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## EFFECTS OF STORAGE LIGHTING AND TEMPERATURE ON METABOLISM AND KEEPING QUALITY OF CHRYSANTHEMUM MORIFOLIUM CUT-FLOWERS RELATIVE TO NITROGEN FERTILIZATION.[1]

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The effect of illumination upon keeping quality of chrysanthemums and other cut-flowers has been investigated to a very limited degree. Light was found to increase vase life of chrysanthemums by maintaining the carbohydrate food supplies in the leaves at useful levels. It has also been shown that chrysanthemum leaves from cut-flowers are capable of carrying on significant amounts of photosynthesis at a temperature of 45°F found in cold storage. The objective of this investigation was to study the interrelationships of pre-harvest nitrogen nutrition and light and temperature in storage on the keeping quality and metabolism of chrysanthemum cut flowers.

Four rates of nitrogen (12, 24, 36, and 48 lbs/A/week) and 3 fertilizer schedule durations (weekly for 6, 10, and 14 weeks) were applied to 'Iceberg' chrysanthemums grown in ground beds under "natural saran". Potassium was held constant at 25 lbs/A/week and applications were terminated along with the nitrogen variable after 6, 10, and 14 weeks. Nitrogen and potassium were derived from $NH_4NO_3$ and $K_2SO_4$ and applied as a liquid weekly. Rooted cuttings were set November 1, pinched 2 weeks later, pruned 4 weeks after setting, and long-day cycles terminated 6 weeks after setting.

Keeping quality of cut flowers was measured in terms of the number of days required for leaves and flowers to deteriorate to the extent that they would be of no value to the consumer. The severe end point of longevity was set intentionally so that differences between treatments could be fully recognized.

Three stems from each plot were placed in quart glass jars containing 5 inches of distilled water with 2 drops of 5% sodium hypochlorite per liter. Stems 30 inches in length with leaves stripped from the lower 8 inches were used. Water was replaced in each jar weekly, at which time

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a one-half inch portion of each stem base was removed. Lighting (120 foot-candles) was provided by "cool white" fluorescent tubes under glass panes which supported the flowers held in transparent glass jars. Complete darkness was provided by the use of wooden frames covered with heavy cloth. Bottom lighting was used to avoid the shading effect of flowers.

The effects of nitrogen variables on 'Iceberg' cut-flower quality are shown in Table 1. Each increase in nitrogen rate as well as each increase in duration of weekly fertilization was associated with a significant increase in nitrogen content for both flowers and leaves. The average weight per stem increased for all increases in nitrogen rate and duration except from 36 to 48 lb. of nitrogen. Foliage was consistently greener with increases in either nitrogen variable.

Chlorophyll contents of leaves decreased with the passage of storage time (Table 2). Light and refrigeration each retarded the rate of loss of chlorophyll, and together their effects were additive in prolonging the life of leaf chlorophyll as evidenced by the data for the 6 weeks storage.

Table 1. Effect of rate and duration of nitrogen fertilization upon nitrogen content, weight per stem and foliage color of chrysanthemum cut-flowers at harvest.

| Fertilization | Nitrogen content (% dry wt) | | Avg fresh wt of flowers, gram/stem | Avg foliage color index[a] |
|---|---|---|---|---|
| | Leaves | Flowers | | |
| **Nitrogen rate** | | | | |
| 12 lb/acre/week | 3.12 | 1.90 | 56 | 2.4 |
| 24 lb/acre/week | 3.78 | 2.32 | 64 | 3.6 |
| 36 lb/acre/week | 4.19 | 2.38 | 71 | 3.9 |
| 48 lb/acre/week | 4.46 | 2.53 | 72 | 4.6 |
| **Weeks Nitrogen applied** | | | | |
| 6 weeks | 3.31 | 1.99 | 59 | 2.9 |
| 10 weeks | 3.81 | 2.15 | 67 | 3.6 |
| 14 weeks | 4.54 | 2.70 | 71 | 4.4 |

[a]Color rating index, 1-5, where 1 = yellowish green, 2 = light green, 3 = medium green, 4 = dark green, and 5 = very dark green.

Chlorophyll content at harvest increased in response to increased rates of nitrogen application, and this increase was still evident at 1, 2, 4, and 6 weeks of storage after harvest. Longer periods of nitrogen fertilization resulted in higher initial chlorophyll contents as well as higher contents at subsequent samplings during storage. The effects of lengthening the period of nitrogen application on chlorophyll content was similar to the effects of increasing the rates of nitrogen applied.

Lighting and refrigeration during storage prolonged the existence and increased the magnitude of the photosynthetic capacity in leaves. There was an additive effect in that light together with refrigeration maintained photosynthetic capacity for the longest period of time.

Table 2. Effect of light (L), temperature, nitrogen rate, and duration of nitrogen fertilization upon average chlorophyll content of leaves of chrysanthemum cut-flowers.

| Variables | Chlorophyll, mg/g fresh wt. x $10^{-2}$ (weeks of storage) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 weeks (at harvest) | 1 week | | 2 weeks | | 4 weeks | | 6 weeks |
| | | Dark | Light | Dark | Light | Dark | Light | Light |
| **Temperature (T)** | | | | | | | | |
| 45°F | 191 | 158 | 153 | 130 | 130 | 93 | 79 | 19 |
| 75°F | 191 | 64 | 152 | 0[a] | 121 | a | a | a |
| Means | 191 | 109 | 155 | 65 | 126 | | | |
| **Nitrogen rate (R)** | | | | | | | | |
| 12 lb/acre/week | 153 | 107 | 135 | 39 | 96 | 58 | 42 | a |
| 24 lb/acre/week | 190 | 97 | 154 | 58 | 119 | 67 | 67 | a |
| 36 lb/acre/week | 203 | 117 | 164 | 76 | 136 | 110 | 86 | a |
| 48 lb/acre/week | 220 | 119 | 173 | 85 | 151 | 138 | 122 | 57 |
| **Weeks Nitrogen applied(W)** | | | | | | | | |
| 6 weeks | 158 | 101 | 145 | 55 | 102 | 65 | 52 | a |
| 10 weeks | 198 | 101 | 155 | 60 | 116 | 61 | 68 | 19 |
| 14 weeks | 220 | 124 | 167 | 79 | 158 | 154 | 115 | 39 |

[a] Leaves had completely deteriorated prior to this sample.

The respiration rete of leaves sampled at the beginning of storage was generally greater than rates determined for subsequent sampling.

Light and refrigeration were both effective in prolonging storage life of chrysanthemum cut-flowers (Table 3). The effect of light was much more effective in prolonging the life of leaves than of flowers. Flowers were relatively long-lived in the dark at 45°F; however, light and refrigeration effects were additive in producing greater longevity of leaves and flowers. Increasing the nitrogen rate increased the longevity of leaves in the light but had little effect in the dark. Increasing nitrogen rates decreased longevity of flowers in the dark but slightly increased longevity in the light. Longer durations of nitrogen application increased longevity of leaves and flowers in the light but decreased the longevity in the dark.

## Summary

Light and refrigeration each prolonged the storage life of the cut-flowers; and together were additively beneficial. At 45°, the longevity of leaves was increased 34% by light and at 75°, longevity of leaves was increased by 240%. Light increased the longevity of flowers by 12% at 45°and by 57% at 75°. Light and refrigeration during storage retained the photosynthetic capacity of leaves at higher levels and for longer durations than did storage conditions of darkness and elevated temperatures. Increasing rates and duration of nitrogen application resulted in increased chlorophyll content and usually of photosynthetic capacity of leaves at harvest as well as after 1, 2, and 4 weeks of storage. Increasing nitrogen rates resulted in improved keeping quality of leaves in lighted storage, but had little effect in the dark. Increases in the duration of nitrogen fertilization resulted in increased keeping quality of leaves in the light but had no effect on leaves in the dark. Increased duration of nitrogen application had no effect on keeping quality of flowers in the light and decreased the keeping quality in the dark.

Table 3. Effect of light (L), temperature, Nitrogen rate, and duration of Nitrogen fertilization on storage life of chrysanthemum leaves and flowers.

| | Avg number of days longevity[a] | | | |
|---|---|---|---|---|
| | Leaves | | Flowers | |
| | Dark | Light | Dark | Light |
| **Temperature (T)** | | | | |
| 45°F | 27.8 | 37.2 | 33.1 | 37.0 |
| 75°F | 7.6 | 25.9 | 12.7 | 20.0 |
| **Nitrogen rates (R)** | | | | |
| 12 lb/acre/week | 17.1 | 27.9 | 23.4 | 27.7 |
| 24 lb/acre/week | 18.3 | 30.5 | 23.9 | 28.3 |
| 36 lb/acre/week | 17.9 | 33.2 | 22.7 | 29.1 |
| 48 lb/acre/week | 17.5 | 34.5 | 21.6 | 28.8 |
| **Weeks Nitrogen applied (W)** | | | | |
| 6 weeks | 17.9 | 29.1 | 24.4 | 28.1 |
| 10 weeks | 17.6 | 31.4 | 22.9 | 28.7 |
| 14 weeks | 17.6 | 34.2 | 21.5 | 28.6 |

[a]Longevity of leaves and flowers is expressed as the number of days elapsed when the leaves and flowers had completely withered.