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# Physiological Response of *Dendrobium* cv. Earsaklul to Plant Growth Promoters and Growing Conditions

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**Abstract—***The investigation was conducted at College of Horticulture, Kerala Agricultural University, Vellanikkara, Thrissur, Kerala from April, 2011 to March, 2013. The experiment was laid out in completely randomized design comprising six treatments, four replications and five plants per treatment for recording observations. The results revealed the treatment combination $T_3$ recorded maximum dry matter production (14.27 g plant$^{-1}$), crop growth rate (0.131 g m$^{-2}$ day$^{-1}$), highest rate of photosynthesis (6.36 µmol $CO_2$ m$^{-2}$ s$^{-1}$) and rate of transpiration during day time (6.56 µmol m$^{-2}$ s$^{-1}$). Among growing systems, leaf area (28.92 cm$^2$), dry matter production (11.92 g plant$^{-1}$), crop growth rate (0.115 g m$^{-2}$ day$^{-1}$), net assimilation rate (0.009 g m$^{-2}$ day$^{-1}$), rate of photosynthesis (6.86 µmol $CO_2$ m$^{-2}$ s$^{-1}$), transpiration rate during night (0.32 µmol m$^{-2}$ s$^{-1}$) and transpiration rate during day (6.00 µmol m$^{-2}$ s$^{-1}$) were recorded maximum in plants grown under $S_2$. The interaction of plant growth promoters and systems of growing had significant influence on all physiological attributes.*

**Keywords***: Dendrobium cv. Earsakul, nutrients, Piriformospora indica (PGPRE), micro climatic conditions and physiological traits.*

## 1. INTRODUCTION

Among the orchid genera, *Dendrobium* is a very complex and extremely large genus widely used in the commercially cut flower production. It is the second largest genus in the family with nearly 1600 species, is one of the commercially important species. Most *Dendrobium* species are epiphytic and are from tropical and sub-tropical regions. It is a popular genus for cut flower production. Many growers in the states of Kerala, Tamil Nadu and Coastal Karnataka are cultivating *Dendrobium* on a commercial scale. Dendrobiums occupy nearly 90 per cent of the area under orchid cultivation in Kerala due to the easy management practices and plant material availability (Rajeevan and Sobhana, 1993). These hybrids are in the foremost position in floriculture trade especially in ornamental cut flower sprays and its capability in blooming continuously and a prolonged post-harvest life relative to other orchid hybrids (Puchooa, 2004).

The type of nutrients, their quality and frequency of application play an important role on the growth and quality of flower. In orchids, growth and floral initiation is determined by the genotype and its interaction with the environmental conditions. Temperature, humidity, light and photoperiod are some of the important environmental conditions that influence growth and reproductive biology of orchids. Regulation of light intensity is essential for successful orchid culture. During plant development, the transition from vegetative to reproductive growth is triggered by a number of environmental and endogenous signals. Under controlled conditions of greenhouse, the flowers exhibit the best quality attributes required for the market. For better growth, yield and quality of the flowers, the system of growing is very important. Micro climate inside the growing system may drastically influence the growth, flowering and quality of flowers (Femina *et al*., 2006).

In most *Dendrobium* orchids, rapid vegetative growth occurs at temperatures between 24°C and 30°C (Leonhardt, 2000). In their natural habitat, epiphytes usually meet with a greater degree of environmental stress. Fernandez (2001) reported that in *Dendrobium*, remarkable increase in plant growth was noticed in treatments with 35 per cent and 50 per cent shading (both at double level) and 50 per cent single level shading. The plant growth was considerably less in intense light conditions. The major constraints encountered in *Dendrobium* orchid cultivation are growing conditions, long pre blooming period and susceptibility to pest and diseases. It is envisaged that growing tropical orchids for cut flower production and potted plants will benefit from the recent advances in plant physiology and biotechnology. For the orchid industry, producing an improved hybrid, through conventional breeding or genetic engineering, is only the beginning.

Optimization of the production processes and ensuring a quality product for the market is equally important. To achieve this goal, a good basic understanding of orchid physiology is

essential to solve key physiological issues. However, we lack information on the some physiological aspects on tropical orchids under greenhouse cultivation, particularly at a commercial level. This information is crucial in the optimization of the growth and yield of orchids in commercial farms. Keeping in view all these, the present investigation was taken up with the objective to study the physiological traits of *Dendrobium* cv. Earsakul as influenced by nutrients under three microclimatic conditions.

## 2. MATERIALS AND METHODS

The experiment was carried out at the orchidarium of All India Coordinated Floriculture Improvement Project (AICFIP) in the Dept. of Pomology & Floriculture, College of Horticulture, Vellanikkara, Thrissur, Kerala. Studies were conducted over a period from April, 2011 to March, 2013 in three types of growing systems *viz.*, two level shade house ($S_1$), top ventilated polyhouse ($S_2$) and fan and pad system ($S_3$). Commercially cultivated orchid hybrid variety *Dendrobium* cv. Earsakul was used for the study. Plants were grown under 50 per cent shade in two level shade house (size: 21.00 m x 6.00 m x 3.50 m x 2.00 m, top one layer shade net, lower one layer poly film 200 micron with misting system), top ventilated polyhouse (size: 21.00 m x 6.00 m x 3.50 m x 2.00 m, poly film 200 micron covering with shade net and misting system) and in 75 per cent shade in fan and pad system (size: 12.50 m x 8.00 m x 6.00 m x 4.00 m, poly film 200 micron covering, UV stabilized shade net with fan and pad for cooling system).The major nutrients $N:P_2O_5:K_2O$ at two different ratios, *viz.*, 3 : 1 : 1 and 1 : 2 : 2 @ 0.2 per cent were applied as foliar sprays during vegetative and flowering stages, respectively. The frequency of application was weekly twice. Nutrient combinations were made using ammonium nitrate, ortho-phosphoric acid and potassium nitrate.

The treatments consists of $T_1$-POP recommendations of KAU (foliar feeding with fertilizer mixture of $N:P_2O_5:K_2O$ 3:1:1 during vegetative period and 1:2:2 during flowering period @ 0.2 per cent, spraying at weekly twice as ammonium nitrate, ortho-phosphoric acid and potassium nitrate respectively), $T_2$- POP + PGPRE (the fungal culture of *Piriformospora indica* (PGPRE) was mixed with vermiculite @ 1 g per 100 g of vermiculite and applied near the root zone at the time of planting) + bone meal (15 g per plant applied near root zone at the time of planting), $T_3$ - POP + OM (bone meal, neem cake and ground nut cake 100 g each, soaked in water for 3-4 days and diluted to 10-15 times with water, filtered and sprayed over plants at 15 days interval) + vermiwash (diluted to 3 per cent and sprayed at 15 days interval) + PGPRE + bone meal, $T_4$- POP + OM + VW + PGPRE + bone meal + GR (BA 50 mg/l and $GA_3$ 10 mg/l sprayed at monthly intervals), $T_5$ - 10:20:10 NPK + GR and $T_6$ - NPK + GR + OM + VW + PGPRE + bone meal. The experiment was laid out in completely randomized design comprising six treatments, four replications and five plants per treatment for recording observations. The observations on physiological attributeswere recorded. The experimental data were analyzed by the ANOVA (Analysis of Variance technique (Panse and Sukhatme, 1985).The data on physiological observations were recorded by the following methodssuggested in RGR by (Blackman, 1919), in NAR (Williams, 1946) and in CGR (Yaduraju and Ahuja, 1996).

## 3. RESULTS AND DISCUSSION

### Leaf area

Leaf area was significantly influenced by various treatment combinations (Table 1). Plants nourished with treatment $T_4$ recorded significantly higher leaf area (29.99 $cm^2$) which was on par with $T_3$ (29.33 $cm^2$) and $T_2$ (27.43 $cm^2$). This could be well explained that the leaf area was determined by a number of leaves per plant. The results are in consonance with earlier findings of Bichsel and Starman (2008) in *Dendrobium nobile*. Response of growing systems on leaf area was significant. Significantly higher leaf area was recorded in $S_2$ (28.92 $cm^2$) which was followed by $S_3$ (24.94 $cm^2$). The leaf area in $S_3$ was on par with $S_1$ (23.97 $cm^2$). The increase in leaf number resulted in increase in leaf area (or) increase in leaf area could be attributed to increase in leaf number.

T x S interaction on leaf area was significant (Table 1). Significantly higher leaf area of 34.41 $cm^2$ was recorded in the combination $T_3S_2$ which was on par with $T_4S_1$ (31.25 $cm^2$) and $T_4S_2$ (30.46 $cm^2$). The *Piriformospora indica* would influence the production of more number of leaves per plant which in turn enhance the leaf area in top ventilated polyhouse with the condition of high temperature, high light intensity and low relative humidity. Foliar feeding of organic manures might also the reason for highest leaf area.

### Dry matter production (DMP)

The results indicated that different plant growth promoters markedly influenced the DMP (Table 1). Among plant growth promoters tried, treatment $T_3$ recorded significantly higher DMP (14.27 g $plant^{-1}$) which was followed by $T_6$ (10.28 g $plant^{-1}$) and this was on par with $T_4$ (9.43 g $plant^{-1}$) and $T_2$ (8.82 g $plant^{-1}$). The plant height and number of shoots per plant were highest in the treatment POP + OM + VW + PGPRE + Bone meal whereas, the number of leaves per plant, leaf area was more in the treatment POP + OM + VW + PGPRE + Bone meal + GR. This might be the reason for more DMP observed in those treatments. The above finding was supported by Cardoso *et al*. (2012) in *Phalaenopsis* orchid. Multiple growing sites had significant influence on DMP. Significantly higher DMP was recorded in $S_2$ (11.92 g $plant^{-1}$). The plant height, number of leaves, number of shoots and leaf area were maximum in top ventilated polyhouse which might have resulted in increased DMP in plants grown under top ventilated polyhouse.T x S interaction had significant influence on DMP (Table 1). The treatment $T_3S_2$ recorded significantly higher DMP of 16.07 g $plant^{-1}$ which was on par with $T_4S_2$ (15.47 g $plant^{-1}$), $T_6S_1$ (14.80 g $plant^{-1}$), $T_3S_1$

(13.93 g plant$^{-1}$) and $T_3S_3$ (12.80 g plant$^{-1}$). These results are in conformity with earlier results of plant growth promoters and systems of growing on DMP.

**Crop growth rate**

CGR was significantly influenced by various plant growth promoters (Table 1). The plant growth promoter $T_3$ recorded significantly higher CGR of 0.131 g m$^{-2}$ day$^{-1}$ which was on par with $T_6$ (0.125 g m$^{-2}$ day$^{-1}$), $T_4$ (0.091 g m$^{-2}$ day$^{-1}$), $T_1$ (0.090 g m$^{-2}$ day$^{-1}$) and $T_2$ (0.085 g m$^{-2}$ day$^{-1}$). The CGR is the proportion of dry matter production and time period of growth. This was in accordance with the findings of Dhinesh (2009) in *Dendrobium*. CGR was significantly influenced by three multiple sites. Significantly higher CGR was recorded in $S_2$ (0.115 g m$^{-2}$ day$^{-1}$). Regarding T x S interaction, significantly higher CGR was recorded in $T_6S_1$ (0.179 g m$^{-2}$ day$^{-1}$) which was on par with $T_3S_1$ (0.169 g m$^{-2}$ day$^{-1}$), $T_6S_2$ (0.147 g m$^{-2}$ day$^{-1}$), $T_3S_2$ (0.130 g m$^{-2}$ day$^{-1}$) and $T_4S_2$ (0.116 g m$^{-2}$ day$^{-1}$). The possible reason could be due to the treatments NPK + GR + PGPRE + OM + VW + Bone meal under the favourable environmental condition of two level shade house might resulted in high CGR.

**Relative growth rate**

RGR differed significantly among various inputs applied (Table 1). The treatment $T_4$ recorded significantly higher RGR (0.013 g g$^{-1}$ day$^{-1}$) which was on par with $T_2$ (0.011 g g$^{-1}$ day$^{-1}$) and $T_3$ (0.010 g g$^{-1}$ day$^{-1}$). Since the six month plants were in active growth phase, it was significantly showing the unit increasing DMP. This could lead to increase in RGR. The above results are corroborated with the findings of Dhinesh (2009) in *Dendrobium*. RGR did not varied significantly under three growing conditions.The interaction of plant growth promoters and growing systems influenced significantly the RGR. Maximum RGR of 0.019 g g$^{-1}$ day$^{-1}$ was recorded in $T_4S_3$ which was on par with $T_4S_1$ (0.018 g g$^{-1}$ day$^{-1}$). Under fan and pad system, a uniform environmental condition with high relative humidity might facilitated the maximum RGR.

**Net assimilation rate**

None of the plant growth promoters responded significantly on NAR (Table 2).

Growing systems had significant influence on NAR. Significantly higher NAR of 0.009 g m$^{-2}$ day$^{-1}$ was recorded in $S_2$. Above results are in conformity with the findings of Samasya (2000) in *Dendrobium*. In T x S interaction, highest NAR was recorded under the combination $T_6S_2$ (0.011 g m$^{-2}$ day$^{-1}$) which was on par with all other treatments except $T_5S_3$ (0.003 g m$^{-2}$ day$^{-1}$) and $T_6S_3$ (0.002 g m$^{-2}$ day$^{-1}$). The interaction effect was clearly suggesting the results of plant growth promoters and systems of growing in independent cases on NAR. These results are in agreement with the findings ofJin *et al*. (2009) in *Dendrobium.*

**Number of stomata**

Response of number of stomata to plant growth promoters was significant (Table 2).Higher count of stomata of 41.14 per mm$^2$was recorded in $T_4$which was on par with $T_2$ (38.70 per mm$^2$) and $T_6$ (38.21 per mm$^2$). The number of leaves per plant might be high due to influence of growth regulators. This could be the result of more number of stomata due to increasing number of leaves and larger area of the leaves. A similar trend was recorded in *Dendrobium* by Yukawa *et al*. (1992). Among growing conditions, highest number of stomata was recorded under $S_3$ (38.34 per mm$^2$) which was on par with $S_2$ (38.27 per mm$^2$). The fan and pad system recorded highest number of stomata.Under fan and pad system, the uniform environmental conditions were maintained throughout the growth phase of the plants. This could be the adaptations for maintaining the physiological processes of the plants.

The T x S interaction showed that, the combination of $T_2S_2$ recorded significantly higher number of stomata (44.92 per mm$^2$) which was on par with $T_6S_3$ (43.00 per mm$^2$), $T_4S_3$ (41.72 per mm$^2$), $T_4S_2$ (41.38 per mm$^2$), $T_4S_1$ (40.33 per mm$^2$), $T_3S_3$ (39.38 per mm$^2$), $T_2S_3$ (39.38 per mm$^2$), $T_6S_2$ (39.36 per mm$^2$) and $T_5S_3$ (38.35 per mm$^2$). This might be due to the fact that in top ventilated polyhouse, the favourable environmental conditions would have influenced the number of stomata in the leaves.

**Rate of photosynthesis**

Photosynthetic rate was significantly influenced by various treatments applied (Table 2). The treatment $T_3$ recorded significantly higher rate of photosynthesis (6.36 µmol $CO_2$ m$^{-2}$ s$^{-1}$) which was on par with $T_1$ (5.61 µmol $CO_2$ m$^{-2}$ s$^{-1}$) and $T_2$ (4.81 µmol $CO_2$ m$^{-2}$ s$^{-1}$).Among growing systems, highest photosynthetic rate was recorded under $S_2$ (6.86 µmol $CO_2$ m$^{-2}$ s$^{-1}$) which was followed by $S_1$ (4.05 µmol $CO_2$ m$^{-2}$ s$^{-1}$) and this was on par with $S_3$ (3.55 µmol $CO_2$ m$^{-2}$ s$^{-1}$). The positive effect of POP + OM + VW + PGPRE + Bone meal in increasing DMP and CGR were recorded in earlier results which indicated that higher the rate of photosynthesis would increase the food reserves which subsequently increased DMP and CGR. This may be explained by the fact that the plants were in active growth stage. Under top ventilated polyhouse system, high temperature and high light intensity resulted in higher rate of photosynthesis. T x S interaction on photosynthetic rate was significant (Table 2). The combination of $T_3S_2$ recorded significantly higher rate of photosynthesis (9.73 µmol $CO_2$ m$^{-2}$ s$^{-1}$) which was on par with $T_1S_2$ (8.86 µmol $CO_2$ m$^{-2}$ s$^{-1}$) and $T_5S_2$ (6.90 µmol $CO_2$ m$^{-2}$ s$^{-1}$).

**Transpiration rate at night time**

Rate of transpiration at night time varied significantly due to the influence of treatments (Table 2). The input combination $T_2$ recorded significantly higher rate of transpiration (0.26 µmol m$^{-2}$ s$^{-1}$) which was on par with $T_4$ (0.25 µmol m$^{-2}$ s$^{-1}$). The *Piriformospora indica* and plant growth promoters access

to more growth and there by more water and hence promoted higher rate of transpiration. The response of rate of transpiration to the growing systems was significant. Highest transpiration rate of 0.32 µmol $m^{-2}$ $s^{-1}$was recorded under $S_2$.This could be due to higher temperature, lower relative humidity would result in gradient in vapour pressure deficit resulting in higher rate of transpiration. These results are in tune with the statement of Nagoaka *et al.* (1984) and Samasya (2000) in *Dendrobium.*

Rate of transpiration during night was significantly influenced by plant growth promoters and growing systems. The combination of $T_4S_2$ recorded significantly higher rate of transpiration (0.46 µmol $m^{-2}$ $s^{-1}$) which was on par with $T_2S_2$ (0.45 µmol $m^{-2}$ $s^{-1}$). This phenomenon could be due to reason that positive influences of plant growth promoter's favours for better growth of the plants *i.e.* number of leaves per plant, leaf area, number of stomata were higher in earlier results. Higher temperature and lower relative humidity prevailing in side top ventilated polyhouse favour for higher transpiration rate.

**Transpiration rate at day time**

A perusal of the data presented in Table 2 revealed that, various plant growth promoters had significant influence on rate of transpiration at day time. Significantly maximum rate of transpiration of 6.56 µmol $m^{-2}$ $s^{-1}$ was recorded in $T_3$ which was on par with $T_5$ (5.37 µmol $m^{-2}$ $s^{-1}$). This might be due to positive influence of all applied plant growth promoters favour for luxurious growth of the plants there by resulted in increased rate of transpiration during day time and *i.e.* the indication for healthy growth of the plants. The data presented in table indicated that, growing systems had significant influence on rate of transpiration. Highest transpiration rate of 6.00 µmol $m^{-2}s^{-1}$was recorded under $S_2$. The possible reason for highest transpiration rate under top ventilated polyhouse was due to higher temperature, high light intensityand low relative humidity. In high light intensity, the water present in mesophyll cells diffuses rapidly resulting in increase in humidity of internal air and this increases the rate of transpiration (Cho and Kwack, 1996).In T x S interaction, the combination of $T_5S_2$ recorded significantly higher rate of transpiration (9.19 µmol $m^{-2}$ $s^{-1}$) which was on par with $T_3S_1$ (8.83 µmol $m^{-2}s^{-1}$) and $T_3S_2$ (7.77 µmol $m^{-2}$ $s^{-1}$).

**Table 1: Influence of plant growth promoters (T), growing systems (S) and T x S interaction on physiological parameters of *Dendrobium* cv. Earsakul.**

| Treatments | Leaf area ($cm^2$) | | | | Dry matter production (g $plant^{-1}$) | | | | Crop growth rate (g $m^{-2}$ $day^{-1}$) | | | | Relative growth rate (g $g^{-1}$ $day^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $S_1$ | $S_2$ | $S_3$ | Mean | $S_1$ | $S_2$ | $S_3$ | Mean | $S_1$ | $S_2$ | $S_3$ | Mean | $S_1$ | $S_2$ | $S_3$ | Mean |
| $T_1$ | 19.26 | 26.88 | 28.73 | 25.03 | 5.38 | 9.27 | 7.93 | 7.53 | 0.076 | 0.104 | 0.089 | 0.090 | 0.009 | 0.010 | 0.007 | 0.009 |
| $T_2$ | 23.71 | 29.66 | 28.94 | 27.43 | 7.10 | 12.43 | 6.92 | 8.82 | 0.067 | 0.107 | 0.080 | 0.085 | 0.012 | 0.012 | 0.009 | 0.011 |
| $T_3$ | 24.85 | 34.41 | 28.95 | 29.33 | 13.93 | 16.07 | 12.80 | 14.27 | 0.169 | 0.130 | 0.093 | 0.131 | 0.011 | 0.011 | 0.008 | 0.010 |
| $T_4$ | 31.25 | 30.46 | 28.27 | 29.99 | 6.72 | 15.47 | 6.12 | 9.43 | 0.084 | 0.116 | 0.075 | 0.091 | 0.018 | 0.013 | 0.019 | 0.013 |
| $T_5$ | 21.49 | 27.42 | 16.51 | 21.81 | 5.10 | 10.25 | 6.93 | 7.43 | 0.071 | 0.085 | 0.079 | 0.078 | 0.008 | 0.009 | 0.007 | 0.008 |
| $T_6$ | 23.25 | 25.72 | 18.23 | 22.06 | 14.80 | 8.05 | 7.98 | 10.28 | 0.179 | 0.147 | 0.011 | 0.125 | 0.007 | 0.008 | 0.006 | 0.007 |
| Mean | 23.97 | 28.92 | 24.94 | | 8.84 | 11.92 | 8.11 | | 0.107 | 0.115 | 0.078 | | 0.010 | 0.010 | 0.008 | |
| CD (*P*=0.05) | T: 2.71<br>S: 1.91<br>T x S: 4.69 | | | | T: 1.95<br>S: 1.38<br>T x S: 3.38 | | | | T: 0.040<br>S: 0.028<br>T x S: 0.069 | | | | T: 0.003<br>S: NS<br>T x S: 0.005 | | | |

**Table 2: Influence of plant growth promoters (T), growing systems (S) and T x S interaction on physiological parameters of *Dendrobium* cv. Earsakul.**

| Treatments | Net assimilation rate (g $m^{-2}$ $day^{-1}$) | | | | Number of stomata | | | | Rate of photosynthesis (µmol $CO_2$ $m^{-2}$ $s^{-1}$) | | | | Rate of transpiration (Night) (µmol $m^{-2}$ $s^{-1}$) | | | | Rate of transpiration (Day) (µmol $m^{-2}$ $s^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $S_1$ | $S_2$ | $S_3$ | Mean | $S_1$ | $S_2$ | $S_3$ | Mean | $S_1$ | $S_2$ | $S_3$ | Mean | $S_1$ | $S_2$ | $S_3$ | Mean | $S_1$ | $S_2$ | $S_3$ | Mean |
| $T_1$ | 0.004 | 0.009 | 0.004 | 0.006 | 34.32 | 31.80 | 28.26 | 31.46 | 4.24 | 8.86 | 3.73 | 5.61 | 0.14 | 0.23 | 0.11 | 0.16 | 1.73 | 4.40 | 3.15 | 3.09 |
| $T_2$ | 0.006 | 0.009 | 0.004 | 0.006 | 31.80 | 44.92 | 39.38 | 38.70 | 4.83 | 6.10 | 3.49 | 4.81 | 0.16 | 0.45 | 0.18 | 0.26 | 3.81 | 5.27 | 3.11 | 4.06 |
| $T_3$ | 0.007 | 0.009 | 0.005 | 0.007 | 34.82 | 34.33 | 39.38 | 36.17 | 4.94 | 9.73 | 4.41 | 6.36 | 0.14 | 0.23 | 0.10 | 0.16 | 8.83 | 7.77 | 3.09 | 6.56 |
| $T_4$ | 0.009 | 0.009 | 0.006 | 0.008 | 40.33 | 41.38 | 41.72 | 41.14 | 3.62 | 6.01 | 3.26 | 4.29 | 0.21 | 0.46 | 0.07 | 0.25 | 3.88 | 5.39 | 3.24 | 4.17 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_5$ | 0.006 | 0.006 | 0.003 | 0.005 | 28.55 | 37.85 | 38.35 | 34.91 | 2.48 | 6.90 | 3.88 | 4.42 | 0.10 | 0.37 | 0.12 | 0.19 | 4.46 | 9.19 | 2.47 | 5.37 |
| $T_6$ | 0.004 | 0.011 | 0.002 | 0.006 | 32.29 | 39.36 | 43.00 | 38.21 | 4.20 | 3.58 | 2.58 | 3.45 | 0.15 | 0.14 | 0.15 | 0.15 | 2.41 | 3.95 | 2.96 | 3.10 |
| Mean | 0.006 | 0.009 | 0.004 | | 33.68 | 38.27 | 38.34 | | 4.05 | 6.86 | 3.55 | | 0.15 | 0.32 | 0.12 | | 4.18 | 6.00 | 3.00 | |
| CD (*P*=0.05) | T: NS<br>S: 0.002<br>T x S: 0.007 | | | | T: 3.41<br>S: 2.41<br>T x S: 5.91 | | | | T: 1.72<br>S: 1.21<br>T x S: 2.98 | | | | T: 0.032<br>S: 0.023<br>T x S: 0.056 | | | | T: 1.29<br>S: 0.91<br>T x S:2.23 | | | |

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