J-PAL, Vol. 11, No. 1, 2020 **ISSN: 2087-3522**
DOI: 10.21776/ub.jpal.2012.010.01.01 **E-ISSN: 2338-1671**

GA3 and NPK Fertilization Applications Affect *Phalaenopsis amabilis* L. orchid for Plant Growth

Sunawan[1], Rose Novita Sari Handoko[1]*, Istiqomah Rusdiana Rahayu[1], Aminudin Afandhi[2]

[1]Department of Agrotechnology, Faculty of Agriculture, University of Islam Malang, Malang, Indonesia
[2]Department of Plant Protection, Faculty of Agriculture, Universitas Brawijaya, Malang, Indonesia

Abstract

Application of GA3 and NPK fertilizers is already known to promote growth of plants. Potential effects of GA3 and NPK on the growth of *Phalaenopsis ambilis* L. orchid were investigated in the present study. However, increasing application GA3 concentrations of 0, 1, 2, 3, 4, 5 ppm/plant and NPK concentrations of 0, 1, 2, 3, 4 gram/plant. The observation started 30, 45, 60, 75, 90 days after application. This research was use the concentration of GA3 and NPK separately (without combination), each treatment showed a significant effect on the number of leaves, stem diameter, leaf area and leaf area index and had no significant effect to plant height variables. Treatment of GA3 (3 ppm / plant) showed positive results on the variable number of leaves, leaf area and leaf area index. Increasing the concentration of GA3 to 5 ppm / plant did not show any significant difference with the treatment of GA3 concentration of 3 ppm / plant. This shows that plants are needed in small amounts. The dose of fertilizer 1 g / plant showed positive results on the variable number of leaves and stem diameter, while for the leaf area variable and leaf area index required higher NPK fertilizer osis ie 2 g / plant. The increase of NPK fertilizer dosage up to 4 g / plant was not significantly different from treatment 1 and 2 g / plant.

Keywords: *Phalaenopsis ambilis* L., GA3, NPK, Growth

INTRODUCTION*(Calibri 10 Bold, Left, Capslock)

Phalaenopsis orchid is of commercial importance in the horticultural industry for its attraxtive inflorescence [1]. In Indonesia, the orchid harvest area from 2016 to 2017 has increased from 1,387,241 m^2 to 1,721,941 m^2 and production of 19,978,078 stems to 20,045,577 stems. The centers of production of cut flowers such as chrysanthemums, roses, savory nights, orchids are East Java, West Java, Banten, Central Java, North Sumatra, Bali. East Java Province is ranked 4th in orchid production [2]. The export volume of orchids increased by 27.92 percent, from 40.56 tons in 2017 to 51.89 tons in 2018. The FOB value of orchid exports also increased by 15.95 percent, from 292,963 US$ in 2017 to 339,686 US$ in 2018 [3].

Phalaenopsis orchid is an ornamental plant that has high aesthetic value. The shape, size, color and unique flower resistance make the special attraction of these ornamental plant species, so much demand by consumers both from within and outside the country [4]. One of the obstacles faced in the cultivation of orchids is that one of the vegetative growth is very slow. Therefore, to overcome this problem, it is necessary to find a solution. Growth of orchid seeds can be stimulated by adding growth regulators such as auxin, gibberellins and cytokines. These growth regulators can stimulate division, enlargement, cell differentiation, and protoplasmic flow in vegetative growth of plants, including root organs [5]. In addition to plant growth regulators, orchid growth is also encouraged by using fertilizers. The type of fertilizer used for orchid cultivation is generally in the form of compound fertilizer, which is fertilizer that contains micro nutrients and macro nutrients. However, the main requirements for fertilizers for orchids must contain three important nutrients namely Nitrogen (N), Phospor (P), and Potassium (K). In its application the application of fertilizer must adjust to the phase of plant growth [4].

Agricultural cultivation efforts in terms of growth is one of the important aspects to maintain the production of cultivated plants to be stable or increase. Giving NPK and Gibberellic (GA3) fertilizer is one way to improve the quality of ornamental plants especially the *Phalaenopsis amabilis* L. The effect of gibberellic on flowering of plants is proven in research on *Anthurium andreanum* cv. Avo Cuba [6]. The application of

Correspondence address:
Rose Novita Sari Handoko
Email : rosensh@unisma.ac.id
Address : Mayjen Haryono street, Alley 10, Number 193, Dinoyo, Lowokwaru district, Malang city, East Java 65144, Indonesia

Grow Quick LB fertilizer containing macro nutrients N, P, K and micro nutrients, Cu, Mn, Zn, B, Fe, Mo, vitamin B1 has a positive effect on *Dendrobium* orchid seedling growth [7]. From some previous studies as a reference for research to be carried out, namely the effect of NPK and GA3 fertilizer for the growth of *Phalaenopsis amabilis* L. at the right doses.

MATERIAL AND METHOD

The study was conducted in a screen house, in at the experimental garden of Faculty of Agriculture, University of Islam Malang 500 m above sea level. The average temperature was 21-24 ºC at night is 21 - 24 ºC during the day average relative 60 - 80%. Keep green house conditions kept moist by watering every day. *Phalaenopsis* sp was 6 months old and have not flowered. Growing raw materials (ferns and charcoal). The study was conducted in September 2019 until March 2020.

Design of Research

This research used factorial experimental design which is arranged by using Randomized Complete Block Design (RCBD) with a control consisting of 2 treatment factors and three repetitions. Data obtained were analyzed using analysis of variance to determine the effect between treatments. If there is an interaction between treatments, it is continued by using Duncan Multiple Range Test (DMRT) level of 5% (to find out the differences between treatments).

Factor 1 was the concentration of growth regulator GA3. It consists of control and five levels. Treatment concentrations of GA3 which were 0, 1, 2, 3, 4, 5 ppm/plant and respectively labeled as G0 to G5. Factor 2 was NPK fertilizer dosage, which consists of control and four sconcentrations. It includes 0, 1, 2, 3, 4 g/plant namely P0 to P5. NPK and GA3 applications with water dilution and sprayed near root.

Placement of orchids in the experimental plot was carried out by placing the plant at an orchid spacing between rows of 20 cm, spacing in rows of 15 cm and spacing of orchids with a shelf edge of 15 cm. In each treatment there were three replications, and one replication with one plant.

Variable Observation of Research

Observations were made at ages of 30, 45, 60, 75, 90 and 105 days after application of fertilizers. Observations are conducted without destruction with the following observational variables (vegetative growth):

a. Plant height (cm)

Plant height is measured from the base of the plant to the tip of the plant.

b. Number of leaves (strands)

The number of leaves is calculated starting from the leaves that appear and open entirely.

c. Leaf area (cm^2)

Leaf area is measured starting from the largest, medium and small leaves. Leaf area is measured using the formula:

$$LD = P \times L \times fk \times D$$

$$fk = \frac{C / B \times A}{P \times L}$$

Where :

fk = correction factor

A = initial paper area

B = initial paper weight

C = the weight of the leaf image

D = number of leaves

P = leaf length

L = leaf width

d. Leaf area index

The observed using a formula:

$$ILD = \frac{LD}{LT} \ (m^2\ m^{-2})$$

Where :

ILD = leaf area index ($m^2\ m^{-2}$)

LD = leaf area (m^2)

LT = area of shaded land (m^2)

RESULT AND DISCUSSION

Number of Leaves

Treatment of GA3 and NPK was observed with each dose and had an effect on the number of leaves. GA3 concentration treatments significantly effect at 30 days after application and the treatment dose of NPK fertilizer significantly effect at the age of 75 and 90 days after application. The average value of the number of leaves after being tested with the Duncan 5% test is presented in Table 1.

Table 1. Average Number of Leaves (sheets) in Treatment of GA3 Concentration and NPK Fertilizer Doses

Treatment (ppm/plant)	The Number of Leaves (sheet) at Age (days after application)					
	30		45	60	75	90
0	2.78	a	2.82	3.09	3.07	3.21
1	2.89	b	3.09	3.09	3.19	2.87
2	3.07	c	3.22	3.33	3.44	3.16
3	3.40	f	3.33	3.51	3.36	3.20

4	3.24	d	3.13	3.24	3.27		3.34	
5	3.33	e	3.24	3.51	3.68		3.23	
DMRT 5%	NR		NR	NR	NR		NR	
Treatment (gram/plant)	**30**		**45**	**60**	**75**		**90**	
0	3.07		3.11	3.2	3.33	abc	3.13	ab
1	3.00		2.91	3.57	3.69	c	3.63	b
2	3.06		3.24	3.48	3.59	bc	3.30	ab
3	3.28		3.20	3.11	3.07	ab	3.05	ab
4	3.19		3.24	3.11	2.98	a	2.74	a
DMRT 5%	NR		NR	NR	R		R	

Notes: The numbers accompanying the same letters in the same column show no significant difference in the Duncan 5% test. NR = Not Real, R = Real.

In Table 1 it is shown that at the age of 30 days after application GA3 treatment there was a significant difference, the highest leaf number was achieved at GA3 3 ppm / plant. that is 3,4 leaves and significantly different from other treatments. While the lowest value in the treatment without GA3. The treatment of NPK fertilizer dose significantly affected the age of 75 and 90 days, that the treatment dose of NPK 1 g / plant was significantly different from the treatment of NPK fertilizer 5 g / plant, but it was not significantly different from other treatments. Treatments of GA3 0.15-0.2 ppm is known to significantly increase the number of shoots, height, number of leaves, and number of roots [8].

Plant Height

The results of analysis of variance showed that there was no interaction effect between treatment of GA3 concentration and doses of NPK fertilizer on plant height variables. Separately also there was no significant effect on each treatment. The average value of plant height after being tested with Duncan 5% test is presented in Table 2.

Table 2. Average Plant Height (cm) in Treatment of GA3 Concentration and NPK Fertilizer Doses

Treatment (ppm/plant)	Plant Height (cm) at Age (days after application)				
	30	**45**	**60**	**75**	**90**
0	2.14	2.53	2.73	2.73	3.11
1	2.40	2.66	2.92	2.92	3.31
2	2.37	2.64	2.72	2.72	2.96
3	2.22	2.57	2.72	2.72	3.27
4	2.50	2.82	2.98	2.98	3.45
5	2.54	2.88	2.97	2.97	3.51
DMRT 5%	NR	NR	NR	NR	NR
Treatment (gram/plant)	**30**	**45**	**60**	**75**	**90**
0	2.35	2.64	2.78	2.98	3.1
1	2.39	2.66	2.86	3.20	3.52
2	2.31	2.68	2.83	3.11	3.32
3	2.19	2.53	2.65	2.99	3.23
4	2.57	2.90	3.08	3.25	3.17
DMRT 5%	NR	NR	NR	NR	NR

Notes: NR = Not Real, R = Real.

As the orchids are slow growing, slow release fertilizer mixtures (NPK) can be used to get best result. Application of spray nutrient containing NPK with different concentration varied on the basis of growth stage of plants. During vegetative growth large quantities of nitrogren are required. Nutrient colution of NPK plays a vital role in the growth and development of orchid. Growth features are the first concern for better comprehending about the potential mood of orchid variety [9]. GAs are known to trigger stem elongation and flowering [10]. Gibberelin acid (GAs) can effectively shorten the length of the juvenile phase [11].

Stem Diameter

The results of analysis of variance that shows difference in interaction between treatment of GA3 concentration and doses of NPK fertilizer on the diameter of the variable stem. However, apart from difference between NPK fertilizer at 90 days after application. The average value of stem diameter after being tested with the Duncan 5% test is given in Table 3.

Table 3. Average Stem Diameter (cm) in Treatment of GA3 Concentration and NPK Fertilizer Doses

Treatment (ppm/plant)	Stem Diameter (cm) at Age (days after application)					
	30	**45**	**60**	**75**	**90**	
0	0.47	0.50	0.53	0.55	0.59	
1	0.49	0.52	0.55	0.56	0.61	
2	0.48	0.52	0.54	0.56	0.63	
3	0.49	0.53	0.57	0.60	0.66	
4	0.47	0.51	0.53	0.55	0.62	
5	0.51	0.54	0.58	0.59	0.69	
DMRT 5%	NR	NR	NR	NR	NR	
Treatment (gram/plant)	**30**	**45**	**60**	**75**	**90**	
0	0.50	0.52	0.54	0.56	0.58	a
1	0.49	0.53	0.57	0.61	0.69	b
2	0.47	0.50	0.54	0.57	0.62	ab
3	0.49	0.52	0.55	0.54	0.62	ab
4	0.49	0.53	0.55	0.57	0.65	ab
DMRT 5%	NR	NR	NR	R	R	

Notes: The numbers accompanying the same letters in the same column show no significant difference in the Duncan 5% test. NR = Not Real, R = Real.

Table 3 shows that the NPK fertilizer dosage treatment showed a significant difference in the age of 90 days after application, where 1g / plant treatment was significantly different from the treatment without NPK fertilizer (0 g / plant), but not significantly different from other treatments. The lowest average stem diameter value was found in the treatment without NPK fertilizer (0 g / plant), that is 0.58 cm. NPK fertilizer is a macro nutrient to help plant growth. Orchids in the growth phase require fertilizers with low P and K levels. We recommend that when orchids enter the generative period (flowering) orchids require fertilizer with high P and K levels [12].

Leaf Area

The results of analysis of variance showed that there was no interaction effect between treatment of GA3 concentration and doses of NPK fertilizer on leaf area variables. But separately there is a real influence on each treatment. The treatment of GA3 concentration significantly affected the age of 30, 60, 75 and 90 days after application and the NPK fertilizer dosage treatment significantly affected the ages 30, 45, 60, 75 and 90 days after application. The average leaf area values after being tested with the Duncan 5% test are presented in Table 4.

Table 4. Average Leaf Area (cm^2) in Treatment of GA3 Concentration and NPK Fertilizer Doses

Treatment (ppm/plant)	Leaf Area (cm^2) at Age (days after application)									
	30		45		60		75		90	
0	12.01	a	15.20	a	16.85	a	18.58	a	21.01	a
1	15.10	ab	18.05	a	20.67	ab	19.87	ab	28.33	ab
2	15.35	ab	18.09	a	23.05	ab	25.27	bc	31.04	b
3	17.33	b	20.15	a	23.00	ab	28.08	c	32.20	b
4	16.54	b	18.49	a	22.40	ab	25.60	bc	28.98	ab
5	16.87	b	19.78	a	23.88	b	27.22	c	32.47	b
DMRT 5%	R		NR		R		R		R	
Treatment (gram/plant)	30		45		60		75		90	
0	13.05	a	15.31	a	16.17	a	17.01	a	19.11	a
1	14.41	ab	17.05	ab	19.84	ab	22.90	ab	25.71	ab
2	15.11	ab	18.66	ab	22.97	b	26.36	b	34.00	b
3	16.70	ab	19.03	ab	23.91	b	27.55	b	33.84	b
4	18.40	b	21.41	b	25.30	b	26.71	b	32.37	b
DMRT 5%	R		R		R		R		R	

Notes: The numbers accompanying the same letters in the same column show no significant difference in the Duncan 5% test. NR = Not Real, R = Real.

Table 4 shows that the treatment of GA3 concentrations was significantly different in leaf area variables 30, 60, 75 and 90 days after application. All days after application between treatments 1 to 5 ppm / plant there was no significant difference, but significantly different from the treatment without GA3. Likewise, NPK pupk dosage treatments at ages 30, 45, 60, 75 and 90 days after application between treatments 1 to 4 / plant showed no significant difference, but significantly different from treatments without GA3 (0 g / plant).

Leaf Area Index

The results of analysis of variance showed that there was no interaction effect between treatment of GA3 concentration and the dose of NPK fertilizer on leaf area index variables. But separately there is a real influence on each treatment. The treatment of GA3 concentration significantly affected the age of 30, 60, 75 and 90 days after application and the NPK fertilizer dosage treatment significantly affected at all days The average value of the leaf area index after being tested with the Duncan 5% test is presented in Table 5.

Table 5. Average Leaf Area Index (m^2 m^{-2}) in Treatment of GA3 Concentration and NPK Fertilizer Doses

Treatment (ppm/plant)	Leaf Area Index (m^2 m^{-2}) at Age (days after application)									
	30		45		60		75		90	
0	0.040	a	0.040	a	0.056	a	0.062	a	0.070	a
1	0.050	ab	0.050	a	0.069	ab	0.066	ab	0.094	ab
2	0.051	ab	0.051	a	0.077	ab	0.084	bc	0.103	b
3	0.058	b	0.058	a	0.077	ab	0.094	c	0.107	b
4	0.055	b	0.055	a	0.075	ab	0.085	bc	0.097	ab
5	0.056	b	0.056	a	0.080	b	0.091	c	0.108	b
DMRT 5%	R		NR		R		R		R	
Treatment (gram/plant)	30		45		60		75		90	
0	0.043	a	0.051	a	0.054	a	0.057	a	0.064	a
1	0.048	ab	0.057	ab	0.066	ab	0.076	ab	0.086	ab
2	0.050	ab	0.062	ab	0.077	b	0.088	b	0.113	b
3	0.056	ab	0.063	ab	0.080	b	0.092	b	0.113	b
4	0.061	b	0.071	b	0.084	b	0.089	b	0.108	b
DMRT 5%	R		R		R		R		R	

Notes: The numbers accompanying the same letters in the same column show no significant difference in the Duncan 5% test. NR = Not Real, R = Real.

Table 5 shows that the GA3 concentration treatment was significantly different for the leaf area index variable at 30, 60, 75 and 90 days after application. At all days between treatments 1 to 5 ppm / plant there was no significant difference, but significantly different from the treatment without GA3 (0 ppm / plant). Likewise, NPK pupk dosage treatments at all days between treatments 1 to 4 / plant showed no significant difference, but significantly different from treatments without GA3 (0 g / plant). The size of the plants was obtained through the width and the length of the leaves obtained after the treatment with different concentrations of GA3. The reproductive phase was evaluated by the flowering quality, such as the time of the first flowering, flowering rate (%), the length of inflorescence, the number of flowers and the quality of the flowers obtained in each treatment. The quality of flowers was measured by the diameter of flowers and petals of flowering plants. Gibberellins are plant hormones biochemically characterized as tetracyclic diterpenoid acids [13].

Conclusion

This research was use the concentration of GA3 and NPK separately (without combination), each treatment showed a significant effect on the number of leaves, stem diameter, leaf area and leaf area index and had no significant effect to plant height variables. Treatment of GA3 (3 ppm / plant) showed positive results on the variable number of leaves, leaf area and leaf area index. Increasing the concentration of GA3 to 5 ppm / plant did not show any significant difference with the treatment of GA3 concentration of 3 ppm / plant. This shows that plants are needed in small amounts. The dose of fertilizer 1 g / plant showed positive results on the variable number of leaves and stem diameter, while for the leaf area variable and leaf area index required higher NPK fertilizer osis ie 2 g / plant. The increase of NPK fertilizer dosage up to 4 g / plant was not significantly different from treatment 1 and 2 g / plant.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the support of funding by research grant funds 2019 in University of Islam Malang.

REFERENCES

[1]. G. S. Li., J. Duan, Z. L. Chen, S. J. Zeng, Y. M. Jiang, D. C. Joyce. 2006. KClO3 applications affect Phalaenopsis orchid flowering. *Scientia Horticulturae* 110: 362-365

[2]. Statistics Indonesia. 2017. Statistics of Ornamental Plants Indonesia, Jakarta

[3]. Statistics Indonesia. 2018. Statistics of Ornamental Plants Indonesia, Jakarta

[4]. Mulyadi, M., Saepul, Y. A., Abdurahman, D. Wibowo, H. 2006. Pengaruh Pemberian Konsentrasi Pupuk Dan Media Tanam

Terhadap Pertumbuhan Vegetatif Fase Seedling Anggrek *Phalaenopsis*. PS Agronomi, Fakultas Pertanian, Universitas Sultan Ageng Tirtayasa, Serang. 12 hal.

[5]. Nikmah, Z. C., Slamet, W. Kristanto, B. A. 2017. Aplikasi Silika dan NAA terhadap Pertumbuhan Anggrek Bulan (*Phalaenopsis amabilis* L.) pada Tahap Aklimatisasi. J. Agro Complex 1(3): 101-110.

[6]. Suradinata, Y. R., Nuraini, A., Sela, A. 2016. Respons bunga anggrek *Dendrobium* F1 (*Dendrobium* Malaysian Green) pada berbagai konsentrasi giberelin. Jurnal Kultivasi, Vol. 15:1.

[7]. Surtinah, Mutryarny, E. 2013. Frekuensi Pemberian Grow Quick LB terhadap Pertumbuhan Bibit Anggrek *Dendrobium* pada Stadia Komunitas Pot. Jurnal Ilmiah Pertanian, Vol. 10, No. 2

[8]. Mukminin, L. H., Al Asna, P. M., Setiowati, F. K. 2016. Pengaruh Pemberian Giberelin dan Air Kelapa terhadap Perkecambahan Biji Anggrek Bulan (*Phalaenopsis amabilis* L.). Bioeksperimen, Vol. 2, No. 2.

[9]. Monda, T., Prosanta, K. D., Mahtalat A., Md. Monirul, I., Md. Hossen, A. 2014. Growth performance of orchid (*Dendrobium* Sp.) as influenced by different NPK spray concentration. *International Journal of Biosciences*, Vol. 4, No. 7, pp. 15-27.

[10]. Hisamatsu, T., Koshioka, M., Kubota, S., Fujime, Y., King, R.W., Mander, L.N., 2000. The role of gibberellin biosynthesis in the control of growth and flowering in *Matthiola incana*. *Physiol. Plant*. 109, 97–105.

[11]. Sgamma, T., 2017. Juvenility. In: 2nd ed. In: Thomas, B., Murphy, D.J., Murray, B.G. (Eds.), *Encyclopedia of Applied Plant Sciences*, vol. 1. Academic Press, California, pp. 437-441.

[12]. Tarigan, H. M. 2009. Pengaruh Beberapa Media Tanam dan Intensitas Pemupukan terhadap Pertumbuhan Anggrek (*Oncidium golden Shower*). (Skripsi). Departemen Ilmu Tanah, Fakultas Pertanian, Universitas Sumatera Utara.

[13]. Cardoso, J. C., Elizabeth O. O., Joao, D. R. 2012. Gibberellic acid in vegetative and reproductive development of Phalaenopsis orchid hybrid genus. *Horticultura Brasileira* 30 (1); 71-71.