Investigation of most suitable Gibberellin Acid concentration and fertilizer application to stimulate flower bud initiation of Lipstick plant (*Aeschynanthus radicans*)

D.S.A. Nisansala[1], H. K. L. K. Gunasekera[1*] and M.M.D.J.Senarathna [2]

1 Department of Agricultural and Plantation Engineering, Faculty of Engineering Technology, The Open University of Sri Lanka

2 Floriculture Research and Development Unit, Department of National Botanical Gardens, Peradeniya, Sri Lanka

ABSTRACT

Aeschynanthus radicans is an excellent ornamental plant, indoor oxygenating plant and traditional medicinal plants that commercially propagated by stem cuttings. However, growing these species are not economical due to poor flower formation. Hence stimulation for initiation flower bud is very important to increase the quantity and quality of flowers. Therefore, present study was aimed to find out a high productive flowering procedure in order to make flowering feasible and economical. The experiment was arranged as two–factor factorial with Completely Randomized Design (CRD) combined with twelve treatments randomized in ten replicates. Treatment structure consisted of three concentrations of GA3, i.e.100mg GA3/L^{-1} talk (H1), 150mg GA3/L^{-1} talk (H2) and 200mg GA3/L^{-1} talk (H3) as well as with three Fertilizer N:P:K ratio, i.e. 6:30:30 NPK(F1), 13:02:44 NPK(F2), 11:8:15 NPK(F3) and 14:14:14(C) the Control which were randomly assigned for each treatment. Each plant were re-potted in the plastic pots with sand and leaf mold as 1:1 ratio media and placed them in a shade house under 50% shade condition. Measurements were taken on Number of leaf buds, number of flower buds, lifetime of bloomed flowers, size of the flowers, length of vines, weight of vine and size of leaf at 7 days after treatment. The data were tabulated and analyzed subjected to the Analysis of Variance (ANOVA) procedure of Statistical Analysis System (SAS). Duncan's New Multiple Range Test (DNMRT) was performed to compare the differences among treatment means at p=0.05. According to the study findings, the best performance was recorded with the GA3 at H1 (100mg/ L-1) concentrations and F1 (8:30:30 NPK) Fertilizer ratio.

Key words: *Aeschynanthus radicans,* Gibberellin acid, NPK fertilizer, Flower

1* - Corresponding Author: hkgun@ou.ac.lk

INTRODUCTION

Aeschynanthus plants are noted for their brilliant red, orange, or yellow tubular flowers that often appear in large terminal clusters. The interesting shape of the calyx and emerging bud has given some of them the common name of "lipstick. *Aeschynanthus* plants are now among the most popular hanging basket and potted flowering plants in the floriculture industry. Aeschynanthus species are important traditional medicinal plant. Plant extracts are used for treating rheumatoid arthritis and for postpartum convalescence (Li et al. 2014). *Aeschynanthus rhododendron* plant is a free flowering plant, but during flowering period can be observed very poor flower formation in Sri Lanka. However the poor flower formation during the flowering period cannot be taken high economical income and cannot use for decorative purposes. It may be the reasons of improper hormone and fertilizer applications. Hence stimulation for initiation flower bud is very important to increase the quantity and quality of flowers. Therefore, this study is aimed to investigation the most suitable Gibberellin Acid concentration and fertilizer application for stimulating flower bud initiation of Lipstick plant (*Aeschynanthus radicans*). Gibberellic acid (GA3) is a plant growth regulator with numerous highly valued applications in agriculture(Rodrigues et al., 2011).

METHODOLOGY

The study was conducted at of Royal Botanical Gardens, Peradeniya. The experiment was laid out in Completely Randomize Design (CRD) with two-way treatment structure. Treatment structure consists of three different concentration of Gibberellin Acid i.e.100mg/L^{-1} (H1), 150mg/L^{-1}(H2), 200mg/L^{-1} (H3) and three different levels of NPK ratio i.e. 8:30:30-(F1), 13:02:44-(F2), 11:8:15-F3. Ten plants were assigned randomly in each treatment combination.

Treatment structure

H-Three different concentrations of Gibberellin Acid:

Hormone concentration -01 (**H1**) - Gibberellin Acid 100mg/L^{-1}
Hormone concentration -02 (**H2**) - Gibberellin Acid 150mg/L^{-1}
Hormone concentration -03 (**H3**) - Gibberellin Acid 200mg/L^{-1}
F – Four type of Fertilizer:
Fertilizer type - 01- (**F1**) - (8:30:30)
Fertilizer type - 02- (**F2**) - (13:02:44)
Fertilizer type - 03- (**F3**) - (11:8:15)

Fertilizer type - 04-Control (**C**) - (14:14:14)

The pot experiment was conducted by using six weeks old (12cm height) 120 lipstick plants which were taken from the variety of *Aeschynanthus radicans*. Plants were kept in a net house under 50% shade, 24 ^{o}C-29 ^{o}C average temperature and 80% relative humidity. After one week, three concentrations of Gibberellin Acid i.e. 0.1g/L (H1), 0.15g/L (H2), 0.2g/L (H3) and three type fertilizer i.e. (F1)-(8:30:30), (F2)- 13:02:44), (F3)- (11:8:15) were applied for set of 10 plants. Seven days after the treatments measurements were taken on length of the vine, number of leaf buds and weight of the flowers. In addition to that measurements were taken twice a week on number of flower buds and size of the flowers. Data were tabulated and analyzed by using analysis of variance (ANOVA) procedure of statistical analysis system (SAS). Duncan's new multiple range test (DNMRT) was used to compare the differences among the treatment means at p=0.05.

RESULTS AND DISCUSSION

Effect of treatment combination on mean number of flower buds *of Aeschynanthus radicans.*

According to the results, the most effective treatment which given significantly ($p<0.05$) higher number of flower buds emerged was observed in the treatment combination of T1 (100mg/L^{-1} Gibberellin acid consecration with 8:30:30 N: P: K fertilizer ratio) (Figure 1). Furthermore, average number of flower buds had showed a significant difference ($p<0.05$) among treatments combination T1 (100mg/L^{-1} GA3 +8:30:30 NPK with other all treatment combination. In this experiment the highest number of flower buds (9.70) was showed in T1 (100mg/L^{-1} GA3 +8:30:30 NPK), and the lowest number of flower buds (0.80) was showed in T12 Control (200mg/L^{-1}+14:14:14 NPK) compared to other treatments.

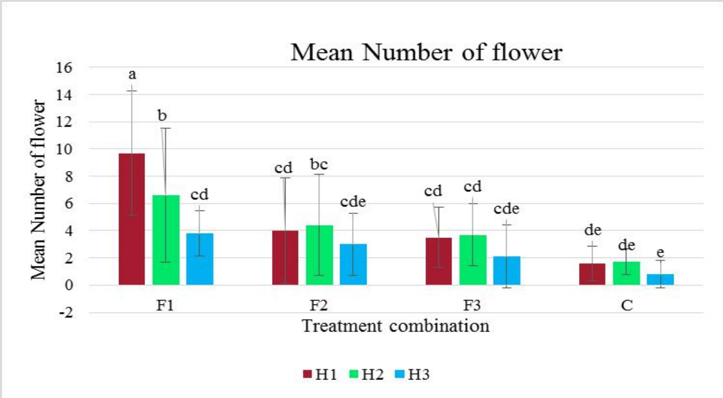

Figure 1 Effect of different treatment combinations on formation of number of flower buds of *Aeschynanthus radicans*

According to present study, the highest number of flower buds (9.70) given in T1 (100mg/L^{-1} GA3 +8:30:30 NPK), and the lowest number of flower buds (0.80) given in T12 Control (200mg/L^{-1}+14:14:14 NPK) compared to other treatments. This result was in agreement with the studies of Cui et al., (2009) Amil et al., (2016) and Fayaz et al., (2017).

Table 1 Effect of different types of fertilizer ratio on number of leaf buds, length of vines, length of flowers and width of flowers *Aeschynanthus radicans.*

Treatment (fertilizer)	Mean Number of leaf buds	Mean Length of vines(cm)	Mean length of flowers (cm)	Mean width of flowers (cm)
F1	5.29^{a}	33.43^{a}	6.03^{a}	2.43^{a}
F2	5.09^{a}	36.96^{a}	6.00^{a}	2.38^{a}
F3	5.11^{a}	36.53^{a}	5.31^{a}	2.16^{a}
C	3.17^{b}	21.50^{b}	3.67^{b}	1.68^{b}

Note: *Means with same letter along the column are not significantly different at p<0.05. Measurements are the means of ten replicates*

Among different type of fertilizer ratio tested average number of leaf buds emerged had showed significantly different ($p<0.05$) during the study period. In this experiment the highest mean number of leaf buds (5.29) was showed in F1 (8:30:30 NPK) and the lowest mean number of leaf buds (3.17) was showed in Control (14:14:14 NPK) compared to other treatments. Among different type of fertilizer ratio tested average length of vines had showed significantly different ($p<0.05$) during the study period. According to the results, the most effective treatment which given significantly ($p<0.05$) higher length of vines was F3 (11:8:15 NPK) (Table 1). Fangjie et al., (2020) reported that fertilization plays an important role in promoting the initial growth and promoted the height and stem diameter of plants to the greatest extent after 30 days of transplanting. The result of nutritional application is in close agreement with the findings of Deng et al., (2019) and Adhikari (2009).

Kumarasinghe et al, (2019) also reported that foliar application of nutrients could found that application of Albert's solution increase the plant height of *in vitro* Anthurium plantlets. Hence Albert's solution has the potential to increase plant height as it has optimum amount of nutrients. It could be the reason for highest plant height recorded in A1.

Table 2. Effect of different concentrations of Gibberellin Acid (GA3) hormone on Number of leaf buds, width of flowers and length of flowers of *Aeschynanthus radicans*

Treatment (Hormones)	Mean Number of leaf buds	Mean width of flower(cm)	Mean length of flower(cm)
H1	5.13^{a}	2.44a	5.86^{a}
H2	4.64^{ab}	2.28^{a}	5.60^{a}
H3	4.23^{b}	1.69^{b}	4.32^{b}

Note: *Means with same letter along the column are not significantly different at p<0.05. Measurements are the means of ten replicates*

Among different Gibberellin Acid (GA3) concentrations tested average number of leaf buds emerged had showed significantly different ($p<0.05$) during the study period.According to the results, the most effective treatment which given significantly ($p<0.05$) higher number of leaf buds per plant was H1 (100mg/L^{-1} GA3) (Table 4.3). On the other hand, average number of leaf buds, showed a significant difference ($p<0.05$) among treatments H2 (150mg/L^{-1} GA3) with H3 (200mg/L^{-1} GA3). Then average number of leaf buds, showed a significant difference ($p<0.05$) among treatments H1 (100mg/L^{-1} GA3), H2 (150mg/L^{-1} GA3), H3 (200mg/L^{-1} GA3). Ribeiro et al., 2010) reported that the effects of plant growth regulators on the flowers and as such, these effects are contradictory. This result is similar to that of Brackmann et al. (2005) who evaluated the effect of GA3 on three varieties of chrysanthemums and noted the promotion of senescence of both leaves and flowers.

Miceli et al., (2019) reported that many experiments have been carried out to study the effect of spraying exogenous gibberellic acid (GA3) at very low concentrations on various crops, showing that hormone requirement, relative concentrations, and responses may vary for different species and different growth stages. Foliar application of gibberellins has been generally adopted because these hormones are naturally synthetized in young leaves and from there are subsequently transported throughout the plant moving both acropetally and basipetally. Rubasinghe *et al*., (2009) also reported that this is due to stimulation of cell elongation and cell division by GA_3 at the cellular level. Ferthermore, Miceli et al., (2019) reported that moreover, GAs play important roles in regulating biomass allocation. Genotypes of many species with high levels of endogenous GAs are characterized by higher leaf: root or shoot: root ratios compared to those with low levels of endogenous Gas. Rubasinghe et al., (2009) reported that use of GA_3 increased plant height, inter nodal length, number of leaves and number of branches of *Chirita moonii*. The best performance was recorded with GA_3 at 150mg/l. Plants treated with 50mg/l, 150mg/l and 200mg/l GA_3 levels. Mean number of leaves were significantly increased in seedlings treated with 100 mg/l, 150 mg/l and 200 mg/l GA_3 levels. According to the results from the present study

100mg/L^{-1} GA3 concentrations was showed the highest mean of leaf buds (5.13) and 200mg/L^{-1} was showed the lowest mean of leaf bud (4.23) by all treatments tested. In addition to that, the study findings clearly showed average width of flowers did not showed significantly different (p=0.05) among treatments H1 (100mg/L^{-1} GA3) and H2 (150mg/L^{-1} GA3). Further the average width of flowers, showed a significant difference ($p<0.05$) among treatments H3 (200mg/L^{-1} GA3) with H1 (100mg/L^{-1} GA3) and H2 (150mg/L^{-1} GA3) (Table 2). In this experiment the highest average width (2.44cm) of flowers was showed in H1 (100mg/L^{-1} GA3) and the lowest width (1.69cm) of flowers was showed in H3 (200mg/L^{-1} GA3) compared to other treatments. Mills-ibibofori et al.,(2019) reported that Gibberellic acid (GA3) is a hormone found in plants, which is produced in low amounts. Synthetic GA3 is commonly used in commercial agriculture. This hormone is very influential and can control plant development, promote growth, and elongate cells. Gibberellic acid can also promote petal growth and enhance other flowering characteristics. Furthermore, Rajesh (2014) reported that there are various commercially available formulations of synthetic growth regulators and the exogenous application of PGRs has been reported numerous times in various ornamental plants. Such as tulip, dahlia, gladiolus, iris, lily. The objective of the application of PGRs differs according to the type of plant but the increase in compactness of foliage is required in certain ornamental plants and improvement in flower characteristics is also a key objective in some other ornamental plants *etc.* Gupta & Chakrabarty, (2013) also reported that moreover, for a long time it has been known that in *Glechoma hederacea*, stamen-derived GAs stimulate corolla growth. 52 Griffiths 44 found that not only the stamen and petal development arrested and the pistil length reduced, but also reduced the pedical elongation in triple receptor mutants of *Arabidopsis*. Further, Hu et al.,46 identified stamens and/or flower receptacles as 2 potential sites for bioactive GA synthesis in *Arabidopsis* flowers, and suggest that GAs are transported from these organs to promote petal growth.

Furthermore, Miceli et al., (2019) reported that GA3 treatments promote cell division and cell enlargements that may result in stem elongation and that exogenous gibberellins can break the rosette or enhance and control the flowering of rosette plants by means of rapid enlargement of already differentiated tissues. GAs promote cytogenesis and cell elongation in stems and can also stimulate flowering when they reach the shoot apex. According to the results from the present study 100mg/L^{-1} GA3 concentrations was showed the highest width (2.44cm) and 200mg/L^{-1} was showed the lowest width (2.28cm) by all treatments tested.

Among different Gibberellin Acid (GA3) concentrations tested average length the results from the present study, average length of flowers did not showed significantly different (p=0.05) among treatments H1 (100mg/L^{-1} GA3) and H2 (150mg/L^{-1} GA3). Then average length of flowers, showed a significant difference ($p<0.05$) among treatments H3 (200mg/L^{-1} GA3) with H1 (100mg/L^{-1} GA3) and H2 (150mg/L^{-1} GA3) (Table 4.3). In this experiment the highest average length (5.86cm) of flowers showed in H1 (100mg/L^{-1} GA3) and the lowest length (4.32cm) of flowers was showed in H3 (200mg/L^{-1} GA3) compared to other treatments (Table 2). Miceli et al., (2019) reported that exogenous applications of gibberellins were shown to actively influence various physiological activities, such as vegetative growth, flowering and flower morphology, earliness, fruit set, ion transport and osmoregulation, leaf area expansion, internode elongation and can also increase biomass production, fruit weight and dry matter. These effects can vary greatly depending on hormone requirement, relative concentrations, and plant responses at different growth stages. Jung et al., (2020) also reported GAs generally induce bolting and flowering in long-day and biennial plants, although GA is not a universal flowering stimulus. Several studies reported that GAs had complex roles in flowering induction that varied under different circumstances and in different plant species. Furthermore, Mills-ibibofori et al.,

(2019) reported that only height and flower diameter were significantly affected by GA3. All GA3 rates produced taller plants compared to no supplemental lighting. No supplemental lighting had the greatest number of flowers though 50 and 150 mg L-1 GA3 were not different.

CONCLUTION

According to the study findings on different concentrations Gibberellin acid (GA3) and different ratios NPK Fertilizer on flower bud initiation and development of *Aeschynanthus radicans,* the best performance was recorded form GA_3 at H1 (100mg/ L^{-1}) concentration and NPK (8:30:30) fertilizer combination.

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