# EFFECT OF ETHANOL AND SUCROSE ON DISPLAY LIFE OF CUT RACEMES OF *LUPINUS HAVARDII*

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## ABSTRACT

By recurrent selection and breeding, we have developed blue, white and pink colored genotypes of *Lupinus havardii* Wats. that have great potential as a specialty cut flower crop. Our current improved genotypes show very little flower abscission, although some flowers do senesce during vase life. This investigation forms a part of our ongoing studies related to evaluation of post harvest performance of cut racemes, and reports the results of the effect of ethanol (1-10%), alone and in combination with sucrose (SUC), on flower senescence and vase life of cut racemes. Increasing concentrations of ethanol reduced the senescence of flowers and greatly enhanced their display life. Ethanol (>5%), depending upon the genotype, induced moderate to severe collapse of inflorescence axis above the vase solution, although the flowers remained fresh for a long time. SUC and ethanol, in combination, acted additively, and further extended the vase life. Our initial experiments using ethylene inhibitors/promoters revealed that the effects of ethanol are partially mediated via inhibition of ethylene production and ethylene sensitivity.

## INTRODUCTION

Inhibition of ethylene synthesis and flower senescence in carnation by ethanol was first described by Heins in 1980. Ethanol prevented climacteric ethylene, inhibited conversion of ACC to ethylene, interfered with action of ACC-synthase, and inhibited the formation of ACC (Heins, 1980; Wu et al., 1992). By preventing ethylene formation as well as ethylene action, and many of the normal senescence and metabolism related processes ethanol treatment results in enhanced vase life of carnation flowers (Podd et al., 2002). Recently, there had been a renewed interest in evaluating the potential benefits of ethanol liquid and/or vapors in the production and/or post harvest handling of both potted and cut floral crops. Since the reported responses to ethanol vary widely in different plants (http://www.chainoflifenetwork.org/moa/dbs/post_harvest/default.cfm) it is necessary to test the efficacy of ethanol in different floral crops.

This study forms a part of our ongoing research on post harvest performance of cut racemes of Big Bend bluebonnet, which has potential as a new specialty cut flower crop (Mackay et al., 2005), and summarizes our results relating to the effect of ethanol and sucrose on postharvest display life of cut racemes.

## MATERAILS AND METHODS

Pants of *Lupinus havardii* Wats. were grown in non-shaded green houses at Agriculture Research Center of Texas A&M University, Dallas. Cut racemes of three enotypes viz., Blue Select (BS), 'Texas Ice' (TI) and Pink Bulk (PB) were used in this study (Mackay et al. 2005).The racemes were put into glass vases containing either water or test solution containing 1-10% ethanol at

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22±2°C under cool florescent lamps (30µmol.m$^{-2}$.sec$^{-1}$). An experiment was also performed to study the effect of ethanol and sucrose in combination.

## RESULTS AND DISCUSSION

As reported earlier for carnations and chrysanthemum flowers (Wu et al., 1992; Petridou et al., 2001) ethanol treatment delayed the senescence of flowers and improved the quality of vase life of cut racemes of bluebonnet (Table 1). Incorporation of sucrose together with ethanol resulted in further enhancement of post harvest display life of the cut racemes. Earlier we reported that sucrose and GA in combination considerably improved the display life of Big Bend bluebonnet, while STS and 1-MCP, inhibitors of ethylene perception, completely prevented flower abscission (Mackay et al., 2005). The results of the current study indicate that sucrose and ethanol in combination also act additively in delaying flower senescence and extending vase life and longevity (Table 1). In fact, the first batch of flowers of the season, consisting mainly of the vigorously growing racemes originating from the primary floral axis responded even better, and it was not unusual for these racemes to exhibit a vase life of 16-18 days in the presence of ethanol and sucrose in combination.

It has been reported previously that high concentrations of ethanol weaken the flowering axis in carnation causing stem topple (Heins, 1980; Wu et al., 1992). Depending on the concentration of ethanol used and the genotype, a low to severe collapse of flowering axis was also observed in cut racemes of Big Bend bluebonnet

(Fig. 1). The white flowered genotype 'Texas Ice' was found to be relatively more resistant to axis collapse in response to ethanol than the blue flowered 'Blue Select' and the pink flowered 'Pink Bulk' genotypes. However, in spite of the axis collapse the flowers continued to keep fresh without any apparent signs of senescence for an extended period of time (Fig. 1).

Ethanol improves post harvest display life and longevity of flowers by disrupting many of the processes related to metabolism and senescence including ethylene biosynthesis and action (Wu et al., 1992; Podd et al., 2002). Results of our preliminary study indicate that in cut racemes of Big bend bluebonnet, incorporation of ethanol in the medium considerably reduced the promotion of flower abscission/senescence induced by either ACC or CEPA (unpublished data), and a pretreatment with STS and 1-MCP also effectively prevented flower abscission and senescence (Sankhla et al., 2004). These results are in accordance with the previously reported observations that the effects of ethanol are mediated via its effect on ethylene metabolism. In addition to ethylene metabolism, ethanol also affects other metabolic processes (Podd et al., 2002). Recently, ethanol has been shown to mimic some effects induced by GA in potato tuber sprouting and down regulates the action of some of the genes involved in cell division, starch biosynthesis, and storage proteins (Vreugdenhill et al., 2006), albeit via partly different signaling pathways than those affected by GA. Our results with Big Bend bluebonnet indicate that both ethanol and GA(unpublished data) and ethanol and sucrose, in combination act additively in improving post harvest life of cut racemes of Big Bend bluebonnet. However, prior evaluation of suitable concentration is necessary to avoid axis collapse due to high ethanol level in the holding medium.

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Table 1. The effect of ethanol (ETH) and sucrose (SUC) on flower senescence and vase life of *Lupinus havardii* genotypes 'Texas Ice' (TI), Blue Select (BS) and Pink Bulk (PB).

| Concentration (%) | Flower senescence (%) | | | Vase Life (Days) | | |
|---|---|---|---|---|---|---|
| | TI | BS | PB | TI | BS | PB |
| 0 | 10±4 | 22±3 | 25±3 | 10±2 | 7±1 | 8±1 |
| $ETH_1$ | 8±2 | 18±2 | 20±2 | 10±2 | 8±1 | 8±2 |
| $ETH_5$ | - | 5±1 | 8±2 | 14±1 | 12±1 | 12±1 |
| $ETH_{10}$ | - | - | - | - | - | - |
| $SUC_2$ | 6±1 | 10±2 | 8±2 | 14±1 | 11±1 | 12±2 |
| $SUC_2$+$ETH_5$ | - | - | - | 16±1 | 14±1 | 14±1 |

Fig. 1. Collapse of raceme axis in response to ethanol in the vase solution. Note that the flowers remained fresh even after axis collapse and the white breeding lines are relatively more resistant to ethanol than the other lines.