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# Effect of portion of cuttings and root microbial inoculants, chitosan and IBA on rooting of Aglaonema cuttings (*Aglaonema commutatum* L.)

**Bashaboina Sunil, P Prasanth, Lakshminarayana and Praneeth Kumar**

**Abstract**
A field investigation entitled "Effect of portion of cuttings and root microbial inoculants, chitosan and IBA on rooting of Aglaonema cuttings (*Aglaonema commutatum* L.)" was carried at Floriculture Research Station, (Agricultural Research Institute) Rajendranagar, Hyderabad during October to April 2020-2021. The experiment was laid out in Factorial Completely Randomized Design with three replications. The experiment was conducted with two factors, portion of cuttings (Top and middle) as one factor and different levels of root microbial inoculants, chitosan and IBA as another factor. The study revealed that, among different treatment combinations *i.e*., $P_1$ - (Top cutting) with $S_6$ - (*P. fluorescence* -5 ml / kg) + IBA - 1000 ppm) recorded least number of days taken to rooting (24.08 days), average length of root per cutting (14.28 cm), rooting percentage (86.67 %), fresh weight of roots per cutting (15.52 g) anddry weight of roots per cutting (4.86 g). Hence, it can be concluded that, Top cuttings + P. fluroscence 5ml/ kg + IBA 1000 ppm found to be best treatments for improve rooting of Aglaonema cuttings.

**Keywords:** Aglaonema, chitosan, IBA-Indole Butyric Acid and root microbial inoculants

## 1. Introduction
*Aglaonema commutatum* commonly called as Chinese evergreen belongs to the family Araceae. The genus name comes from the Greek words '*aglaos'* meaning bright or clear and '*nema'* meaning a thread in reference to the stamens. It is an evergreen perennial that generally resembles Dieffenbachia (dumb cane) in appearance (Chen *et al.,* 2002) [2] which commonly known as aroids. The genus *Aglaonema* is comprised of 21 species which inhabit to humid and heavily shaded forests of many territories of Asia (Chen *et al.,* 2003; Govaerts and Frodin, 2002) [3, 8]. It typically grows to 20" tall and is characterized with thick, elliptic to lance-shaped, dark green leaves (4-8" long and 2-3" wide) with attractive silver-grey blotches on erect, sometimes branched stems. *Aglaonema* proven to be an effective cleanser of formaldehyde and benzene, found in detergents and cosmetics. In 1989, National Aeronautics and Space Administration (NASA) discovered that houseplants can absorb harmful toxins from the air, especially in enclosed spaces with little air flow. NASA recommends two or three plants in 8 to 10-inch pots for every 100 square feet. Some plants are better at removing certain chemicals than others. Now-a-days, *Aglaonema sp*. becomes very famous in especially during the pandemic covid-19, many people tend to stay home to stop the spreading of the virus, one of the activities can be done during stay at home is growing the plants as well as ornamental plants as they pleqtoremediate harmful volatiles from the indoor air.
Chitosan is a biopolymer, a chitin derivative a compound which is completely safe for the environment. This compound is characterized by unique properties, such as bioactivity and biocompatibility (Dias *et al.,* 2013) [5]. Chitosan can induce a multitude of biological processes in plant tissues, including the stimulation of chitinases, accumulation of phytoalexins, synthesis of proteinase inhibitors and increasing lignification. Further, *Pseudomonas* belong to Plant Growth Promoting Rhizobacteria (PGPR), an important group of bacteria that play a major role in the plant growth promotion, induced systemic resistance, biological control of pathogens *etc*. *Pseudomonas fluorescens* BBc6 improve the rooting of de-rooted shoot hypocotyls of Norway spruce and enhance root elongation (Karabaghli *et al.,* 1998) [9]. Another bioinoculant, Vesicular-Arbuscular Mycorrhizal fungi (VAMF) is one type of mycorrhizal fungi that is commonly associated with the roots of horticultural crops. Optimal uses for commercially available VAMF inoculum have not been well defined.

In view of above facts, chitosan is having many biological activities in plant systems, *Pseudomonas* and VAMF has significant role in rooting of cuttings. *Aglaonema* is a very important ornamental house plant, which is propagated by stem cuttings but with slow growth. Hence, to study the influence of root microbial inoculant and chitosan effects solely and in combination with IBA in induction of rooting and growth of Aglaonema cuttings, the present investigation has been formulated

## Material and methods

Experiment was carried out at Floriculture Research Station, (Agricultural Research Institute) Rajendranagar, Sri Konda Laxman Telangana State Horticulture University, Hyderabad during November 2020 to March 2021.

The experiment consisted of two factors. Factor I: Two levels in portion of cutting i.e; Top cutting ($P_1$), Middle cutting ($P_2$) and Factor II: Eight levels of bio-fertilizers, $S_1$ - VAM (Vesicular Arbuscular Mycorrhizae) - 5 ml / kg of media, $S_2$ - *Pseudomonas fluorescence* - 5 ml / kg of media, $S_3$ - Chitosan – 1000 ppm, $S_4$ – IBA (Indole-3-Butyric Acid) - 1000 ppm, $S_5$ – VAM - 5 ml / kg of media + IBA - 1000ppm, $S_6$ – *Pseudomonas fluorescence* - 5 ml / kg of media + IBA - 1000 ppm, $S_7$ – Chitosan – 1000 ppm + IBA - 1000 ppm and $S_8$- Control (without treatment). Experiment was laid out in Factorial Completely Randomized Design with three replications.

Top cuttings 15-20 cm long with 3-4 buds and Middle cuttings 10 cm long with 2-3 buds were selected for the treatment application. The cuttings were treated with one per cent Bavistin to prevent the occurrence of fungal disease. Later, they are treated with chitosan, microbial inoculants (*Psuedomonas fluorescence* and VAM) and IBA.

The treated cuttings were placed in Red soil, sand, FYM (2:1:1) media filled in polybags. For application o treatments to cuttings liquid formulations of Psuedomonas and powder form of VAM were used.

Treated cuttings were planted in polybags and the soil around cuttings were pressed firmly. Single cutting was planted in single polybags. Polybags were kept under the semi-shade condition for better rooting.

Five randomly selected rooted cuttings were taken out from polybags at 180 days after planting of cuttings with care. Roots were dipped in water to loosen the media and washed with clean water to take observations of rooting of cuttings *i.e.*, days taken to rooting, average length of root per cutting (cm), number of roots per cutting, rooting percentage, fresh weight of roots per cutting (g)and dry weight of roots per cutting (g).

## Result and discussion

### Days taken to rooting

The data recorded on number of days taken to rooting as influenced by the portion of cuttings and root microbial inoculants, chitosan and IBA are presented in Table 1.

The interaction between portion of cuttings and root growth stimulants on number of days taken to rooting of Aglaonema cuttings was significant. The treatment combination of $P_1S_6$ (Top cutting +*P. fluorescence* 5 ml / kg + IBA - 1000 ppm) recorded minimum number of days for rooting (24.08 days). which was at par with $P_1S_2$ (Top cutting +*P. fluorescence*- 5 ml / kg media) (25.50days). Whereas, the treatment combination $P_2S_8$ (Middle cutting + Control) recorded maximum number of days (60.13 days). The other treatment combinations recorded intermediate values.

The early rooting in $P_1S_6$ might be due to the auxin concentration applied externally might be sufficient for root induction of cuttings. It has been reported that auxin existence is necessary for induction of the root starter cells. Similar findings have been reported by Kazankaya *et al*. (2005) [10] in case of cultivars of rose. Further, *Pseudomonas fluorescence* improves the plant growth directly or indirectly by production of plant growth substances, improving the uptake of certain nutrients from the soil. The present investigation clearly showed that the combination of Plant Growth Promoting Rhizobacteria (PGPR) (*Pseudomonas fluorescens*) and rooting hormone (IBA) has the synergetic effect and increased root initiation. Similar result was also reported by Sayedi *et al.* (2013) [17].

### Average length of root per cutting (cm)

The data recorded on average length of roots (cm) as influenced by the Portion of cuttings and root microbial inoculants, chitosan and IBA are presented in Table 1.

The interaction between portion of cuttings and root growth stimulants on average length of root of Aglaonema cuttings was significant. The treatment combination of $P_1S_6$ (Top cutting + *P. fluorescence* 5 ml / kg + IBA – 1000 ppm) recorded highest average length of roots (14.28 cm). Which was followed by $P_1S_5$ (Top cutting + VAM - 5 g /kg media + IBA – 1000 ppm) (13.04 cm). whereas, the treatment combination $P_2S_8$ (Middle cutting + Control) recorded lowest average length of roots (1.90 cm).

The result shows that the root length was significantly increased with the application of *P. fluorescence* and IBA individually or in combination (*P. fluorescence* + IBA1000ppm). *P. fluorescence* improves the plant growth directly or indirectly by production of plant growth substances, improving the uptake of certain nutrients from the soil and additionally show antagonistic effects on some pathogenic microorganisms. Application of rooting hormone (IBA) and adding *P. fluorescence* into the rooting substrate significantly increased root length of cuttings. Result recorded by Sayedi *et al.* (2013) [17] showed similarly results in bougainvillea cuttings. Similarly, Kuldeep *et al*. (2013) [11] reported that plants inoculated with mix culture of *G. mosseae* + *A. laevis* + *P. fluorescens* showed best response in terms of greater root lengthin Gerbera.

Increased in root length when treated with IBA shows that these hormones initiate synthesis of structural or enzyme proteins in the process of adventitious root formation. The increase in the root length through the process of acidification caused by auxin application to cuttings was explained by Bharathy *et al*. (2004) [1]. Similar findings were observed by Sharma *et al.* (2014) [20] in Apple clonal rootstock.

### Number of roots per cutting

The data recorded on number of roots per cutting as influenced by the portion of cuttings and root microbial inoculants, chitosan and IBA are presented in Table 1.

The interaction between portion of cuttings and root growth stimulants on number of roots per cutting of Aglaonema cuttings was significant. The treatment combination of $P_1S_5$ (Top cutting + VAM-5g/kg media + IBA – 1000 ppm) recorded highest number of roots per cutting (30.10), which was followed by $P_1S_6$ (Top cutting + *P. fluorescence* 5ml/kg + IBA –1000ppm) (26.11). Whereas the treatment combination $P_2S_8$ (Middle cutting + Control) recorded lowest number of

roots per cutting (2.40). The other treatment combinations recorded intermediate values.

The result shows that the number of roots were significantly increased with the application of VAM and IBA in combination (VAM + IBA-1000 ppm). VAM fungi are known to increase rooting due to the production of growth hormones such as auxins, gibberellin like substances and cytokinin's (Scagel and Linderman, 1998) [18]. Similarly, number of lateral roots in Arbuscular Mycorrhizal Fungi (AMF) treatment increased to more than twice than those in non-AMF treatment of chrysanthemum reported by Sohn *et al.* (2003) [22]. similarly, Ercan *et al.* (1999) [6] demonstrated increased number of roots in *Rubia tinctorum* by application of PGPR inoculation.

Increased rooting response of IBA in cuttings may be attributed to induction of more vigorous cell division at the basal end of cutting and increases accumulation of sugars, which favours callus formation and subsequently rooting. Beneficial effects of IBA was also reported by Singh and Motilal (1979) [21] in Bougainvillea cv. Thimma, Panwar *et al*. (1994) [14] in Bougainvillea. These findings are also in agreement with the results recorded by Mishra and Sharma (1995) [13] in Bougainvillea.

**Rooting percentage**

The data recorded on rooting percentage as influenced by portion of cuttings and root microbial inoculants, chitosan and IBA are presented in Table 2.

The interaction between portion of cuttings and root growth stimulants on rooting percentage of Aglaonema cuttings was significant. The treatment combination of $P_1S_6$ (Top cutting + *P. fluorescence* 5ml/kg + IBA – 1000ppm) recorded highest rooting percentage (86.67 %), which was followed by $P_1S_5$ (Top cutting + VAM - 5g /kg media + IBA – 1000ppm) (84.65 %) and $P_1S_3$ (83.33 %) without any significant difference. Whereas, the treatment combination $P_2S_8$ (Middle cutting + Control) recorded lowest rooting percentage (39.33 %).

The difference in rooting percentage in portion of cuttings may be due to show morphogenetic processes as a result of reduction in carbohydrate content in cutting base (Stlotz and Hess, 1996). Similar observation of higher total carbohydrate content in the root portion of cutting by Reuveni and Adato (1974) [16]. Further, the top cuttings might be associated with higher carbohydrates-Nitrogen (C/N) ratio leading to higher rooting percentage as reported by Mahros *et al.* (1994) [12].

The increased rooting percentage by application of PGPR'S might be due to auxin production by microbes (Erturk *et al.*, 2010) [7].

**Fresh weight of roots per cutting (g)**

The data recorded on fresh weight of roots per cutting as influenced by the portion of cuttings and root microbial inoculants, chitosan and IBA are presented in Table 2.

The interaction between portion of cuttings and root growth stimulants on fresh weight of roots per cutting of Aglaonema was significant. The treatment combination of $P_1S_6$ (Top cutting + *P. fluorescence* 5 ml/kg + IBA – 1000 ppm) recorded highest fresh weight of roots per cutting (15.52 g). which was followed by $P_1S_5$ (Top cutting + VAM - 5g/kg media + IBA – 1000ppm) (14.30 g). Whereas, the treatment combination $P_2S_8$ (Middle cutting + Control) recorded lowest fresh weight of roots per cutting (3.72 g).

The result shows that the fresh weight of roots was significantly increased with the application of *P. fluorescens* and IBA combination (*P. fluorescens* + IBA-1000ppm).Auxin treatment induced higher number of primary and secondary roots, which might have also resulted in elongation of these roots through cell division (Debnath and Maiti, 1990) [4] and consequently accounting for higher fresh weight of roots. Similarly, highest average fresh weight of root per cutting (0.39g) was recorded under $5gL^{-1}$ concentration of IBA in *Duranta golden* reported by Singh *et al*. (2014) [20].

The mycorrhizal helper bacteria such as *P. fluorescens* (PSB) are known to stimulate mycelial growth of arbuscular mycorrhizal fungi. The microbiologically solubilized phosphate could, however, be taken up a mycorrhizal mycelium, there by developing a synergistic microbial interaction. The role of PSB as a biofertilizer is unique in making the fixed soil phosphorus available to plants. PSB produce plant growth regulating substances, such as auxins which promote root growth and ultimately improve the growth of the plant.The obtained results revealed that the treatment of cuttings with biofertilizers and auxins significantly improved the rooting parameters which was supported by the reporter of Prasad *et al.* (2012) [15] in chrysanthemum.

**Dry weight of roots per cutting (g)**

The data recorded on dry weight of roots per cutting as influenced by the portion of cuttings and root microbial inoculants, chitosan and IBA are presented in Table 2.

The interaction between portion of cuttings and root growth stimulants on dry weight of roots per cutting of Aglaonema was significant. The treatment combination of $P_1S_6$ (Top cutting + *P. fluorescence* 5 ml/kg + IBA – 1000 ppm) recorded highest dry weight of roots per cutting (4.86 g) which was followed by $P_1S_5$ (Top cutting + VAM - 5 g / kg media + IBA – 1000 ppm) (4.12 g). Whereas, the treatment combination $P_2S_8$ (Middle cutting + Control) recorded lowest dry weight of roots per cutting (0.55 g). The other treatment combinations recorded intermediate values.

The result shows that the dry weight of roots was significantly increased with the application of *P. fluorescens* and IBA in combination (*P. fluorescens* + IBA-1000ppm) might be due to increased number of roots and root length with this treatment. Whereas Auxin treatment induced higher number of roots, cell elongation of roots with cell division and consequently accounting for higher fresh weight and thus dry weight of roots. The results of the present study are in conformity with findings of Singh *et al.* (2014) [20] in Golden Duranta.

**Conclusion**

Among the different combination of treatments, $T_6$ ($P_1S_6$) (Top cutting + *Pseudomonas fluorescence* - 5 ml / kg of media + IBA - 1000 ppm) proved to be the best treatment to improve root parameters of Aglaonema cuttings.

**Table 1:** Effect of portion of cuttings and root growth stimulants (microbial inoculants, Chitosan and IBA) on days taken to rooting, average length of roots (cm) and number of roots per cutting of Aglaonema (*Aglaonema commutatum* L.)

| Root Growth Stimulants (S) | Days taken to rooting | | | Average length of roots (cm) | | | Number of roots per cutting | | |
|---|---|---|---|---|---|---|---|---|---|
| | Portion OF Cuttings (P) | | | Portion of Cuttings (P) | | | Portion of Cuttings (P) | | |
| | $P_1$ Top cutting | $P_2$ Middle cutting | Mean | $P_1$ Top cutting | $P_2$ Middle cutting | Mean | $P_1$ Top cutting | $P_2$ Middle cutting | Mean |
| $S_1$-VAM - 5 g / kg media | 30.33 | 52.10 | 41.21 | 10.41 | 3.00 | 6.70 | 13.52 | 3.99 | 8.75 |
| $S_2$-*P. fluorescence*- 5 ml / kg media | 25.50 | 44.27 | 34.88 | 10.94 | 4.41 | 7.67 | 20.65 | 4.84 | 12.74 |
| $S_3$-Chitosan – 1000 ppm | 30.23 | 53.71 | 41.97 | 10.21 | 3.31 | 6.76 | 16.22 | 4.21 | 10.21 |
| $S_4$-IBA - 1000 ppm | 28.78 | 45.62 | 37.20 | 11.02 | 4.11 | 7.56 | 18.28 | 5.99 | 12.13 |
| $S_5$-VAM-5 g /kg media + IBA-1000 ppm | 27.50 | 46.60 | 37.05 | 13.04 | 6.51 | 9.77 | 30.10 | 8.70 | 19.40 |
| $S_6$-*P. fluorescence* (5ml/kg) + IBA-1000 ppm | 24.08 | 43.21 | 34.00 | 14.28 | 7.95 | 11.11 | 26.11 | 8.20 | 17.15 |
| $S_7$-Chitosan–1000 ppm + IBA-1000 ppm | 28.78 | 47.71 | 38.24 | 11.93 | 6.21 | 9.07 | 24.10 | 7.65 | 15.85 |
| $S_8$-Control (untreated) | 36.69 | 60.13 | 48.41 | 6.50 | 1.90 | 4.20 | 4.24 | 2.40 | 3.32 |
| Mean | 29.07 | 49.16 | | 11.04 | 4.67 | | 19.15 | 5.74 | |
| | P | S | P X S | P | S | P X S | P | S | P X S |
| SEm ± | 0.40 | 0.08 | 1.14 | 0.05 | 0.11 | 0.16 | 0.08 | 0.17 | 0.25 |
| CD at 5% | 1.16 | 2.32 | 3.01 | 0.16 | 0.33 | 0.48 | 0.25 | 0.51 | 0.72 |

**Table 2:** Effect of portion of cuttings and root growth stimulants (microbial inoculants, Chitosan and IBA) on rooting percentage (%), fresh weight of roots per cutting (g) and dry weight of roots (g) of Aglaonema (*Aglaonema commutatum* L.)

| Root Growth Stimulants (S) | Rooting percentage (%) | | | Fresh weight of roots per cutting (g) | | | Dry weight of roots (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Portion Of Cuttings (P) | | | Portion Of Cuttings (P) | | | Portion Of Cuttings (P) | | |
| | $P_1$ Top cutting | $P_2$ Middle cutting | Mean | $P_1$ Top cutting | $P_2$ Middle cutting | Mean | $P_1$ Top cutting | $P_2$ Middle cutting | Mean |
| $S_1$-VAM - 5 g / kg media | 73.33 | 60.00 | 66.66 | 10.53 | 7.76 | 9.14 | 2.99 | 1.41 | 2.20 |
| $S_2$-*P. fluorescence*- 5 ml / kg media | 79.90 | 70.00 | 74.95 | 12.36 | 7.94 | 10.15 | 3.55 | 1.50 | 2.52 |
| $S_3$-Chitosan – 1000 ppm | 83.33 | 60.00 | 71.66 | 11.00 | 8.09 | 9.54 | 3.10 | 1.67 | 2.38 |
| $S_4$-IBA - 1000 ppm | 76.67 | 60.00 | 68.33 | 12.23 | 8.24 | 10.23 | 3.47 | 1.71 | 2.59 |
| $S_5$-VAM-5 g /kg media + IBA-1000 ppm | 84.65 | 76.67 | 80.66 | 14.30 | 8.65 | 11.51 | 4.12 | 1.84 | 2.98 |
| $S_6$-*P. fluorescence* (5ml/kg) + IBA-1000 ppm | 86.67 | 83.33 | 85.00 | 15.52 | 8.83 | 12.17 | 4.86 | 1.97 | 3.41 |
| $S_7$-Chitosan–1000 ppm + IBA-1000 ppm | 73.33 | 66.67 | 70.00 | 12.62 | 8.60 | 10.61 | 3.90 | 1.75 | 2.82 |
| $S_8$-Control (untreated) | 40.67 | 39.33 | 40.00 | 6.10 | 3.72 | 4.91 | 1.01 | 0.55 | 0.78 |
| Mean | 74.81 | 64.50 | | 11.84 | 7.72 | | 3.37 | 1.55 | |
| | P | S | P X S | P | S | P X S | P | S | P X S |
| SEm ± | 0.59 | 1.18 | 1.68 | 0.07 | 0.15 | 0.21 | 0.01 | 0.03 | 0.05 |
| CD at 5% | 1.70 | 3.40 | 4.21 | 0.21 | 0.43 | 0.61 | 0.05 | 0.10 | 0.14 |

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