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Effect of water soluble fertilizers on flowering of *Phalaenopsis* hybrid cv. Shagan

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Abstract
An investigation was carried out to find out the effect of water soluble fertilizers on flowering of orchid (*Phalaenopsis* Hybrid) cv. Shagan at BTCC, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha during the period January 2016 to March 2017. *Phalaenopsis* cv. The tissue cultured orchid plantlets were planted in pots containing potting mixture comprising of coal and coconut fibre, in equal proportion. Total population was ninety nine having eleven different treatments and each treatment contains 3 pots. The trial was conducted with ten treatments *viz.* T_1 (NPK 0:0:50 @0.1%), T_2 (NPK 0:0:50 @ 0.2%), T_3 (NPK 0:52:34 @ 0.1%), T_4 (NPK 0:52:34 @ 0.2%), T_5 (NPK 13:0:45 @ 0.1%), T_6 (NPK 13:0:45 @ 0.2%), T_7 (NPK 19:19:19 @ 0.1%), T_8 (NPK 19:19:19 @ 0.2%), T_9 (NPK 20:20:20 @ 0.1%), T_{10} (NPK 20:20:20 @ 0.2%) and T_{11} (control). The experiment was laid out in Completely Randomized Design with three replications. Water soluble fertilizers were applied by dissolving in water. Among all the fertilizers treatment T_7 (NPK 19:19:19 @ 0.1%) recorded the maximum flower parameters, including number of spike per plant, spike length, number of flowers per spike, diameter of flower and flowering duration as compared to other treatments. It is therefore suggested that for getting better quality of spike and flower, treatment T_7 (NPK 19:19:19 @ 0.1%) is recommended under Bhubaneswar condition in *Phalaenopsis* cv. Shagan.

Keywords: Water soluble fertilizers, *Phalaenopsis* orchid

Introduction
Orchids are distinctive plants and highly priced in international market due to their intricately designed spectacular flowers, brilliant colours, delightful appearance, myriad sizes, shapes, forms and long lasting qualities. Orchidaceae family consists of about 600 - 800 genera and 25,000 - 35,000 species and over 74,000 natural and manmade hybrids. They are always in demand in the international florist trade for their longer lasting and bewitchingly beautiful flowers. India is the centre of origin of many Orchid species and nearly 1300 species and 140 genera dwell in the country. Majority of the orchids are day neutral and are not influenced by day length.

The genus *Phalaenopsis* was established by Dr. Karl Lud-Wig Blume, the Dutch botanist in 1825. These are also called as moth orchids. Plant epiphytic on trees and rocks, with monopodial growth; stems short with few to several leaves borne together. Flowers small to large of various colours. Petals similar to sepals, slightly narrower or much broader. Lip three lobed, joined to the column foot without a hinge, variable and complex with antenna like appendages usually present. Column short to elongate, with a prominent foot. Anther terminal, incumbent two celled. Pollinia two, waxy, subglobose or ovoid, somewhat cleft, on a fairly long stripe.

As a rule, some kind of *Phalaenopsis* is in bloom at any time of the year. However, the members of the section *Phalaenopsis* generally bloom from late summer through winter into spring, with the peak in winter and spring, although the hybrids are far less seasonal and tend to bloom in varying degree throughout the year. Since *Phalaenopsis* has a monopodial manner of growth, the flower spikes can be produced at any time without regard to the maturity of the new growth. The inflorescence arises from the base of the leaves and continues to grow in some species as flowers are produced in succession. The inflorescence may be branched or unbranched. When the rachis is unbranched the flowers are usually produced in two rows, but sometimes the flowers are scattered in all directions or arranged spirally.

Phalaenopsis grows well in temperature ranging from 65F at night to 80F in the day. It does not require a great deal of light, approximately 1000 foot candles being sufficient.

During the day time a high humidity must be maintained with about 70% minimum and higher if the temperature rises. *Phalaenopsis* demand good air movement. It requires proper nutrition for its growth and development. Importance of N, P, K fertilizations has been demonstrated in different species of orchids. Spray application of cow dung and oilcake solution, and micronutrients gave better results in several epiphytic orchids. Use of coated and slow release fertilizers, for example, Osmocote is most suitable for terrestrial orchids. To monitor the weather and nutrient requirements of orchid plants regularly during different growth phases and to administer in proper dose at right time, misting and fertigation technology can be profitably employed.

Several studies found that *Phalaenopsis* plants require high nutrient concentrations for optimal growth under warm environmental conditions (Lee and Lin, 1988; Wang, 1996; Wang and Gregg, 1994) [7, 17, 14]. *Phalaenopsis* cannot uptake nutrient significantly from root so foliar nutrient application is very widespread practice in orchid cultivation. So water soluble Nitrogen, phosphorus and potassium with different concentration are commonly used as foliar spray which can be taken up by the plants almost immediately. Otherwise if the plant get too much NPK at a time it may produce abundant foliage but cannot produce quality flowers. But information regarding the nutritional supplement to *Phalaenopsis* orchids through foliar spray is very scanty. Moreover, the farmers are not able to follow the recommendations, as the recommended NPK formulations are not readily available in the market.

Materials & Methods

The orchid used in the study for the experiment was *Phalaenopsis* Hybrid cv. Shagan producing purple colour flower. It shows a monopodial growth habit: a single growing stem produces 1 or 2 alternate, thick, fleshy, elliptical leaves. Small size clay pots with aeration holes are used for planting of orchid seedlings. Potting of tissue cultured orchid seedlings are done by using coal and coconut husk as potting mixture and crutches are placed below the pot for proper drainage. Seedlings are placed in the middle of the pot & pots are placed in iron benches in the net house.

The different treatment manipulated as follows T_1 NPK (0:0:50) 0.1%, T_2 NPK (0:0:50) 0.2%, T_3 NPK (0:52:34) 0.1%, T_4 NPK (0:52:34) 0.2%, T_5 NPK (13:0:45) 0.1%, T_6 NPK (13:0:45) 0.2%, T_7 NPK (19:19:19) 0.1%, T_8 NPK (19:19:19) 0.2%, T_9, NPK (20:20:20) 0.1%, T_{10} NPK (20:20:20) 0.2%, T_{11} (CONTROL).. The treatments were arranged in a completely randomized design with 11 treatments in 3 replications.

Different water soluble fertilizers containing macro nutrients (N, P, K) in different proportions are used for the experiment for better growth and yield of *Phalaenopsis* orchid. 10gms of fertilizer are taken by weighing in an electronic balance and mixed with 100 ml water which can be measured by use of measuring cylinder and these are mixed thoroughly in a beaker. We can stir the solution till it gets mixed properly. Then the nutrient solution can be used immediately or can be kept in air tight bottles at a cool temperature for future use. 5ml /10 ml of nutrient solution is taken in a beaker and can be diluted with 495 or 490 ml water respectively and is applied to the plants by the use of a clean hand pump sprayer.

The plants under the treatment were sprayed with the fertilizers (nutrients) with the help of a clean hand pump sprayer. While spraying maximum care was taken to prevent the adjoining plants getting sprayed. Control plants were sprayed with only clean tap water. During flowering maximum care was taken to avoid the flowers getting sprayed. Along with these proper horticultural practices like irrigation, weeding & plant protection measures need to be followed.

Results

Number of spike per plant: The data presented in Table 1 revealed that among the different applications of water soluble fertilizers on orchid (*Phalaenopsis* Hybrid), treatment T_7 (NPK 19:19:19 @ 0.1%) (2.0) showed highest number of spike per plant followed by treatment T_9 (NPK 20:20:20 @ 0.1%) (1.67) and T_5 (NPK 13:0:45 @ 0.1%) (1.67) which was statistically at par.

Length of spike: The data presented in Table 1 revealed that among the different applications of water soluble fertilizers on orchid (*Phalaenopsis* Hybrid), treatment T_7 (NPK 19:19:19 @ 0.1%) (47.94 cm) showed maximum length of spike followed by treatment T_9 (NPK 20:20:20 @ 0.1%) (44.19 cm) and the treatments were statistically at par.

Number of flowers per spike: The data presented in Table 1 revealed that among the different applications of water soluble fertilizers on orchid (*Phalaenopsis* Hybrid), treatment T_7 (NPK 19:19:19 @ 0.1%) (10.00) showed highest number of flowers per spike followed by treatment T_9 (NPK 20:20:20 @ 0.1%) (7.44) which was statistically at par.

Diameter of flower: The data presented in Table 1 revealed that among the different applications of water soluble fertilizers on orchid (*Phalaenopsis* Hybrid), treatment T_7 (NPK 19:19:19 @ 0.1%) (7.50 cm) showed maximum flower diameter followed by treatment T_9 (NPK 20:20:20 @ 0.1%) (7.44 cm) and the treatments were statistically at par.

Duration of flowering: The data presented in Table 1 revealed that among the different applications of water soluble fertilizers on orchid (*Phalaenopsis* Hybrid), treatment T_7 (NPK 19:19:19 @ 0.1%) (92.67 days) showed highest bloom life followed by treatment T_7 (NPK 20:20:20 @ 0.1%) (91.67 days) and the treatments were statistically at par.

Table 1: Effects of water soluble fertilizers on flowering of (*Phalaenopsis* hybrid) cv. Shagan

	Treatments	Number of spike per plant	Length of spike (cm)	Number of flowers per spike	Diameter of flower (cm)	Duration of flowering (days)
T_1	NPK 0:0:50 (0.1%)	1.00	35.89	6.33	7.17	81.67
T_2	NPK 0:0:50 (0.2%)	1.00	33.36	6.00	7.17	82.00
T_3	NPK 0:52:34 (0.1%)	1.00	31.00	5.33	7.00	80.00
T_4	NPK 0:52:34 (0.2%)	1.33	33.14	6.00	7.33	79.33
T_5	NPK 13:0:45 (0.1%)	1.67	41.17	8.33	7.42	90.33
T_6	NPK 13:0:45 (0.2%)	1.33	32.72	7.33	7.08	84.33
T_7	NPK 19:19:19 (0.1%)	2.00	47.94	10.00	7.50	92.67
T_8	NPK 19:19:19 (0.2%)	1.33	37.25	7.67	6.67	73.00

T_9	NPK 20:20:20 (0.1%)	1.67	44.19	8.67	7.44	91.67
T_{10}	NPK 20:20:20 (0.2%)	1.33	33.81	6.33	7.17	73.33
T_{11}	Control	1.00	23.33	4.33	5.50	70.33
S.E		0.27	5.50	1.33	0.45	6.24
C.D		0.49	9.96	2.42	0.83	11.31

Discussion

Effects of water soluble fertilizers on flowering parameter in orchid (*Phalaenopsis* Hybrid) cv. Shagan

By spraying orchid (*Phalaenopsis* Hybrid) plant with different concentration of water soluble fertilizers significantly increased in the different flowering parameters like number of spikes per plant, length of spike, number of flowers per spike, flower diameter, bloom life, pedicel length and internodal length compared to the untreated plants.

Foliar spray of different concentration of water soluble fertilizers on orchid (*Phalaenopsis* Hybrid), maximum number of spikes per plant (2.00), length of spike (47.94 cm), number of flowers per spike (10.00) flower diameter (7.5 cm), bloom life (92.67 days), pedicel length (3.83 cm) and internodal length (3.40 cm) were recorded in treatment T_7 (NPK 19:19:19 @ 0.1%) followed by T_9 (NPK 20:20:20 @ 0.1%) and the treatment was statistically at par.

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 primorida for its reproductive parts (Tisdale and Nelson, 1975). Potassium moves readily with in plants and tends to translocate to the areas of growth (Troeh and Thompson, 1993) [3]. 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 frequently as a consequence of active K+ uptake (Lauchli and Pfloger, 1978) [6]. Therefore, more uptake of P and K resulted into healthy growth and ultimately could produce highest number of spike per plant and flowers per spike.

These results support the findings of Higaki and Imamura (1987) [5] in Vanda; Poole and Seeley (1978) [10] in *Cattleya*, *Cymbidium* and *Phalaenopsis*; Wang and Gregg (1994) [14], Wang (1996) [17], Amberger and Roeber (1997) [2] in *Phalaenopsis*; Wang (1995) [15] in *Dendrobium* and *Phalaenopsis*; Wang (2000) [17] in Hybrid Moth Orchid; Naik and Barman (2006) [8] in *Cymbidium* hybrid; Bhattacharjee (1981) [3], Swapna *et al*. (2002) [11]; Bichsel and Starman (2010) [4], Nair and Sujatha (2010)[9], Kabir *et al*. (2012), Ahmad and Saravanan (2014) and Trishita *et al*. (2014) in *Dendrobium* and Rajesh (2009) and Ali *et al*. (2014) [1] in *Mokara* Sp.

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