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VASE-LIFE AND BUD FORCING OF CARNATIONS

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SUMMARY

An investigation was made into the effectiveness of four treatments for increasing vase-life and forcing buds of carnations (*Dianthus caryophyllus* L.). The treatments were Aadural-AK, 8 hydroxyquinoline citrate plus sucrose, lemonade, and water (the control). These treatments were applied to carnation buds at three stages of development: tight, square, and open.

Mean weight change was shown to be a useful indicator of vase-life. Three treatments successfully increased the vase-life of open flowers. The best treatment was 8 hydroxyquinoline citrate plus sucrose which increased the vase-life of open carnation flowers by 150% when compared with the control (water). Although the three chemical treatments successfully forced square buds, 8 hydroxyquinoline citrate plus sucrose failed to force tight buds. Aadural-AK and lemonade were both effective in forcing tight buds but, as lemonade caused a severe stem discoloration, Aadural-AK is considered to be the best treatment for bud forcing.

I. INTRODUCTION

Flower cultivars with a known long vase-life are always in popular demand. Most of the early research for floral 'preservatives' investigated substances to prevent the growth of bacteria in the holding water and consequent blockage of the vascular tissue of the stem. Copper coins and chloride bleaches were commonly used for this purpose, and both were generally unsatisfactory. Silver nitrate was used in Europe as a successful bactericide which produced no detrimental side effects to flowers. However, it was found that bactericides alone were not successful in increasing vase-life significantly.

Gamobkötő, Pais and Sembery (1968) showed that the sugar content of the stem decreased rapidly after cutting, and that this was associated with wilting of the flowers. Adding sucrose to the holding water can increase vase-life significantly and it was suggested that the mechanism of action of sucrose was to supply sugars for respiration and also to induce stomatal closure. However, most plants cannot utilize sucrose directly in metabolism, and this suggests that any respiratory effect must follow hydrolysis of sucrose to glucose and fructose, and uptake of the glucose for use in metabolism.

Marousky (1968) showed that cut flowers form a physiological plug in their vascular tissue, possibly as a result of harvest injury. Marousky (1968, 1969) showed that 8 hydroxyquinoline citrate (8HQC) inhibited, but did not prevent completely, vascular blockage in cut roses and gladioli.

The physiological activity of this chemical has been investigated by other workers. Larsen and Cromarty (1967) showed that 8HQC at concentrations greater than 300 p.p.m. inhibited the growth of a range of micro-organisms. However, Marousky (1969) reported that 8HQC inhibited vascular blockage even when rose stems were held in sterile solutions. Marousky (1971) showed that roses held better in acid solutions of pH 3 than in solutions of pH 5 to 7. However, the role of 8HQC in inhibiting vascular blockage could not be described wholly as a pH effect. It is suggested that 8HQC as well as sucrose has a role as an anti-desiccant.

Other compounds used to increase vase-life of cut flowers are anti-senescent agents. These have the effect of decreasing respiration rate and are usually salts of maleic hydrazide. Also, forms of aluminium ion are commonly used to aid stabilization of colour. In summary, most patented compounds to prolong vase-life contain some form of sugar, pH depressant, metallic salt and substances to suppress microbial growth.

Recent research has been oriented towards finding a substance which would not only prolong vase-life, but also allow continued development and opening of a flower after cutting in the bud stage. A substance of this type would allow damage caused by adverse weather and in transit to be minimized.

Kohl and Smith (1960) reported that carnation buds, cut at the stage when 6·4 to 25·4 mm (0·25 to 1 in.) of the petals protruded, would open if a floral preservative solution was used at 21.1°C. The more advanced carnation buds gave the best results. Holley and Cheng (1966) obtained similar results, and also investigated dry storage of carnation buds. Carnation buds dry-stored at 0.6°C kept at least as well after storage as open flowers, and carnations in the bud stage withstood temperature stresses better than open flowers.

The aim of this trial was to compare the effectiveness of three solutions, Aadural–AK, 8HQC plus sucrose, and lemonade in prolonging the vase-life and in bud-forcing, that is, opening flowers from the bud stage. Aadural–AK has been introduced in Europe by N.V. Aagrunol Ltd., of Groningen. In tests, this chemical has been shown to bring carnations cut in bud into full flower without any loss of quality or vase-life. In the United States, 8HQC plus sucrose has been used (Hardenburg, Vaught and Brown 1970, Holley and Cheng 1966, and Marousky 1968 and 1969) to force chrysanthemum and carnation buds and to prolong the vase-life of many flowers. Lemonade is a carbonated beverage of pH 3 containing 11% sucrose, 5% apple juice, 1.1% citric acid and 0.028% sodium benzoate. It is used locally to increase the vase-life of cut flowers.

II. MATERIALS AND METHODS

American Sim Carnations (*Dianthus caryophyllus* L) were obtained from a commercial grower at Victoria Point, near Brisbane. These were graded into three classes (plate 1). Tight buds were tapered at the tip with less than 0·5 cm of colour showing. Square buds were flattened at tip with 0·5 to 1·0 cm of colour showing. The amount of colour showing was measured vertically from the tips of the sepals. Buds classified as open were those with a diameter greater than 6·0 cm.

Each bud was weighed and its diameter measured. The buds were placed in order in plastic buckets containing 2 litres of solution and supported by Nylex Trical Mesh. This mesh support allowed data to be collected on individual buds. Thermohygrographs showed that the mean daily and mean nightly temperatures during this trial were 22 and 18°C respectively. The relative humidity ranged from 80 to 100%.

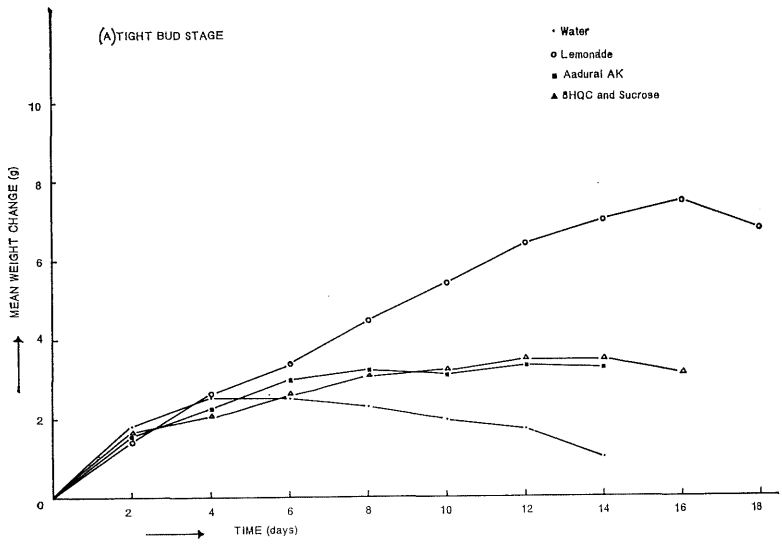
Four treatments were used; distilled water, lemonade, Aadural–AK at the manufacturer's recommendation of 40 g l^{-1} and a 600 p.p.m. solution of 8HQC containing 2% w/v AR sucrose. Solutions were not changed during the trial. The design was a completely randomized block with two replicates and five buds per replicate. Data were collected on weight and diameter of each bud every second day until wilting occurred.

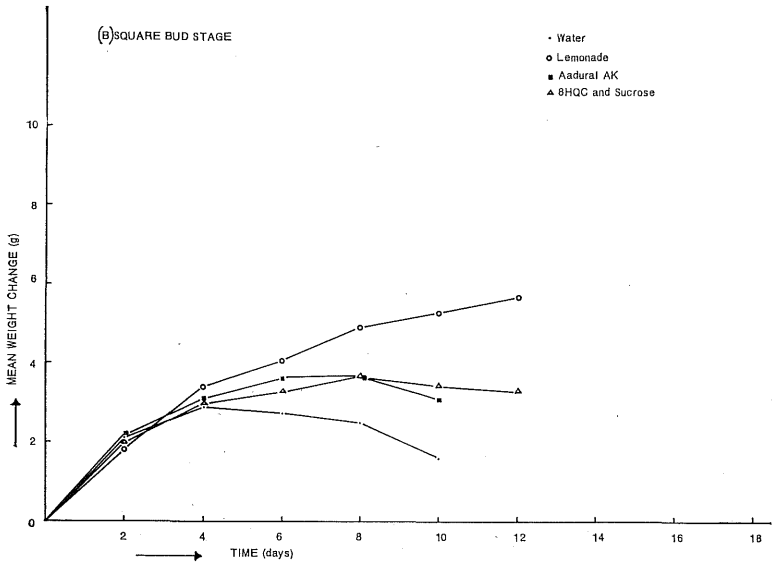
Analyses of variance were conducted on vase-life data within each bud stage and among bud stages enabling a chemical x bud stage interaction to be estimated. In figures 1A, 1B and 1C, data are presented as a mean weight-change of buds plotted against time in each treatment. Vase-life was measured as the number of days to the maximum mean weight change. Analyses of variance were conducted for bud diameter for tight buds at the fourth, eighth and twelfth day and for square buds at the fourth and eighth day.

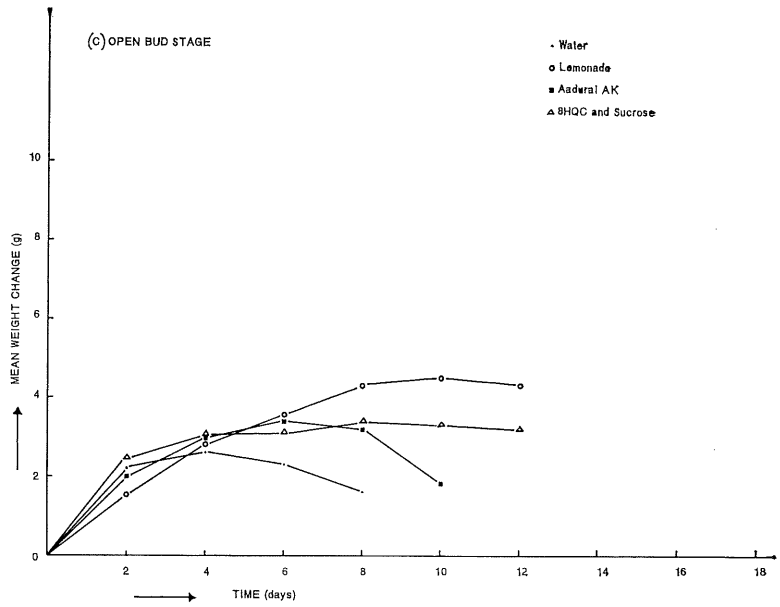
III. RESULTS

Plate 1.—Bud stages

Figure 1—Relationship between mean weight change and time when carnations from each bud stage are held in each treatment.







IV. DISCUSSSION

Assessment of the vase-life of cut flowers has been made by a visual scoring method based on loss of turgidity and petal burn (Holley and Cheng 1966; and Hardenburg, Vaught and Brown 1970). However, it has been demonstrated that vase-life is related to fresh weight (Marousky 1971). In this trial, mean fresh weight change was a useful indicator of vase-life, and a rapid decrease in mean weight change indicated the end of the vase-life (figures 1A, 1B, 1C). All chemical treatments were successful in increasing the vase-life of open flowers (figure 1C, table 1). The best treatment was 8HQC plus sucrose which increased the vase-life of open flowers by 150% when compared with water. The lemonade and 8HQC plus sucrose treatments provided similar vase-lives.

TABLE 1

MEAN VASE-LIFE (DAYS) FOR FOUR HOLDING CHEMICALS AND THREE BUD STAGES

—	Tight	Square	Open
Water	6·2	5·0	4·4
Lemonade	16·9	13·8	10·2
Aadural-AK	14·7	7·6	7·2
8HQC + sucrose	13·2	9·8	11·0
LSD 5%	1·65	1·86	1·58

The similarity of the results presented in figures 1A, 1B and 1C suggests that the two processes, increasing vase-life and bud-forcing, may be operating through similar mechanisms. Thus it is likely that a chemical which increases vase-life will also be successful as a bud-forcing agent. An exception to this was 8HQC plus sucrose, which was successful in increasing vase-life of open flowers but which failed to force tight buds (tables 2 and 3).

TABLE 2

PERCENTAGE OF BUDS OPENED TO SIZE 6·0 cm

—	Tight	Square
Water	20	50
Lemonade	100	90
Aadural-AK	100	100
8HQC + sucrose	30	100

TABLE 3

MEAN DIAMETER (cm) OF BUDS SAMPLED FROM FOUR HOLDING CHEMICALS AT THREE INTERVALS

—	Day 4		Day 8		Day 12
	Tight	Square	Tight	Square	Tight
Water	2·60	5·40	3·37	5·72	4·13
Lemonade	2·92	6.67	5·84	7·62	7·62
Aadural-AK	3·43	7·05	4·95	7·49	6·92
8HQC + sucrose	2·54	6·16	3·29	6·92	4·83
LSD 5%	0·588	0·689	1·293	0·7801	1·002

It is necessary to consider changes in diameter in addition to changes in mean weight to describe the effectiveness of the treatments for bud-forcing. All treatments forced square buds but only lemonade and Aadural–AK forced tight buds (tables 2 and 3). The failure of 8HQC plus sucrose to force the tight buds in this trial does not necessarily contradict previous work (Hardenburg, Vaught and Brown 1970; Holley and Cheng 1966; and Kohl and Smith 1960) as the buds were tighter than those previously used. The rate of opening of tight buds was greater initially for those in Aadural–AK but the buds in lemonade reached a greater size by the twelfth day (table 3).

Although lemonade was effective both in prolonging vase-life and in bud-forcing, it had two disadvantages. It caused a severe discoloration of the stem, evident by the fourth day, and economically it does not compare favourably with the costs of Aadural–AK and 8HQC plus sucrose. These disadvantages will inhibit its use commercially.

Two related areas appear to show promise for further work. These are holding flowers in these treatments at a low temperature to extend the holding periods, and studying vase-life and bud-forcing when carnations are held in these chemicals for varying periods of time and later placed in water.

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