

Effect of different N: P: K ratios on the growth performance of *Alternanthera sessilis* (Var. Rubra): implications on ornamental aquatic plant industry

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Abstract- *Alternanthera sessilis* Var. Rubra is a colourful foliage plant which has a high demand in ornamental aquatic plant industry. This study investigated the best N: P: K ratio to obtain maximum growth performance of *Alternanthera sessilis* Var. Rubra in order to cater the demand by cost-effective application of fertilizer. As per the results obtained ($p < 0.05$), plants treated with 2N: P: 2K fertilizer ratio show the highest growth performance in terms of shoot length, fresh weight of roots, total leaf area and number of leaves. The plants that were treated with 2N:2P: K fertilizer ratio showed the highest growth performance for the growth parameters of root length, fresh weight of shoots and number of new nodes. Most of the growth parameters that are important for ornamental aquatic plant industry such as shoot length, total leaf area and number of leaves were given by the 2N: P: 2K fertilizer ratio. Hence, 2N: P: 2K fertilizer ratio is the best for *Alternanthera sessilis* (Var. Rubra) to obtain optimum growth performance for ornamental aquatic plant industry.

Index Terms- *Alternanthera sessilis* (Var. Rubra), N: P: K ratio, growth performance, ornamental aquatic plant industry

I. INTRODUCTION

Despite the significance of *Alternanthera sessilis* Linn. (Amaranthaceae) as one of the most popular and widely consumed leafy vegetables in tropical countries, currently it is utilized as an ornamental aquatic plant; especially the coloured varieties (i.e. Var. Rubra). This plant is known by the common names such as sessile joyweed & dwarf copper leaf and has the origin in Brazil. *A. sessilis* considered as an aquatic plant since it prefers to grow in well-moisten soil conditions (Wahunndeniya and Kurukulaarachchi, 1999). This plant is commonly utilized as an ornamental aquatic plant for water gardening and other decorative aquariums all over the world (Tomaino, 2006).

Although the selection of most suitable growing medium is vital in any kind of ornamental plant production, applying of fertilizers are also have a crucial role as nutrient improvers. Because, it can ultimately enhance the productivity of the plant that is being concerned (Ingles, 2004). Nitrogen (N), Phosphorous (P) and Potassium (K) are considered as the most essential major nutrient for plant growth. Nitrogen is capable of increasing the length of the vegetative parts of the plant (Rademacher and Nelson, 2001) while Phosphorous can enhance its rapid growth. Potassium is an important nutrient to maintain overall health of the plant which involves in many metabolic processes of the plants such as enzyme activity, protein

synthesis, photosynthesis, osmoregulation, stomatal movement, energy transfer, phloem translocation, ionic balance and stress resistance (Wang et al., 2013). Certain researchers have studied the effect of different N: P: K ratios on various ornamental plants (El-Naggar and El-Nashorty, 2009; Kapugama and Peiris, 2010) and have found that alteration of these ratios have a significant effect on the growth performance of the plant. Hence, the aim of this work was to determine the best N: P: K ratio to increase the growth of *Alternanthera sessilis* which has currently drawn a significant importance as an ornamental aquatic plant.

II. MATERIALS AND METHODOLOGY

The experiments were conducted in the Aquatic Plant Unit (APU) at Uva Wellassa University of Sri Lanka, Badulla. Initially, a stock of healthy plants of *A. sessilis* was obtained from the Aquatic plant unit of Uva Wellassa University. As propagules nearly 3 cm shoots with 2 internodes were used. All the shoot portions were selected carefully to maintain the uniformity of all propagules. For this purpose, all propagules were selected as two nodes immediately above the shoot- root junction. All used propagules were in same shoot diameter and contained four leaves. In each propagule, four leaves were trimmed in half before the potting.

Plastic pots were used as the containers to fill the potting medium. As the potting medium a mixture of coir dust, compost and sand 1:1:1 by volume was used. These three components were mixed well as a mixture and filled in to the pots in same quantities. Then prepared propagules were planted as five per one pot. First node of each propregule was inserted (nearly 5mm) into the potting media. Since there were eight treatments, 80 pots were prepared with propagules as 10 replicates for one treatment. All the pots were placed under 30% shade place to avoid the impacts from rain and adverse wind conditions. Completely Randomized Design (CRD) was used for the placement of pots. Seven different fertilizer treatments; (N: P: K), (2N: P: K), (2N: P: 2K), (2N:2P: K), (N: 2P: K), (3N: P: K), (3N:2P: K) were applied in the recommended dosages defined by the Royal Botanic Gardens, Sri Lanka for leaf plants. As the control, similar plant establishments were used without adding any N, P and K containing fertilizer. For all the treatments including the control, a mixture of micro nutrients were added in recommended dosages by Royal Botanic Gardens, Sri Lanka for foliage plants. Fertilizer treatments were started to apply after 2 weeks of propagule potting. Fertilizer treatments were applied over three months with the two weeks intervals. Water was

applied once in two days using a spraying method until the potting medium gets saturated.

Three months after the plant establishment, shoot length, root length, fresh weight of shoots, fresh weight of roots, number of leaves, total leaf area and number of new nodes were measured. Data were analyzed using the one-way ANOVA procedure in the Minitab 17.0 statistical software package. Tukey Pairwise Comparisons test was used to identify the significant differences among the treatments.

III. RESULTS AND DISCUSSION

Shoot length

The results found that there is a significant effect ($p < 0.05$) on the length of the shoots of *A. sessilis* by different fertilizer treatments with compare to the control. The highest mean shoot length (19.73 cm) was recorded for 2N: P: 2K ratio while the lowest (7.83 cm) was recorded in control. In addition the mean shoot length of the plants treated with 2N: P: K ratio also showed a considerable growth performance (19.73 cm).

Root length

There is a significant difference ($p < 0.05$) on the length of roots when applied different treatments with different N: P: K ratios, comparative to the control. The highest mean root length (18.46 cm) was observed in 2N:2P: K ratio treated plants whereas the lowest (8.37 cm) was recorded for the control.

Fresh weight of shoots

With comparison to the control treatment, the obtained value for fresh shoots weight was significantly different ($p < 0.05$). The maximum recorded fresh shoot weight (4.07 cm) was

with the plants that were treated with 2N:2P: K ratio while the lowest (0.47 cm) was for the control.

Fresh weight of roots

As per the results obtained for fresh weight of roots, there was no significance difference ($p > 0.05$) among the different N: P: K ratio treatments on fresh weight of roots of *A. sessilis* compare to the control. The highest recorded mean value (1.16 cm) for fresh root weight of roots was for 2N: P: 2K ratio while the lowest (0.09 cm) for the control.

Total leaf area

The recorded results shown that there is a significant difference ($p < 0.05$) among control and the different N: P: K ratios on the total leaf area of *A. sessilis*. The recorded highest mean leaf area (129 cm³) was in 2N: P: 2K treated plants and the lowest (26 cm³) was recorded for the control.

Number of leaves

The highest mean number of leaves (43) was recorded for the treatment of 2N: P: 2K ratio and the lowest mean number (8.67) was recorded for the control.

Number of new nodes

The results found that the highest mean number of new nodes (13.67) produced in 2N:2P: K treated plants whereas the lowest number (3.33) was recorded for the control.

Foliage Colour

There was no any identifiable colour difference in any of the treatments with compare to the control or among each other. This might be due to provision of all the micronutrients in recommended dosages for all the treatment in same quantities.

Table 1. Mean Shoot Length, Root Length, Fresh weight of shoots, Fresh weight of roots, Total leaf area, Number of leaves, Number of new nodes of *A. sessilis* with respect to different N: P: K ratio fertilizer treatments.

Treatment	Shoot Length (cm)	Root Length (cm)	Fresh weight of shoots (g)	Fresh weight of roots (g)	Total leaf area (cm ²)	Number of leaves	Number of new nodes
Control	7.83 ^f	8.37 ^e	0.47 ^c	0.09 ^a	26 ^e	8.67	3.33
N: P: K	14.17 ^{de}	9.53 ^{de}	0.86 ^{bc}	0.24 ^a	73 ^{cd}	24.33	6.33
2N: P: K	19.73 ^b	9.90 ^e	2.06 ^b	0.35 ^a	98 ^b	32.67	7.67
2N: P: 2K	21.80 ^a	13.47 ^b	1.41 ^{bc}	1.16 ^a	129 ^a	43.00	9.00
2N:2P: K	18.10 ^{bc}	18.47 ^a	4.07 ^a	0.15 ^a	55 ^d	18.33	13.67
N: 2P: K	17.37 ^c	11.97 ^{bc}	1.35 ^{bc}	0.16 ^a	92 ^{bc}	30.67	8.67
3N: P: K	15.30 ^d	11.63 ^{bc}	1.19 ^{bc}	0.30 ^a	83 ^{bc}	27.67	7.00
3N:2P: K	13.03 ^e	11.43 ^{cd}	0.64 ^c	0.12 ^a	80 ^{bc}	26.67	7.00

*Means that do not share a letter are significantly different for a particular N: P: K ratio fertilizer treatment.

The obtained results show that *A. sessilis* plants treated with 2N: P: 2K fertilizer ratio show the highest growth performance in terms of shoot length, fresh weight of roots, total leaf area and number of leaves. The plants that were treated with 2N:2P: K fertilizer ratio showed the highest growth performance for the growth parameters of root length, fresh weight of shoots and number of new nodes. Application of fertilizer for leafy plants by exceeding the recommended dosages can alter the soil characteristics as well as certain elements in the plant itself. In

addition, addition of high levels of N: P: K fertilizers to plants can be toxic to them and retard the growth (De Lucia *et al*, 2013). Therefore, fertilizer application should have properly quantified before the application (Wahundeniya, 2008). The identification of optimum major nutrient ratio can support the accuracy as well as the effectiveness of this process (Ahamed *et al*, 2012).

In this study it was investigated the effect of artificially added N: P: K fertilizers. However, the organic matters in potting

media have a vital role in providing as well as make available the nutrients to plant roots. Because they provide required space as well as energy for decomposing microorganisms which can ultimately assist in nutrient transformations to readily available forms for plant roots (Maynard and Hochmuth, 2007).

However, under this study it was investigated the optimum N: P: K ratio to obtain best growth performance in *Alternanthera sessilis* (Var. Rubra) as an ornamental aquatic plant. Therefore, most of the growth parameters that are important for ornamental aquatic plant industry such as shoot length, total leaf area and number of leaves were given by the 2N: P: 2K fertilizer ratio.

IV. CONCLUSION

As per the result of this study 2N: P: 2K fertilizer ratio is the best for *Alternanthera sessilis* (Var. Rubra) to obtain optimum growth performance for ornamental aquatic plant industry.

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REFERENCES

- [1] Ahmad, I., Ahmad, T., Gulfam, A. and Saleem, M., 2012. Growth and flowering of gerbera as influenced by various horticultural substrates. Pakistan Journal of Botany, 44, 291-299.
- [2] De Lucia, B., Cristiano, G., Vecchietti, L., Rea, E. and Russo, G., 2013. Nursery growing media: agronomic and environmental quality assessment of sewage sludge-based compost. Applied and Environmental Soil Science, 2013.
- [3] El-Naggar, H. and El-Nasharty, A. B., 2009. Effect of growing media and mineral fertilization on growth, flowering, bulb productivity and chemical constituents of *Hippeastrum vittatum*, herb. American Eurasian Journal of Agricultural and Environmental Science, 6(3): 360-371.

- [4] Ingels, J. E., 2004. Ornamental horticulture: Science operations & management. 3rd edition, pp.20-33. State University of New York, College of Agriculture and Technology Cobleskill, New York.
- [5] Kapugama, D. D. I. and Peiris, S. E., 2010. Identifying a most suitable growing medium and fertilizer combination for the Anthuriumcv 'Tropical Red'. National Symposium on Floriculture Research. Department of National Botanical Gardens, Sri Lanka, 76-82.
- [6] Maynard, D. N. and Hochmuth, G. J., 2007. Knott's Handbook for Vegetable Growers, Fifth Edition, John Wiley & Sons.
- [7] Rademacher, I. F. and Nelson, C.J., 2001. Nitrogen effects on leaf anatomy within the intercalary meristems of tall fescue leaf blades. Annals of Botany, 88(5): 893-903.
- [8] Tomaino, A., 2006. *Alternanthera sessilis*, Invasive species assessment protocol: US national assessments, 4 pp.
- [9] Wahundeniya, K. B. and Kurukulaarachchi, N., 1999. Cultivation leafy vegetables, Department of Agriculture, Peradeniya
- [10] Wahundeniya, K. B., 2008. Crop: Leafy Vegetables, Present Status, National accelerated implementation of domestic food, HORDI/ DOA.
- [11] Wang, M., Zheng, Q., Shen, Q. and Guo, S., 2013. The critical role of potassium in plant stress response. International Journal of Molecular Science, 14: 7370-7390.

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