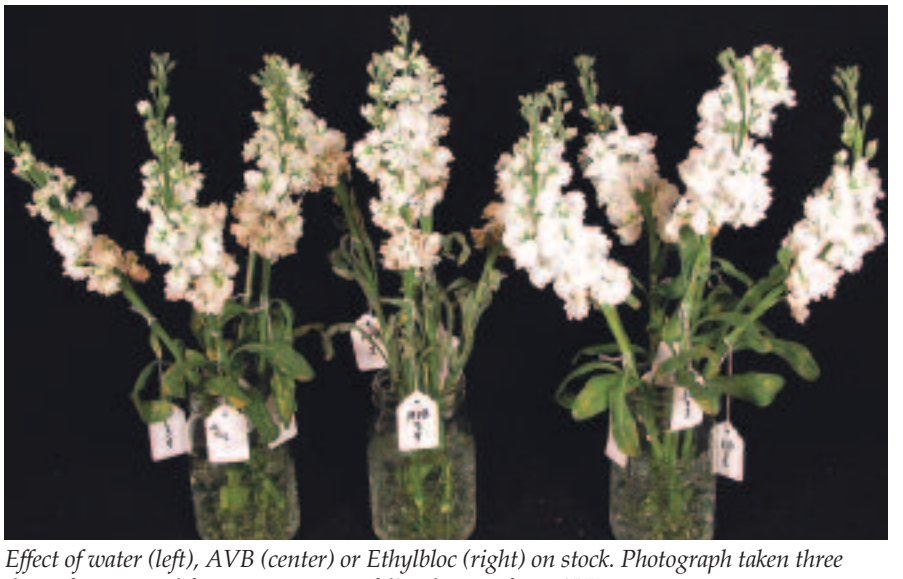
freesia (both cultivars) and waxflower (one cultivar). For both of these species, either AVB or Ethylbloc would be recommended any time cut stems are to be shipped or stored dry. As no differences occurred among AVB- or Ethylbloc-treated flowers and untreated controls when stored wet, growers who do not ship dry would not need to use AVB or Ethylbloc.

3) AVB increased vaselife, while Ethylbloc did not: alstroemeria, delphinium, gypsophila and stock. For delphinium the use of AVB would be recommended at all times, regardless of storage method due to the dramatic increase in consumer vaselife of 5.2-6.8 days (173-210 percent). For gypsophila the results were less clear, as AVB increased consumer vase life by only 1-2 days (16-33 percent). Growers would need to evaluate the effectiveness of AVB in relation to the cost. For alstroemeria AVB provides only a modest increase in consumer vase life of 2.8 days (18 percent) to an already long-lasting species. In addition, AVB was effective only on stems stored wet. Thus, growers would need to evaluate the usefulness of AVB on alstroemeria in relation to the cost. The use of AVB on stock is likely to be beneficial, assuming that the proper concentration can be found, especially since other published reports noted a benefit from AVB treatment without foliar damage.

4) AVB and Ethylbloc either had no effect or negative effects: larkspur, lisianthus, ranunculus, snapdragon and wax flower (one cultivar). For all of these species at least one report in the literature indicated that AVB or Ethylbloc would be useful. Differences between our work and previously published reports may be due to different cultivars or other experimental procedures. Certainly, we tried to follow standard industry procedures, and the lack of effectiveness of AVB or Ethylbloc in our work implies that those compounds may not be effective for growers.

Figure 5. Effect of AVB and Ethylbloc on sweet pea stored either dry in floral boxes or wet in buckets of water.





Effect of water (left), AVB (center) or Ethylbloc (right) on stock. Photograph taken three days after removal from storage. Note foliar damage from AVB.

Effect of water (left), AVB (center) or Ethylbloc (right) on Winter Elegance sweet pea. Photograph taken four days after removal from storage.

Effect of water (left), AVB (center) or Ethylbloc (right) on Early Pink waxflower. Photograph taken seven days after removal from storage.

Obviously, growers should experiment with the use of AVB or Ethylbloc on these species to determine effectiveness in their operations. GPN

John Dole, William Fonteno and Sylvia Blankenship are professors at the Department of Horticultural Science at North Carolina State University, Raleigh, N.C. They can be reached by phone at (919) 515-3537.

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