

GIBBERELIC ACID AND SUCROSE DELAY SENESCENCE OF CUT *LUPINUS DENSIFLORUS* BENTH FLOWERS

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ABSTRACT

The inflorescence of *L. densiflorus* consists of tiers of attractive yellow flowers grouped 6-7 per node. Unlike some other lupines, where both flower abscission and senescence affect vase life, flower senescence is the key factor in *L. densiflorus* that influences postharvest quality and display life of cut inflorescences. This study was undertaken to optimize postharvest protocols for cut inflorescences of *L. densiflorus* and evaluates the role of gibberellic acid (GA) and sucrose on senescence of flowers. Two lines of *L. densiflorus* (light yellow or dark yellow flowers) served as the experimental material. Cut inflorescences were placed in vases containing GA (1-20 mg/l) and sucrose (1-4%) solutions at 22–25°C under illumination (30 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{sec}^{-1}$) for 12 hours per day. Sucrose in the holding solution effectively delayed the onset of flower senescence in both the light yellow and dark yellow flowered lines. As with sucrose, the presence of GA was very effective in delaying flower senescence. Sucrose and GA, in combination, were even more effective than either sucrose or GA alone.

INTRODUCTION

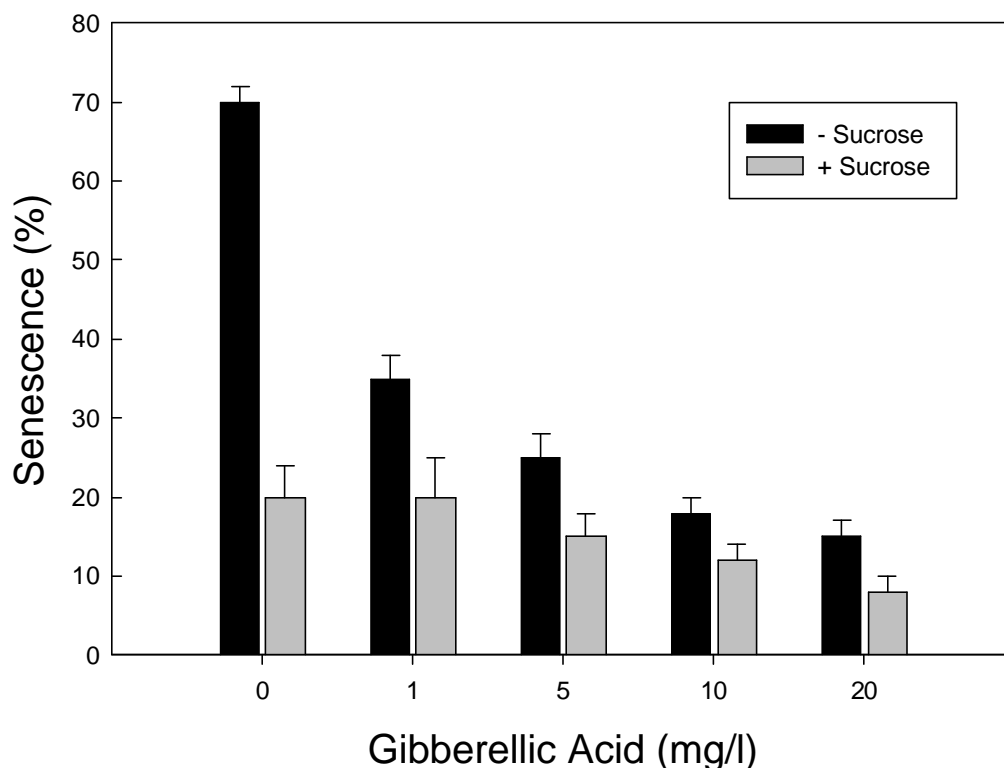
Cut inflorescences of *Lupinus* species have potential as specialty cut flowers, but their sensitivity to ethylene varies widely among species and even in selections within species (3). In some species (e.g., *L. havardii*) flower abscission is particularly sensitive to the presence of ethylene, while in others (e.g., *L. densiflorus*) the cut flowers do not exhibit any abscission even in the presence of a very high concentration of 2-chloroethylphosphonic acid (CEPA) in the holding solution (3). However, in *L. densiflorus* floral senescence is considerably hastened in the presence of CEPA. Earlier we observed that both sucrose and thidiazuron partially counteracted the flower senescence-accelerating effect of ethylene (unpublished results). This study was undertaken to evaluate the role of gibberellic acid (GA), alone and in combination with sucrose, on senescence of *L. densiflorus* flowers.

MATERIALS AND METHODS

Cut inflorescences of two lines of *L. densiflorus var aureus* (Kellog) Munz, one producing 'light' yellow and the other 'dark' yellow flowers, were obtained from plants grown in a non-shaded greenhouse. Cut inflorescences were placed in vases containing GA (1-20 mg/l) and sucrose (1-4%) solutions at 22-25°C under cool white fluorescent bulbs (30 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{sec}^{-1}$) for 12 hours per day. The number of senescent flowers was scored daily and the vase life evaluated at the termination of the experiment.

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Fig. 1. Effect of GA, alone and with sucrose (2%), on flower senescence.



RESULTS AND DISCUSSION

Flowers in *L. densiflorus* are produced in a whorl of 6-7 per node. The senescence of flowers proceeds in an acropetal succession starting from the lowest flowering node.

Individual flowers exhibit typical leguminous features including a relatively big standard (banner spot) petal, two wings and a keel which encloses the ovary and stamen. The first visible signs of petal senescence become apparent at the tip of standard petal with the development of a brownish tinge followed by darkening, discoloration, wilting and drying of the other petals. During the late phase of senescence, a change in the angle of flower peduncle resulting in inrolling of petals towards the inflorescence axis also frequently occurs, especially in the light yellow flowered line.

Incorporation of GA in the holding solution considerably delayed the onset of flower senescence in both the dark yellow (Fig. 1) and the light yellow flowered lines of *L. densiflorus*. This confirms the observations made previously that some flowers last longer when they are held in solutions containing GA (1, 2). In the presence of GA, the flowers often increased in size followed by promotion of elongation of the ovary which resulted in a protrusion of the style and stigma out of the keels. In GA, the cut inflorescences remained fresh with big yellow flowers for at least 8-10 days. As with GA, sucrose considerably delayed the senescence of flowers and increased the size of the flowers. Often in the presence of sucrose, 1-2 additional whorls of flowers opened during the vase life due to opening and growth of additional flower buds.

Sucrose and GA, in combination, proved even more effective in delaying flower senescence than either compound alone (Fig. 1). As a result, the postharvest display life and longevity of flowers indicated a distinct improvement in comparison to control.

Petal senescence is a key factor affecting vase life and quality of cut flowers. Although several plant growth regulators are known to play a role in petal senescence, most studies have focused on ethylene which acts as a promoter of senescence (1, 4). In those flowers where senescence is regulated by ethylene, sugars considerably delay senescence mainly by decreasing ethylene sensitivity (5). A recent study involving analysis of cDNA micro-arrays indicates that sugar feeding delays expression of the same group of several thousand genes as STS which blocks the ethylene receptor (5). Additionally, sugar has also been shown to inhibit ethylene production by decreasing ACC oxidase and ACC synthase activities (6). It is likely that the increased effectiveness of sucrose in delaying flower senescence in *L. densiflorus* may be due to its effect on ethylene sensitivity /production. The above contention is supported by our earlier observation that pretreatment with either STS or 1-MCP effectively delays flower senescence in *L. densiflorus*.

Recent evidence suggests that, like ethylene, even ABA may act as a natural regulator of senescence in some flowers (2), and GA effectively retards the ability of ABA to induce senescence. In *L. densiflorus* also we have observed a distinct antagonism between GA and ABA in influencing floral senescence in cut flowers (unpublished data). However, more studies are necessary to determine whether the effect of GA is due to its ability to antagonize ABA action or is due to its direct effect on senescence.

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