*J. Hort. Sci.*
**Vol. 2 (2): 148-152, 2007**

# Effect of date of harvest and floral preservatives on vase life of cut flowers in tuberose (*Polyanthes tuberosa* L.) cv. Double

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## ABSTRACT

**Studies conducted to find out the effect of date of harvesting and floral preservatives on vase life and quality of tuberose cv. Double revealed that among treatments, harvesting on 1st October ($D_8$) was better for longer vase life, whereas, 15th August ($D_5$) for minimum loss of water, maximum fresh weight of the spike and percentage of opened florets. Similarly, harvesting on 15th September ($D_7$) was found better for longest floret longevity as well as loss uptake ratio. In case of floral preservatives, the treatment 500 ppm aluminum sulphate + 4% sucrose ($C_6$) was found better for longer vase life, maximum uptake of water, lowest loss-uptake ratio and maximum fresh weight of spike, whereas, 400 ppm 8-HQS + 4% sucrose ($C_8$) for maximum floret longevity and floret circumference as well as maximum percentage of opened and lowest percentage of neck bent florets. The treatment, 50 ppm silver nitrate + 4% sucrose ($C_3$) exhibited lowest loss of water. In case of interaction effect, 1st October with 500 ppm aluminum sulphate + 4% sucrose ($D_8C_6$) was found superior for maximum vase life of spike, highest uptake of water and fresh weight of spike.**

**Key words :** Tuberose, vase life, floral preservatives

## INTRODUCTION

Tuberose is grown on a wide range of soil and climatic conditions but it flowers best in warm and humid climate. Among four types of tuberose, the Double floret type is mainly cultivated for cut flowers, whereas single types are grown for loose flower production and also for extraction of essential oil. The post harvest management is one of the most important factors in the production and marketing of cut flowers. At present flower growers are not aware of standardized post harvest technology including the harvesting time and use of floral preservatives to extend the vase life. Available literature indicated the meager work done on date of harvesting and hence an attempt is made to standardize the date of harvesting and use of floral preservatives in tuberose (*Polianthes tuberosa* L.) cv. Double to extend the vase life of cut flower during rainy season.

## MATERIAL AND METHODS

The present investigation was conducted at Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) during rainy season of the year 2003 and 2004 in the factorial C R D. The treatments comprised of different floral preservatives like $T_1$- sucrose @ 4%, $T_2$- Aluminum sulphate @ 500 ppm, $T_3$-Silver nitrate @ 50 ppm, $T_4$-8-HQS @ 400 ppm, $T_5$- citric acid @ 300 ppm and their combinations with sucrose @ 4% ($T_6$, $T_7$, $T_8$, $T_9$) and $T_{10}$- Distilled water (Control). The trial was repeated at fortnightly interval during the season with each of the 8 dates of harvesting ($D_1$ - 15th June, $D_2$ -1st July, $D_3$ -15th July, $D_4$ - 1st August, $D_5$ -15th August, $D_6$ - 1st September, $D_7$ - 15th September, $D_8$ -1st October) starting from 15th June, 2003 to 1st October, 2003. The same was repeated for second year during 2004. Observation on mean temperature, relative humidity and evapo-transpiration rate were recorded. Healthy, uniform and homogenous spikes were selected and harvested at one or two floret opening stage. Spikes were made to uniform length through trimming. Observations like uptake of water, water loss, loss-uptake ratio, fresh weight of spike, percentage of opened, partial opened, neck bent and abscised florets as well as floret longevity, floret circumference and vase life of the spikes were recorded.

**Table 1. Effect of date of harvesting and floral preservatives on vase life of spike, floret longevity and circumference of tuberose.**

| Treatments | Vase life (Days) | | | Floret longevity (Days) | | | Floret circumference (cm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2003 | 2004 | Pooled | 2003 | 2004 | Pooled | 2003 | 2004 | Pooled |
| | | | | | Date of harvesting | | | | |
| $D_1$ | 11.97 | 12.65 | 12.31 | 3.55 | 3.63 | 3.59 | 6.78 | 6.84 | 6.81 |
| $D_2$ | 11.72 | 11.87 | 11.80 | 4.16 | 4.16 | 4.16 | 7.26 | 6.85 | 7.06 |
| $D_3$ | 12.84 | 10.87 | 11.86 | 3.87 | 3.81 | 3.84 | 6.59 | 7.09 | 6.84 |
| $D_4$ | 11.30 | 10.52 | 10.91 | 4.09 | 3.86 | 3.97 | 6.27 | 6.09 | 6.18 |
| $D_5$ | 12.55 | 13.96 | 13.25 | 3.87 | 3.87 | 3.87 | 5.36 | 6.08 | 5.72 |
| $D_6$ | 10.97 | 10.30 | 10.63 | 4.22 | 4.67 | 4.45 | 6.70 | 6.71 | 6.71 |
| $D_7$ | 12.80 | 15.03 | 13.92 | 3.81 | 4.12 | 3.96 | 6.59 | 6.72 | 6.65 |
| $D_8$ | 14.25 | 14.43 | 14.34 | 3.86 | 4.16 | 4.01 | 6.42 | 6.56 | 6.49 |
| S.Em.± | 0.108 | 0.123 | 0.66 | 0.021 | 0.037 | 0.11 | 0.063 | 0.063 | 0.18 |
| C.D. *(P=0.05)* | 0.30 | 0.34 | 2.20 | 0.06 | 0.10 | 0.38 | 0.18 | 0.18 | 0.59 |
| | | | | | Floral preservatives | | | | |
| $C_1$ | 13.12 | 13.61 | 13.36 | 3.78 | 3.94 | 3.86 | 6.11 | 5.85 | 5.98 |
| $C_2$ | 13.09 | 13.26 | 13.17 | 4.14 | 4.65 | 4.39 | 6.77 | 6.64 | 6.70 |
| $C_3$ | 10.90 | 11.40 | 11.15 | 3.78 | 3.61 | 3.70 | 5.84 | 5.57 | 5.70 |
| $C_4$ | 12.25 | 12.16 | 12.20 | 4.39 | 4.05 | 4.22 | 7.45 | 7.86 | 7.65 |
| $C_5$ | 12.15 | 12.56 | 12.36 | 3.62 | 3.96 | 3.79 | 6.21 | 6.67 | 6.44 |
| $C_6$ | 14.37 | 14.50 | 14.44 | 4.37 | 4.56 | 4.46 | 6.92 | 7.28 | 7.10 |
| $C_7$ | 11.96 | 12.06 | 12.01 | 3.60 | 3.66 | 3.63 | 5.85 | 5.67 | 5.76 |
| $C_8$ | 12.72 | 12.37 | 12.54 | 4.44 | 4.49 | 4.46 | 7.84 | 7.99 | 7.91 |
| $C_9$ | 12.92 | 12.51 | 12.71 | 3.73 | 3.89 | 3.81 | 6.39 | 7.03 | 6.71 |
| $C_{10}$ | 9.52 | 10.13 | 9.82 | 3.42 | 3.55 | 3.49 | 5.60 | 5.63 | 5.62 |
| S.Em.± | 0.121 | 0.137 | 0.18 | 0.023 | 0.041 | 0.12 | 0.070 | 0.070 | 0.17 |
| C.D. *(P=0.05)* | 0.34 | 0.38 | 0.56 | 0.06 | 0.12 | 0.38 | 0.20 | 0.20 | 0.53 |
| | | | | | Interaction D x C | | | | |
| S.Em.± | 0.34 | 0.39 | 0.55 | 0.07 | 0.12 | 0.19 | 0.20 | 0.20 | 0.29 |
| C.D.*(P=0.05)* | 0.96 | 1.09 | 1.55 | 0.18 | 0.33 | 0.55 | 0.55 | 0.56 | NS |

## RESULTS AND DISCUSSION

### Vase life of spike

Maximum vase life of spike (14.34 days) was observed at 1st October ($D_8$) date of harvesting, whereas, among preservatives, highest (14.44 days) was recorded in 500 ppm aluminum sulphate+ 4% sucrose ($C_6$) (Table 1). The interaction was also found to be significant with their combination ($D_8C_6$). Similarly minimum vase life (10.63 and 9.82 days) was noted at $D_6$ (1st September) and under control ($C_{10}$), respectively, as well as in their interaction ($D_6C_{10}$). The extended vase life might be due to decreased loss of water as well as loss-uptake ratio, tends to increase the water balance in the spike because of lower range of temperature and evapo transpiration with higher range humidity.

Aluminum sulphate is responsible for lowering the pH of petal and acidifying the holding water, this might have reduced the bacterial growth and improved water uptake. It also reduces transpiration by inducing the stomatal closure. Exogenous sucrose serves as source of energy and respiratory substrate for the maintenance of osmotic potential in flowers. The translocated sucrose accumulates in the flowers increasing its osmotic concentration which improves the ability of the tissue to absorb water and maintain turgidity. Similar results were also reported by Gowda (1990) and Reddy and Singh (1996) in tuberose.

### Floret longevity and circumference

Maximum floret longevity (4.45 days) was recorded in spikes harvested on 1st September ($D_6$). Among floral preservatives, highest floret longevity (4.46 days) was recorded in the $C_8$ treatment (400 ppm 8-HQS + 4% sucrose) (Table 1).

Highest floret circumference (7.06 cm) was registered in 1st July ($D_2$) harvested spikes and the treatment 400 ppm 8-HQS + 4% sucrose ($C_8$) recorded (7.91 cm). The interaction effect was significant for floret longevity, but not for circumference.

### Uptake of water, loss of water and water loss-uptake ratio

The uptake of water, loss of water and water loss-uptake ratio were significant (Table 2) and recorded the best values (83.10 g, 46.85 g and 1.53) in spikes harvested on 15th June ($D_1$), 15th August ($D_5$) and 1st October ($D_8$),

**Table 2. Effect of date of harvesting and floral preservatives on uptake of water, loss of water and loss-uptake ratio during vase life of tuberose.**

| Treatments | Uptake of water (g) | | | Loss of Water (g) | | | Loss-uptake ratio | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2003 | 2004 | Pooled | 2003 | 2004 | Pooled | 2003 | 2004 | Pooled |
| | | | | | Date of harvesting | | | | |
| $D_1$ | 84.53 | 81.67 | 83.10 | 137.23 | 124.87 | 131.05 | 1.68 | 1.58 | 1.63 |
| $D_2$ | 39.90 | 69.27 | 54.58 | 71.17 | 114.43 | 92.80 | 1.91 | 1.73 | 1.82 |
| $D_3$ | 34.97 | 39.70 | 37.33 | 59.03 | 71.03 | 65.03 | 1.74 | 1.97 | 1.86 |
| $D_4$ | 25.43 | 25.87 | 25.65 | 61.33 | 60.50 | 60.92 | 2.6 | 2.57 | 2.58 |
| $D_5$ | 26.93 | 27.27 | 27.10 | 38.20 | 55.50 | 46.85 | 1.56 | 2.22 | 1.89 |
| $D_6$ | 44.67 | 31.17 | 37.92 | 77.70 | 59.07 | 68.38 | 1.77 | 1.98 | 1.87 |
| $D_7$ | 53.03 | 71.33 | 62.18 | 104.80 | 105.33 | 105.07 | 2.15 | 2.15 | 2.15 |
| $D_8$ | 74.50 | 86.93 | 80.72 | 111.60 | 125.40 | 118.50 | 1.57 | 1.48 | 1.53 |
| S.Em.± | 0.344 | 0.695 | 6.71 | 0.594 | 0.911 | 9.69 | 0.029 | 0.041 | 0.14 |
| C.D. *(P=0.05)* | 0.96 | 1.95 | 22.41 | 1.66 | 2.55 | 32.33 | 0.08 | 0.12 | 0.46 |
| | | | | | Floral preservatives | | | | |
| $C_1$ | 53.62 | 61.38 | 57.50 | 80.88 | 92.92 | 86.90 | 1.52 | 1.63 | 1.57 |
| $C_2$ | 64.50 | 72.13 | 68.31 | 93.33 | 104.63 | 98.98 | 1.66 | 1.9 | 1.78 |
| $C_3$ | 36.79 | 37.17 | 36.98 | 72.17 | 72.63 | 72.40 | 2.18 | 2.42 | 2.3 |
| $C_4$ | 45.42 | 47.38 | 46.40 | 87.63 | 88.58 | 88.10 | 1.98 | 2.14 | 2.06 |
| $C_5$ | 36.67 | 52.58 | 44.63 | 73.13 | 85.75 | 79.44 | 2.05 | 1.87 | 1.96 |
| $C_6$ | 72.13 | 82.71 | 77.42 | 89.58 | 109.21 | 99.40 | 1.35 | 1.48 | 1.42 |
| $C_7$ | 37.75 | 40.50 | 39.13 | 75.54 | 69.96 | 72.75 | 2.1 | 1.94 | 2.02 |
| $C_8$ | 47.38 | 52.63 | 50.00 | 96.58 | 99.33 | 97.96 | 2.12 | 2.18 | 2.15 |
| $C_9$ | 47.50 | 51.67 | 49.58 | 81.29 | 86.75 | 84.02 | 1.76 | 1.9 | 1.83 |
| $C_{10}$ | 38.21 | 43.38 | 40.79 | 76.21 | 85.42 | 80.81 | 2.02 | 2.14 | 2.08 |
| S.Em.± | 0.385 | 0.777 | 2.29 | 0.664 | 1.018 | 3.72 | 0.032 | 0.046 | 0.07 |
| C.D. *(P=0.05)* | 1.08 | 2.18 | 7.30 | 1.86 | 2.85 | 11.88 | 0.09 | 0.13 | 0.24 |
| | | | | | Interaction D x C | | | | |
| S.Em.± | 1.09 | 2.20 | 5.67 | 1.88 | 2.88 | 7.18 | 0.09 | 0.13 | 0.19 |
| C.D. *(P=0.05)* | 3.05 | 6.16 | 16.03 | 5.26 | 8.06 | 20.31 | 0.26 | 0.37 | 0.55 |

respectively. This may be due to increased uptake of water associated with reduced loss of water resulting in optimum water balance in the spike. The highest loss-uptake ratio (2.58) was recorded in the spike harvested on 1st August ($D_4$). In case of floral preservatives, maximum uptake of water (77.42 g) and lowest loss-uptake ratio (1.42) were registered in 500 ppm aluminum sulphate + 4% sucrose ($C_6$), whereas, the minimum loss of water (72.40 g) was with 50 ppm silver nitrate ($C_3$). The interaction effect was also found significant and recorded superior at combinations 1st October harvesting + (500 ppm aluminum sulphate + 4 % sucrose) ($D_8C_6$) for uptake of water and loss-uptake ratio, whereas, $D_5C_3$ for loss of water. Both aluminum sulphate and sucrose, help in increased uptake and reduced loss of water. These results are in agreement with the findings of Reddy *et al* (1995) and Reddy and Singh (1996) in tuberose.

**Fresh weight of spike (g)**

Maximum fresh weight (60.72 g) at 14th day was recorded in 15th August ($D_5$) harvested spikes, which was at par with harvesting dates $D_8$, $D_7$, $D_3$ & $D_2$ (Table 3). The higher fresh weight might be due to higher water uptake coupled with lowest loss of water. Low temperature and high humidity during October might have reduced transpiration thus lowering water loss from the spikes.

Significantly highest spike fresh weight (68.71 g) was observed with 500 ppm aluminum sulphate + 4% sucrose ($C_6$), whereas, the lowest fresh weight (44.63 g) was recorded in control ($C_{10}$). It may be due to the fact that both aluminum sulphate and sucrose improve the water retention of the spike. Sucrose has been shown to act as an oxidisable respiratory substrate and antidesiccant and, thus, increases the fresh weight. Similar results were also obtained by Reddy and Singh (1996) and Bhaskar *et al (*2000) in tuberose.

**Percentage of opened and partially opened florets**

Maximum percentage of opened florets (46.39 %) was recorded in $D_5$ (Harvesting at 15th August) and among floral preservatives $C_8$ (400 ppm 8-HQS+ 4 % sucrose) recorded highest (58.20%). Similarly, for percentage of partial opened florets, maximum (5.34 and 5.11%) was observed in $D_6$ (Harvesting at 1st September) and $C_7$ (50 ppm silver nitrate + 4% sucrose), respectively (Table 3). The interaction effect was found non significant for both.

**Table 3. Effect of date of harvesting and floral preservatives on fresh weight of spike, percentage of fully opened and partial opened florets during vase life.**

| Treats | Fresh Weight (g) at 14th days | | | Opened florets (%) at 12th days | | | Partial opened florets at 12th days | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2003 | 2004 | Pooled | 2003 | 2004 | Pooled | 2003 | 2004 | Pooled |
| | | | | | Date of harvesting | | | | |
| $D_1$ | 50.67 | 51.17 | 50.92 | 26.03 | 27.63 | 26.83 | 3.40(10.59) | 3.72(12.84) | 3.56(11.69) |
| $D_2$ | 52.40 | 52.53 | 52.47 | 39.37 | 29.72 | 34.55 | 3.70(12.66) | 3.81(13.55) | 3.75(13.10) |
| $D_3$ | 54.57 | 50.50 | 52.53 | 45.16 | 42.28 | 43.72 | 5.25(26.59) | 4.37(18.06) | 4.81(22.13) |
| $D_4$ | 44.10 | 44.10 | 44.10 | 37.67 | 33.07 | 35.37 | 3.97(14.75) | 3.95(14.59) | 3.96(14.67) |
| $D_5$ | 67.60 | 53.83 | 60.72 | 50.24 | 42.54 | 46.39 | 4.35(17.89) | 4.59(20.05) | 4.47(18.95) |
| $D_6$ | 55.33 | 45.77 | 50.55 | 43.30 | 28.42 | 35.86 | 5.01(24.11) | 5.67(31.15 | 5.34(27.52) |
| $D_7$ | 55.80 | 51.43 | 53.62 | 28.57 | 33.03 | 30.80 | 5.18(25.81) | 4.78(21.89) | 4.98(23.81) |
| $D_8$ | 59.33 | 57.33 | 58.33 | 31.82 | 32.29 | 32.05 | 4.79(21.98) | 3.94(14.51 | 4.37(18.06) |
| S.Em.± | 0.618 | 0.607 | 2.56 | 0.260 | 0.305 | 3.21 | 0.021 | 0.025 | 0.28 |
| C.D. *(P=0.05)* | 1.73 | 1.70 | 8.55 | 0.73 | 0.85 | 10.71 | 0.06 | 0.07 | 0.93 |
| | | | | | Floral preservatives | | | | |
| $C_1$ | 64.96 | 56.50 | 60.73 | 32.62 | 31.33 | 31.97 | 4.32(10.59) | 4.49(12.84) | 4.40(11.69) |
| $C_2$ | 61.83 | 59.63 | 60.73 | 41.51 | 36.86 | 39.19 | 3.9912.66) | 4.06(13.55) | 4.03(13.10) |
| $C_3$ | 58.25 | 47.67 | 52.96 | 25.68 | 16.50 | 21.09 | 4.43(26.59) | 4.69(18.06) | 4.56(22.13) |
| $C_4$ | 47.25 | 42.71 | 44.98 | 51.48 | 48.89 | 50.19 | 4.17(14.75) | 3.85(14.59) | 4.01(14.67) |
| $C_5$ | 46.63 | 49.92 | 48.27 | 35.42 | 32.37 | 33.89 | 4.76(21.68) | 4.17(16.40) | 4.47(18.95) |
| $C_6$ | 69.67 | 67.75 | 68.71 | 44.86 | 42.79 | 43.83 | 4.94(23.40) | 4.54(19.65) | 4.74(21.49) |
| $C_7$ | 50.04 | 49.38 | 49.71 | 27.76 | 18.81 | 23.29 | 5.26(26.68) | 4.96(23.63) | 5.11(25.13) |
| $C_8$ | 46.79 | 46.58 | 46.69 | 56.53 | 59.87 | 58.20 | 4.05(15.41) | 3.95(14.63) | 4.00(15.02) |
| $C_9$ | 55.75 | 47.54 | 51.65 | 35.62 | 29.86 | 32.74 | 4.16(16.31) | 4.51(19.36) | 4.34(17.80) |
| $C_{10}$ | 48.58 | 40.67 | 44.63 | 26.22 | 18.94 | 22.58 | 4.47(19.02) | 4.31(17.54) | 4.39(18.27) |
| S.Em.± | 0.691 | 0.679 | 2.25 | 0.291 | 0.341 | 1.92 | 0.024 | 0.028 | 0.15 |
| C.D. *(P=0.05)* | 1.93 | 1.90 | 7.20 | 0.81 | 0.95 | 6.15 | 0.07 | 0.08 | 0.49 |
| | | | | | Interaction D x C | | | | |
| S.Em.± | 1.95 | 1.92 | 4.64 | 0.82 | 0.96 | 5.09 | 0.07 | 0.08 | 0.54 |
| C.D. *(P=0.05)* | 5.47 | 5.37 | 13.12 | 2.31 | 2.70 | NS | 0.19 | 0.22 | NS |

The result may be due to higher uptake of water with low transpiration because of low temperature with slight changes in relative humidity and evapo-transpiration. The 8-HQS has germicidal and chelating properties, which might have reduced the stem blockage and maintained the water conductivity. Sucrose prevents the moisture stress by increasing the osmotic concentration and water absorption. Similar beneficial effect of sucrose was also noted by Mukhopadhyay, (1982); Reddy *et al* (1997); Singh *et al* (1994) and Nagaraju *et al* (2002) in tuberose.

**Percentage of neck bent and abscised florets**

Significantly lower percentage of neck bent and abscised florets (34.14 & 1.44%) were registered at 15th July ($D_3$) and 15th June ($D_1$), respectively, (Table 4). The results might be due to optimum water balance in the spike, which could have lowered the concentration of abscissic acid (ABA) and ethylene. Among floral preservatives, the lowest (24.12 and 2.72%) were observed in $C_8$ (400 ppm 8-HQS + 4% sucrose) and $C_1$ (4% sucrose), respectively. The interaction was significant for abscised florets only. The 8-HQS initiates the activities of cytokinin, which might have decreased the ethylene production thereby resulting in lower percent of neck bent florets. Sucrose also antagonizes the effects of abscissic acid in delaying the senescence.

## ACKNOWLEDGEMENT

The authors are grateful to the Dean, P.G. Studies, Junagadh Agril. University, Junagadh, for providing necessary facilities.

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Table 4 . Effect of date of harvesting and floral preservatives on percentage of neck bent as well as abscised florets at 12th day of vase life of tuberose.

| Treatment | Neck bent florets (%) | | | Abscised florets (%) | | |
|---|---|---|---|---|---|---|
| | 2003 | 2004 | Pooled | 2003 | 2004 | Pooled |
| | | | Date of harvesting | | | |
| $D_1$ | 34.22 | 36.05 | 35.14 | *1.44(1.07) | 1.44(1.06) | 1.44(1.07) |
| $D_2$ | 36.06 | 38.21 | 37.13 | 2.62(5.87) | 2.60(5.78) | 2.61(5.82) |
| $D_3$ | 35.74 | 32.53 | 34.14 | 3.92(14.39) | 3.96(14.68) | 3.94(14.54) |
| $D_4$ | 39.80 | 36.59 | 38.19 | 4.04(15.32) | 3.80(13.44) | 3.92(14.37) |
| $D_5$ | 36.82 | 35.91 | 36.36 | 3.79(13.37) | 3.93(14.42) | 3.86(13.89) |
| $D_6$ | 40.81 | 39.30 | 40.05 | 3.55(11.61) | 2.75(6.56) | 3.15(8.92) |
| $D_7$ | 37.49 | 36.26 | 36.87 | 4.80(22.06) | 4.68(20.90) | 4.74(21.48) |
| $D_8$ | 39.55 | 38.44 | 38.99 | 4.35(17.91) | 4.29(17.43) | 4.32(17.67) |
| S.Em.± | 0.385 | 0.543 | 1.00 | 0.025 | 0.017 | 0.15 |
| C.D. *(P=0.05)* | 1.08 | 1.52 | 3.33 | 0.07 | 0.05 | 0.49 |
| | | | Floral preservatives | | | |
| $C_1$ | 33.33 | 29.61 | 31.47 | 2.62(5.85) | 2.83(6.99) | 2.72(6.40) |
| $C_2$ | 22.99 | 28.01 | 25.50 | 4.57(19.87) | 4.37(18.06) | 4.47(18.96) |
| $C_3$ | 39.10 | 53.74 | 46.42 | 3.44(10.81) | 3.15(8.90) | 3.29(9.84) |
| $C_4$ | 35.00 | 22.61 | 28.80 | 4.07(15.53) | 3.57(11.77) | 3.82(13.59) |
| $C_5$ | 44.90 | 34.46 | 39.68 | 3.85(13.86) | 3.15(8.90) | 3.50(11.25) |
| $C_6$ | 28.58 | 31.46 | 30.02 | 3.69(12.59) | 3.51(11.32) | 3.60(11.95) |
| $C_7$ | 53.53 | 58.73 | 56.13 | 2.83(7.03) | 3.08(8.46) | 2.95(7.73) |
| $C_8$ | 34.88 | 13.35 | 24.12 | 3.65(12.31) | 3.30(9.86) | 3.47(11.06) |
| $C_9$ | 36.06 | 36.36 | 36.21 | 3.82(13.56) | 3.28(9.74) | 3.55(11.58) |
| $C_{10}$ | 47.21 | 58.28 | 52.75 | 3.12(8.71) | 4.10(15.78) | 3.61(12.00) |
| S.Em.± | 0.431 | 0.607 | 5.60 | 0.028 | 0.020 | 0.25 |
| C.D. *(P=0.05)* | 1.21 | 1.70 | 17.91 | 0.08 | 0.05 | 0.79 |
| | | | Interaction D x C | | | |
| S.Em.± | 1.22 | 1.72 | 7.18 | 0.08 | 0.06 | 0.51 |
| C.D. *(P=0.05)* | 3.41 | 4.81 | NS | 0.22 | 0.15 | 1.44 |

* A figure out of parentheses indicates square root transformed value

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*(MS Received 17 July 2007, Revised 26 October 2007)*