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Effect of Biofertilizer Application on Growth Parameters of *Spathiphyllum illusion*

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Abstract: Biofertilizers have some microorganisms which convert elements to available nutrient for plant's roots. This study was conducted to investigate the effects of biofertilizers and chemical fertilizers on growth indices of *Spathiphyllum illusion*. This trial was carried out in a Randomized complete block design (RCBD) in 3 replications. Treatments were: control (without fertilizer), Nitrokara (nitrogen biofertilizer), urea, Nitrokara + urea, Barvar-2 (phosphate biofertilizer), triple super phosphate, triple super phosphate + Barvar-2, Barvar-2 + Nitrokara. The results showed that "triple super phosphate + Barvar 2" treatment resulted in increasing leaves number, dry and fresh weight of leaves and the size of spadix. "Barvar-2 + Nitrokara" has the best effect on leaf size, height of flower stalk and chlorophyll content. The maximum amount of absorbing nitrogen was obtained under urea application.

Key words: *Spathiphyllum* % Barvar-2 (B2) % Nitrokara (NK) % Urea % Triple super phosphate (TSP)

INTRODUCTION

Peace lily belongs to Araceae [1]. *Spathiphyllum* is a very popular flower for indoor and it grows in tropical region of America and Southeast Asia. *Spathiphyllum* is important ornamental foliage which has a beautiful and creative leaves and white spadix [2]. An exact plan of fertilizer application is important for pot flowers. Media pH is vital for suitable fertilizing. Suitable pH for the most of greenhouse products is about 5.5 to 7. In this pH the most of nutrients are available for plant. In general, for the flower beds, in annual plan, 30 g nitrogen, 15 g phosphorus, 15 g potassium in each square meter must be available [1].

Biofertilizers are live formulates of microorganisms (useful bacteria and fungi) that are ready to be used and improve the quality and the health of the soil and the plant species by increasing the nutrient availability for the soil and plants. Biofertilizers naturally activate the microorganisms found in the soil restoring the soil's natural fertility and protecting it against drought and soil diseases and therefore stimulate plant growth [3]. Biofertilizers were obtained using natural election of different type of beneficial living organism [4]. Using biofertilizers that contain different microbial strains has led to a decrease in the use of chemical fertilizers and has provided high quality products free of harmful agrochemicals for human safety [5]. Biofertilizers are products containing living cells of different types of microorganisms, which have an ability to convert nutritionally important elements from unavailable to available form through biological processes [6]. Bio-fertilization is considered an important factor in reducing the used rates of chemical fertilizers which appear to be safely for environment, improving soil fertility and increasing soil productivity [7]. The effect of biofertilizer on the growth and chemical complex of *Chamaedorea elegans* was studied. The obtained results revealed that mycorrhiza and algae significantly enhanced *Chamaedorea elegans* seedlings growth and increased the content of chlorophylls a, b and nitrogen content in leaves. Also, biofertilizers significantly increased the fresh and dry weights of roots [8]. Application of 60 $kg ha^{-1}$ biophosphate increased plant height and biological yield [9].

Pongamia pinata treating with VAM (Vesicular arbuscular mycorrhiza) caused to increase the plant height, root length and dry material [10]. Barvar-2 (B2) applying in Tuberose caused to increase vase life and increasing of phosphorus absorption compared to triple super phosphate application. Also B2 increased the length of floret, flower diameter, fresh and dry weight

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Table 1: Fertilizer treatments which were used in this study

	Treatments	Amount (per pot)
T_1	Control	without fertilizer
T_2	Nitrokara (NK)	200cc (2.5 ppm)
T_3	Urea	2.1 g
T_4	Nitrokara (NK) + Urea	200cc (2.5 ppm) (NK) + 1g Urea
T_5	Barvar-2 (B-2)	200cc (2.5 ppm)
T_6	triple super phosphate (TSP)	0.4g
T_7	triple super phosphate (TSP) + Barvar-2 (B-2)	0.2g (TSP) + 200cc (B-2)
T_8	Barvar-2 (B-2) + Nitrokara (NK)	200cc (2.5 ppm) (B-2) + 200cc (2.5 ppm) (NK)

Table 2: Chemical analysis of the used plant medium

Potassium (%)	Phosphorus (%)	Nitrogen (%)	pH	EC (μmhos)
0.127	0.12	0.75	6.05	650

[11]. Soluble phosphate as biofertilizer (*Bacillus megaterium*) increased *Eucalyptus camaldulensis* seedlings' growth compared to unfertilized seedlings [12]. The soil inoculation with VA mycorrhiza and phosphobacterium led to best germination, seedling growth and nutrient uptake in oak (*Grevillea robusta*) [13]. Nitrogen biofertilizers such as Nitrokara (NK) help to correct the nitrogen levels of the soil. Nitrogen is a limiting factor for plant growth because plants need a certain amount of nitrogen in the soil to thrive [14]. Due to economic and environmental benefit of biofertilizer, this trial was conducted to reduce the amount of chemical material released to environment and protection the environment.

MATERIALS AND METHODS

The applied biofertilizers in this experiment were phosphorus biofertilizer (Barvar-2) and nitrogen biofertilizer (Nitrokara). The chemical fertilizers were triple super phosphate (TSP) and urea. The pot medium was cocopeat and tea factories' waste with equal volume fraction (1:1). The study was carried out in a randomized complete block design (RCDB) with 8 treatments in 3 replications. Trial pots treated with fertilizers in 3 splits based on Table 1.

Uniformly transplants of *Spathiphyllum* (average height of 20cm, 4 leaves and 1 rhizome) were used in this experiment. Before experiment some traits of medium was measured and it is shown in Table 2. All plants fertilized with a complete fertilizer which contains, N, P, K, Mo, B, Cu and Mg, with concentration 0.005. The study was carried out in the Research Center of Ornamental Plants- Lahidjan, Iran. The plants were grown under greenhouse condition for 7 months. After every month growth parameters including; Number of leaves, plants height (cm), length and width of leaf (cm), time of flowering, length and width of spath (cm), the size of spadix (cm), height of flower stalk (cm), chlorophyll content using chlorophyll measurement (CCM-200), fresh and dry weight of foliage and roots were measured in 4 stages. Dry matter was obtained via oven dried at 75°C. Nitrogen, phosphorus and potassium were measured using Kjeldahl, Spectrophotometer and Flamephotometer, respectively (Table 2). Analysis variance of data was obtained using statistical software of MASTATC and treatment means were compared using LSD ($p<0.05$).

RESULTS AND DISCUSSION

Data presented in Table 3 shows that the effect of trial treatments influenced significantly number of leaves ($p<0.05$). But data mean comparison (Table 4) shows that the best treatment for increasing the number of leaves were the "TSP + B-2". James *et al*. [15] reported that treating *Senna* plants with VAM increased the number of leaves. El-Khateeb *et al*. [8] found that treatments biofertilizers on *Chamaedorea elegans* significantly increased the number of leaves as compared with the control. It can be concluded that treating *Chamaedorea* seedlings with biofertilizers significantly increase nitrogen and phosphorus content in the soil as a result of N fixation and phosphate dissolving by bacteria and mycorrhiza. As well as growth promoting substances such as Indole acetic acid and gibberellins produced by all organisms used. The last part of the experiment, size and numbers of leaves difference between last and first stage was calculated. The results of analysis of variance (Table 3) showed that the effect of trial treatments influenced significantly number of leaves difference ($p<0.05$). Based on data mean comparison (Table 4), the best treatment was "TSP + B-2" (10.11) and urea caused to

Table 3: The results of analysis of variance on some measured traits

		Mean squares									
Source	df	Number of leaves	leaves number Difference	Leaves width Difference	leaves length Difference	Fresh weight	Dry weight	Chlorophyll content	Size of spadix	Flower stalk plant	Nitrogen content
Replication	2	41.38^{ns}	23.14^{ns}	0.86^{ns}	1.22^{ns}	496.16^{ns}	20.14^{ns}	490.82^{ns}	19.4^{ns}	1.70^{ns}	0.1^{ns}
Factor A	7	32.13^{*}	20.64^{*}	1.12^{*}	8.81^{*}	374.60^{*}	8.65^{*}	236.97^{*}	2.05^{*}	6.27^{*}	0.29^{*}
Error	14	9.29	7.07	0.49	1.13	72.47	3.75	77.55	0.84	1.17	0.08
CV (%)	-	27.79	46.48	33.61	29.05	23.34	23.34	19.85	30.95	2.55	7.22

ns and * : Not significant and significant at 5%

Table 4: Data mean comparisons of trial treatments effects on characteristics

Treatments	Number of leaves	leaves number Difference	Leaves width Difference	leaves length Difference	Fresh weight	Dry weight	Chlorophyll content	Size of spadix	Flower stalk plant	Nitrogen content
Control	9.33d	4.78bcd	2.66ab	2.88b	31.81bcd	5.42abc	46.87abc	2d	42.36b	3.96bc
NK	13.88ab	7.66ab	1.35c	2.32b	39.56ab	7.07ab	52.02a	3.92ab	41.78bc	3.91bc
urea	7.55cd	2.22d	1.5bc	2.06b	24.10cd	4.54bc	34.82bc	3.74abc	40.27c	4.49a
(NK) + urea	6.44d	2.56cd	1.81abc	2.73b	17.65d	3.61c	31.53c	2.33bcd	41.71bc	4.38ab
B -2	11.44abcd	6.34abcd	2.34abc	2.45b	38.07abc	6.38abc	47.62ab	2.22cd	42.50b	3.75c
TSP	10.55bcd	5.22bcd	1.56bc	2.73b	44.50ab	8.13ab	35.95bc	3.14abcd	42.31b	3.70c
TSP + B-2	16.44a	10.11a	2.37abc	3.33b	48.90a	8.04a	52.97a	3.98a	42.44b	3.64c
B-2 + NK	12.11abc	6.89abc	3.03a	6.72a	47.14a	7.77ab	52.95a	2.40abcd	45.44a	3.85c

Means with similar letters in column are not significantly different at 5% probability level, (LSD)

the least leaf number (2.22). Mahfouz and Sharaf-Eldin [5] found that application of biofertilizer with chemical fertilizers (only 50% of the recommended dosage of NPK) increased vegetative growth of fennel (plant height, number of branches and herb fresh and dry weight per plant) compared to chemical fertilizer treatments only.

The results of analysis of variance (Table 3) shows that treatments influenced significantly leaf width ($p<0.05$) and data mean comparison (Table 4) shows that the best treatment was obtained under "B-2 + NK" (6.22 cm). Also, based on results (Table 3 and 4) treatments influenced significantly difference of length of leaf ($p<0.05$) and the best treatment was "B-2 + NK" (6.72 cm). These results are in agreement with results El-Khateeb *et al.* [8] on *Chamaedorea elegans*. They showed that biofertilizer (mycorrhiza fungi, algae Hemogreen and Nitrobacteria) caused to increase the length of leaf in this ornamental plant.

Soluble bacteria in the nitrogen biofertilizer by generating soil soluble phosphorus, secretion plant growth hormones, natural enzymes, antibiotics and different compounds such as volatile gasses and sidrophore are capable to develop the aerial parts of plant [16].

The effect of trial treatments was significant on fresh and dry weight of leaves ($p<0.05$). Table 4 indicated that "TSP + B-2" and "B-2 + NK" increased the fresh weight of leaves of *Spathiphyllum* plant. But TSP and "TSP + B-2" increased the dry weight of leaves. Selosse *et al.* [17] reported that the biofertilizers with fixative bacteria increased the absorption potential of plant and dry material in plant. Sharma [18] reported that biofertilizer application increased the biomass and dry material of plants. Who believed that the biological fixation of nitrogen and phosphorus is reason of biomass increasing.

Size of Spadix was influenced under treatments ($p<0.05$). The best treatment was "TSP+ B-2" (Table 4). The microorganisms existing in the biofertilizer B-2 can help to improve growing the plant cell [14]. The treatments influenced the chlorophyll content ($p<0.05$) too (Table 3). Data mean comparison (Table 4) shows that the effective treatments were NK, "TSP+ B-2" and "B-2 + NK". El-Khateeb [8] showed that the mycorrhiza in low concentration (5 g/pot) and algae (Hemogreen) increased significantly the amount of chlorophyll in *Chamaedorea elegans* seedlings.

The result of analysis variance (Table 3) shows the fertilizers affected significantly the height of flower stalk

($p<0.05$). Based on data mean comparison (Table 4), "B-2 + NK" was the best treatment and the minimum height was obtained under Urea treatment. Khalaj [11] reported that fertigation of phosphorus biofertilizers (30 days after planting) + 50% TSP on Tuberose can cause to maximum height of plant.

Table 3 shows that uptake of nitrogen by plant was significant ($p<0.05$) under treatments. Data mean comparison (Table 4) shows urea and" NK + Urea" were the most effective treatments to N content rising. The reason is the increase of access to nutrient in chemical fertilizer [19]. The results showed that the biofertilizer improves the growth parameters of *Spathiphyllum*. Both biofertilizers (NK and B2) increase the chlorophyll content. Also all the biofertilizer treatments significantly increased the fresh and dry matter of leaves. It is recommended to apply chemical fertilizers with biofertilizers for the positive environmental effects of biofertilizer. So this can prevent pollution of soil and water and excessive accumulation of phosphorus and heavy metals such as cadmium and boron. We suggest that some other study should be carried out on the biofertilizer. Finally, biofertilizer improves the growth parameters of *Spathiphyllum*. Both biofertilizers (NK and B2) increase the chlorophyll content too.

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