

# EFFECTS OF DIFFERENT CONCENTRATIONS OF NPK ON VEGETATIVE GROWTH PARAMETERS OF A FLORICULTURALLY IMPORTANT EPIPHYTIC ORCHID, *DENDROBIUM CHRYSANTHUM* WALL. EX LINDL.

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## Abstract

The experiment was conducted at the Orchid house, Department of Botany, Panjab University, Chandigarh, during the period from February-April, 2018 to study the growth performance of a floriculturally important epiphytic orchid, *Dendrobium chrysanthum* Wall. ex Lindl. under the influence of different NPK spray concentrations. In the present investigation, four spray formulations: spray formulation T1 (N:P:K=50:12.5:50), spray formulation T2 (N:P:K=100:25:50), spray formulation T3 (N:P:K=150:25:100), and spray formulation T4 (N:P:K=200:37.5:100) were used along with a control (water). The experiment was laid out in Completely Randomized Design (CRD) with three replications of each treatment. Spray formulations had significant influence on growth of presently tested species. Spray treatment T4 (NPK=200:37.5:100) showed highest number of leaves ( $20.42 \pm 0.41$ ) while minimum number of leaves ( $7.95 \pm 0.19$ ) were observed on use of spray of simple water. Spray treatment T3 (NPK=150:25:100) and spray treatment T1 (NPK=50:12.5:50) showed maximum ( $13.37 \pm 0.44$  cm) and minimum ( $9.23 \pm 0.04$  cm) length of leaves, respectively. Also, maximum width of leaves ( $3.53 \pm 0.35$  cm) was observed in species treated with spray treatment T3 (NPK=150:25:100) whereas the minimum width of leaves ( $1.43 \pm 0.07$  cm) was observed on the species treated by spray treatment T1 (NPK=50:12.5:50). Spray treatment T3 (NPK=150:25:100) showed maximum height of plant ( $38.93 \pm 0.45$  cm), while the minimum height of plant ( $11.55 \pm 0.02$  cm) was observed on spray treatment T1 (NPK=50:12.5:50). Spray treatment T4 (NPK=200:37.5:100) showed maximum stem width ( $10.99 \pm 0.20$  cm), while the minimum stem width ( $5.39 \pm 0.27$  cm) was observed on spray of simple water. In most of the parameters, control had shown the minimum results. Further investigation needs to be undertaken so as to find out the efficacy of different NPK spray formulations on both vegetative and reproductive stages of *Dendrobium chrysanthum* and other related species.

## Introduction

ORCHIDS ARE the most distinctive and highly priced plants in international market due to their intricately designed spectacular flowers with brilliant colours, delightful appearance, myriad sizes, shapes and forms, and long lasting qualities. These flowering plants belong to one of the largest and most multiform family Orchidaceae. This family consists of about 700-800 genera (Arditti, 1980; Dressler, 2006) and about 28,484 species in the world (Govaerts *et al.*, 2017). In India, orchids are represented by about 1,256 species in 155 genera (Singh *et al.*, 2019). Amongst the flowering plants, orchids are excellent items, with their magnificent blooms for garden and can be grown in beds, pots, baskets *etc.* They are found in diverse habitats and are floriculturally important due to an incredible range of diversity in shape and size of their flowers, long shelf-life, attractive structures, and excellent colour of their flowers (De and Pathak, 2015; Janakiram and Baskaran, 2018; Pathak *et al.*, 2001; Singh and Voleti, 1995). These plants have occupied top position amongst the flowering plants valued for cut flowers and as well as pot plants. Orchid industry plays an important role as a source of foreign exchange. It has been observed that the production and trade of floriculture crops has ever increasing trend. Out of about 21 billion USD floriculture

trade, 8% is that of orchids and has an increasing trend of 15% annually (Hegde, 2016; Singh, 2011). They account for 27% of global cut flower production in terms of value (Singh, 1986). In India, the environmental conditions required for the survival of orchids are adequately favourable throughout the year. Various species of orchids are abundantly distributed in the country. Export potential of orchids from India has a bright prospect in future. The orchid genera which are commercially important are *Arachnis*, *Cattleya*, *Cymbidium*, *Dendrobium*, *Mokara*, *Oncidium*, *Phalaenopsis*, and *Vanda* (Laws, 2004). Amongst these genera, dendrobiums are the most popular tropical orchids, getting fame as cut flowers in the world and potted hybrid *Dendrobium* plants are being cultivated at an ever-increasing rate. Infact, rapid growth, easiness of plantlet regeneration, beauty of flower, year round production under controlled conditions, and long lasting of the flowers are the advantages of *Dendrobium*. Orchids cannot uptake nutrients significantly from the roots, hence foliar nutrient application is widely practiced during orchid cultivation. A combination of Nitrogen, Phosphorus, and Potassium in different concentrations is commonly used as foliar spray (Ali *et al.*, 2014). Orchid should be potted in container according to the size of the plant. As the orchids are slow growing plants, slow release of fertilizer mixtures (NPK) can be used to

get best results (Higaki and Imamura, 2007). Applications of spray nutrient containing NPK with different concentrations varies on the basis of growth stage of plants. During vegetative growth, large quantities of Nitrogen are required. Nutrient solution of NPK plays a vital role in the growth and development of orchids. There is a scope of large scale production of orchids in India to meet the demand of international market and to earn foreign currency through export. To be a prosperous orchid producer, its first concern is to comprehend the growth feature. Therefore, fertilizer application as spray should be considered judiciously. However, as there is not much available information on fertilizer application as spray, in dendrobiums, the present experiment was conducted with a view to studying the effect of NPK on the vegetative growth of *Dendrobium chrysanthum* plants.

## Material and Methods

### Experimental Site

Present experiment was conducted in pots to study the effect of NPK spray concentrations on the growth of the plants (*Dendrobium chrysanthum*) in the Orchid house, Department of Botany, Panjab University, Chandigarh during the period from February-April, 2018.

### Experimental Treatments

In the present experiment, four spray formulations (treatments) were used along with a control.

- a. Control (water)
- b. Treatment, T1 (N:P:K=50:12.5:50)
- c. Treatment, T2 (N:P:K=100:25:50)
- d. Treatment, T3 (N:P:K=150:25:100)
- e. Treatment, T4 (N:P:K=200:37.5:100)

### Nutrient Spray Formulation

The spray solutions were prepared by mixing Urea, Ammonium phosphate, and Muriate of Potash. The formulation used in present research contained different ratios of Nitrogen, Phosphorus, and Potassium. Frequent application of water is essential in orchids and during the experimental period *i.e.* February-March, 2018, watering was done on alternate days, and during April-May 2018, watering was done once a day by using a hand sprayer. Green shade net was used for covering Orchid house and creating artificial shade as most epiphytic orchids avoid direct sunlight under natural conditions.

### Data Collection

Data was collected periodically during the growth period of orchid. The growth parameters such as plant height, stem diameter, leaf length and width *etc.* were taken during collection of data.

### Plant Height

The height of plant was measured in centimeter from ground level to top of the main stem by measuring scale at the interval of 15 days during the study period.

### Number of Leaves Per Plant

Number of leaves per plant was measured by counting manually all the leaves in plant from each pot, at the interval of 15 days.

### Leaf Length and Width

Length and width of leaves was measured with a measuring scale of 8 randomly selected leaves from each pot at the interval of 15 days and their average was calculated and expressed in centimeters.

### Stem Diameter

Stem diameter was measured by screw gauge at the middle portion of stem and expressed in centimeters.

### Statistical Analysis

The collected data for growth parameters was analyzed for variance (ANOVA) with help computer package program SPSS(16) and mean difference was compared by Tukey's multiple range test (TMRT) at  $p \leq 0.05$ .

## Results and Discussion

During the present studies in *Dendrobium chrysanthum*, the application of different ratios of NPK nutrients greatly influenced the vegetative growth.

### Plant Height

Plant height was significantly affected by the application of different spray formulations. The data presented in Table 1 and Fig. 1 revealed that amongst the different applications of NPK on *D. chrysanthum*, spray treatment T3 (NPK=150:25:100) showed maximum height of plant ( $38.93 \pm 0.45$  cm), while the minimum height of plant ( $11.55 \pm 0.02$  cm) was observed on spray treatment T1 (NPK=50:12.5:50). Nitrogen, being the main constituent of aminoacids and co-enzymes, is the most imperative element for proper growth and development of plants which significantly increases and enhances the yield and its quality by playing a vital role in biochemical and physiological functions of plant (Leghari *et al.*, 2016).

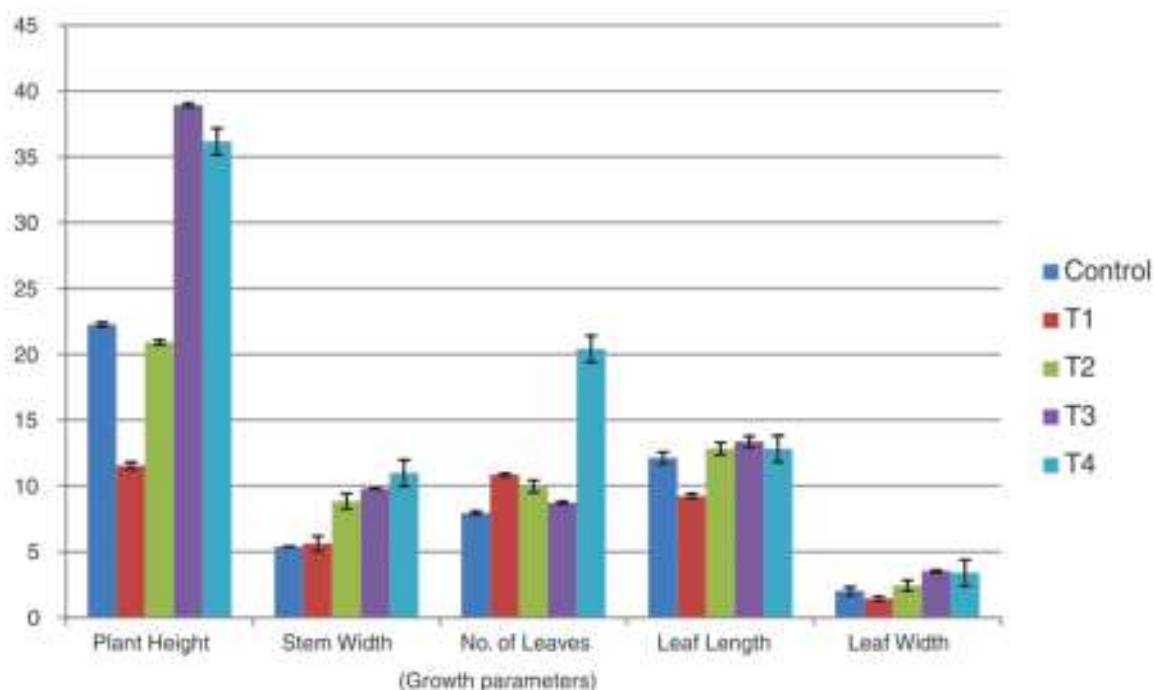


Fig. 1. Effects of different spray formulations of NPK on growth of an epiphytic orchid, *Dendrobium chrysanthum*.

#### Number of Leaves

In the present experiment, it was observed that spray formulation significantly affected number of leaves per plant. The data presented in Table 1 and Fig. 1 revealed that amongst the different applications of NPK on *D. chrysanthum*, spray treatment T4 (NPK=200:37.5:100) showed highest number of leaves ( $20.42 \pm 0.41$ ). The minimum number of leaves ( $7.95 \pm 0.19$ ) were observed on use of spray of simple water. This indicated that possibly photosynthetic activities have increased with treatment T4 application which may have led to higher accumulation of carbohydrate content in leaves.

#### Leaf Length

The data presented in Table 1 and Fig. 1 revealed that amongst the different applications of NPK on *D. chrysanthum*, spray treatment T3 (NPK=150:25:100) showed maximum length of leaves ( $13.37 \pm 0.44$  cm),

while the minimum length of leaves ( $9.23 \pm 0.04$  cm) was observed on spray treatment T1 (NPK=50:12.5:50).

#### Leaf Width

The data presented in Table 1 and Fig. 1 revealed that amongst the different applications of NPK on *D. chrysanthum*, spray treatment T3 (NPK=150:25:100) showed maximum width of leaves ( $3.53 \pm 0.35$  cm), while the minimum width of leaves ( $1.43 \pm 0.07$  cm) was observed on spray treatment T1 (NPK=50:12.5:50).

#### Stem Width

The data presented in Table 1 and Fig. 1 revealed that amongst the different applications of NPK on *D. chrysanthum*, spray treatment T4 (NPK=200:37.5:100) showed maximum stem width ( $10.99 \pm 0.20$  cm), while the minimum stem width ( $5.63 \pm 0.58$  cm) was observed on spray of simple water.

Table 1. Effects of different spray formulations of NPK on growth of an epiphytic orchid *Dendrobium chrysanthum*.

Treatments	Growth parameters					
	Plant height (cm)	Stem width (cm)	Leaf number	Leaf length (cm)	Leaf width (cm)	Leaf area (cm <sup>2</sup> )
Control	22.27±0.17 <sup>c</sup>	5.39±0.27 <sup>d</sup>	7.95±0.19 <sup>a</sup>	12.13±0.16 <sup>b</sup>	2.02±0.02 <sup>bc</sup>	24.50±0.10 <sup>b</sup>
T1	11.55±0.02 <sup>e</sup>	5.63±0.58 <sup>d</sup>	10.86±0.60 <sup>c</sup>	9.23±0.04 <sup>c</sup>	1.43±0.07 <sup>c</sup>	13.19±0.05 <sup>a</sup>
T2	20.92±0.15 <sup>d</sup>	8.85±0.12 <sup>c</sup>	9.98±0.46 <sup>bc</sup>	12.84±0.13 <sup>a</sup>	2.44±0.15 <sup>b</sup>	31.32±0.14 <sup>c</sup>
T3	38.93±0.45 <sup>a</sup>	9.80±0.20 <sup>b</sup>	8.73±0.48 <sup>ab</sup>	13.37±0.44 <sup>a</sup>	3.53±0.35 <sup>a</sup>	47.19±0.40 <sup>d</sup>
T4	36.18±0.30 <sup>b</sup>	10.99±0.20 <sup>a</sup>	20.42±0.41 <sup>d</sup>	12.84±0.09 <sup>a</sup>	3.40±0.32 <sup>a</sup>	26.83±0.21 <sup>b</sup>

By spraying orchid plant with different concentration of NPK significantly influenced the different growth parameters like plant height, stem width, number of leaves, length and width of leaves, etc. Results showed that spray treatment T3 (NPK=150:25:100) was proved the most effective indicating thereby that further increase in spray concentrations of the treatment T4 (NPK=200:37.5:100), there was reduction in the vegetative growth of *Dendrobium chrysanthum* (Table 1; Fig. 1). Phosphorus has been called the 'the key to life' because it is directly involved in most of life processes. An adequate supply of Phosphorus in the life of a plant is important in laying down the primordia for its growth (Tisdale and Nelson, 1975). Potassium moves readily within plants and tends to translocate to the areas of growth (Troeh and Thompson, 1993). Potassium is also involved in the meristematic growth and is of utmost importance for maintenance of water status of the plant. Uptake of water in the cells and tissues is frequent as a consequence of active K<sup>+</sup> uptake (Lauchli and Pflüger, 1978). The present observations in *D. chrysanthum* are inline with the earlier results reported in *Dendrobium chrysotoxum* and *D. williamsonii* (Ngapui *et al.*, 2013); *Dendrobium Sonia* 17 (Nair and Sujatha, 2010); *Spathoglottis plicata* (Paswan and Bhuyan, 2005); *Dendrobium orchid* cv. Sonia 17 (Patnaik *et al.*, 2017); *Dendrobium moschatum* (Bhattacharjee, 1981); *Dendrobium nobile* (Bichsel and Starman, 2010); *Dendrobium Sonia* 17 (Swapna *et al.*, 2002); and *Dendrobium* cv. Emma White (Ahmad *et al.*, 2014).

## Conclusion

It may be concluded that NPK spray formulations variously influenced the vegetative growth of presently investigated floriculturally important, an epiphytic species, *Dendrobium chrysanthum*. The growth was maximum in plants treated by spray formulation treatment T3 (NPK=150:25:100) under green house conditions. Further investigation needs to be undertaken so as to find out the efficacy of different NPK spray formulations on both vegetative and reproductive stages of *Dendrobium chrysanthum* and other related species.

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