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# Influence of Auxin Concentrations on Different Ornamental Plants Rooting

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**Abstract:** Ornamental plants like; Rosemary, Hedera, Syngonium and Gadenia are difficult to root without using a rooting hormone. So, this research was aimed to find out the optimum Auxin (NAA) hormone concentration on cuttings rooting of these plants. Six Auxin treatments (0, 1000, 2000, 3000, 4000 and 5000 ppm NAA) were used in a Completely Randomized Design (CRD) with four replicates. Results obtained showed that rooting was improved by the use of the different Auxin concentrations in compare to the control treatment; 3000 ppm NAA was resulted in the highest rooting percentages of the Rosemary and Hedera cuttings, while best results were obtained by 4000 and 1000 ppm NAA in Gardenia and Syngonium cuttings, respectively. Otherwise; callus results are opposite to that of rooting percentage in most NAA treated cuttings.

**Key words:** NAA, Ornamental plants, rooting, cutting, callus

## INTRODUCTION

Indoor plants are everywhere these days, not only in the big formal displays of hotels, banks and offices but odd little plants nurtured tenderly on filing cabinets in offices, on window-sills in kitchen, on bathroom shelves and doctors waiting rooms. They add something to our quality of lifeand for this we must be grateful (Longman, 1979).

For successful propagation; adventitious root formation is required. The rooting capacity varies with genotypes and, frequently, depends on the age of the plant used as source of cuttings. For years, many efforts have been made to improve adventitious rooting, not only by testing the combined effect of different plant growth regulators (Da Silva, 2008). In addition, authors reported that the presence of cytokinins could enhance the root formation (Pijut *et al*., 2011).

*Rosmarinus officinalis*, is a member of Lamiaceae family and commonly known as rosemary. Moreover, it is native to the Mediterranean region and considered as a woody, perennial fragrant and evergreen shrub (Calabrese *et al*., 2000). This plant is considered as low water requirements, so it could be planted in gardens. Also this plant could be used in improving memory and flavor various food (Huang *et al*., 1994).

Gardenia or Cape Jasmine (*Gardenia jasminoides*) is an evergreen foliage and flowering shrub that grows from one to three feet (30-60 cm) tall. It needs warm days, cool nights and a humid atmosphere (Herwig, 1979). Gardenia produces a beautiful white flower once; it comes from both China and Japan and belongs to the Rubiaceae family (Longman, 1979).

Hedera or Algerian Ivy or Canary Island Ivy (*Hedera canariensis*) is native to Europe that can grow as house plant; it is a member of the Araliaceae family (Longman, 1979). It is planted as foliage climbing pot plants and useful as trailers in hanging baskets or as ground cover between larger plants, it prefer a moist air atmosphere and do not like to be overwatered (Hessayon, 1996).

Syngonium or Goosefoot plant (*Syngonium podophyllum*) belongs to the Araceae or Arum family, originated from tropical Central and South America (Longman, 1979). It requires warmth, moist air and protection from direct sunlight. Aerial roots are produced by the adult plant and a moss stick makes an excellent support for the attractive climbing evergreen foliage plant (Hessayon, 1996).

Gardenia is propagated by soft cuttings, Rosemary by semi-hard wood cuttings, while Hedera and Syngoniums are generally propagated by leaf-bud cuttings (Gilman and Watson, 1994; Hartmann *et al*., 1997).

The concentration of the auxin formulation can be modified to produce optimal rooting of the cuttings (Blythe and Sibley, 2003). Owais (2010) studied the effect of Auxin hormone on rooting of different plants and found significant differences between plants response to Auxin. Also, cultivar had a significant effect on all rooting

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measured parameters (Karimi *et al*., 2012). In addition, it was reported that root quality increased up to 9000 ppm as quick dip (10 sec) but higher Auxin concentrations (12000 ppm) decreased rooting (Polat and Caliskan, 2009). Rashad (2003) reported that the combination of Salicylic Acid on Rosemary cuttings led to increase in growth parameters. Different concentrations of IBA NAA and its combination significantly increased the rooting percentage, average number of roots per shoot, average root length (cm) per shoot and percent survival of rooted stooled shoots in field over control (Lai *et al*., 2007).

Rosemary, Gardenia, Hedera and Syngoniums are difficult to root without using a rooting hormone. This research was aimed to find out the optimum Auxin (NAA) concentration on these plants, under plastichouse conditions.

## MATERIALS AND METHODES

**Source of plant material:** A greenhouse grown plants (Rosemary, Gardenia, Hedera and Syngoniums) were in the vegetative phase of their life cycle, grown in pots in the nursery of Al-Balqa Applied University, As-Salt-Jordan, were used as a source of cuttings in this research, during the winter to early spring of the 2012-2013 seasons.

**Cuttings treatments:** A uniform single-stem of Hedera and Syngonium stock plants were cut into single-node leaf-bud cuttings, that contains a small part of stem, petiole, simple leaf and an axilary bud. On the other hand a terminal stem cuttings (soft cuttings) were taken from the Gardenia plants and a sub-terminal (semi-hard wood cuttings) were taken from the Rosemary plants by choosing a 10-15 cm young long green shoots, the lower leaves were sniped (Hartmann *et al*., 1997), while the immature apical part of the stem was discarded according to recommendations of (Hansen, 1986). The prepared cuttings were soaked in fresh water while working until treated with the rooting hormone (NAA).

A stock solution of Naphthalene Acetic Acid (NAA) Auxin hormone source with 5000 ppm was prepared by dissolving a 1.5 g of a pure powder of Naphthalene Acetic Acid (NAA) in 0.1 N (NaOH), using a stirrer, then the volume was completed with distilled water to be 300 mL, after that dilutions (0, 1000, 2000, 3000, 4000 and 5000 ppm 100 $mL^{-1}$ distilled water) were prepared. The bases of the cuttings were dipped for 5-7 sec in the prepared NAA concentrations (treatments), each treatment was replicated four times with 10 cuttings per replicate, then the treated cuttings were inserted in the rooting medium (a mixture of 1:1 peatmoss and perlite) until rooting was completed after about 6-8 weeks in a fiber glass greenhouse.

**Rooting conditions:** The experiment was conducted in a greenhouse; in which the growing conditions were as follows: Minimum air temperature 18°C; ventilation at 24°C; shading when necessary and relative humidity was 90%. Cuttings were watered once every 2-3 days up to 8 weeks.

**Parameters measured:** The following measurements and readings were taken after rooting period was ended.

**Rooting percentage:** The percentage of rooting were determined by counting the number of the rooted cuttings per replicateand then divided by the total number of cuttings per replicate.

**Callus percentage:** It was determined by counting the number of cuttings that formed callus without rootsand then divided by the total number of cuttings per replicate.

**Average number of roots per rooted cutting:** All produced roots from the rooted cuttings were counted and then the total numbers of roots were divided by the total number of the rooted cuttings.

**Average root length per rooted cutting (cm):** All produced roots were removed, their lengths were measured and the summation of the roots length was divided by the total number of the rooted cuttings.

**Experimental design and statistical analysis:** For each of the used plant materials (Rosemary, Gardenia, Hedera and Syngoniums); six treatments were conducted in a Completely Randomized Design (CRD) with four replicates. All data obtained were statistically analysed according to the design used in this experiment as outlined by Steel and Torrie (1980). Differences between treatment means were compared by using Least Significant Difference at 5% significant level.

## RESULTS AND DISCUSSION

**Rosemary rooting results:** Best results of rooting percentage was obtained by the 3000 ppm with 58.75%, with a significant differences with all of the used NAA concentrations (Table 1), on the other hand rooting was

Table 1: Influence of Auxin concentrations on rosemary plant rooting

| Auxin concentrations (ppm) | Rooting (%) | Callus (%) | Average No. of roots per rooted cutting | Average root lengthper rooted cutting (cm) |
|---|---|---|---|---|
| 0 | 11.0e | 0.0b | 0.50b | 0.50bc |
| 1000 | 28.25c | 0.0b | 3.75a | 2.04a |
| 2000 | 37.5b | 0.0b | 3.50a | 1.06b |
| 3000 | 58.75a | 0.0b | 3.88a | 0.68bc |
| 4000 | 23.25c | 0.0b | 2.75a | 0.68bc |
| 5000 | 0.00e | 0.15a | 0.00b | 0.00c |

*NAA: Naphthalene acetic acid (Auxin Hormone). **Means within each column having different letters are significantly different according to LSD at 5% level

Table 2: Influence of Auxin concentrations on gardenia plant rooting

| Auxin concentrations (ppm) | Rooting (%) | Callus (%) | Average No. of roots per rooted cutting | Average root length per rooted cutting (cm) |
|---|---|---|---|---|
| 0 | 8.00c | 0.00e | 0.83d | 0.1c |
| 1000 | 10.0c | 13.75d | 1.58cd | 0.12c |
| 2000 | 43.8b | 40.0b | 3.65a | 0.50b |
| 3000 | 52.5a | 28.75c | 1.93bc | 0.44b |
| 4000 | 57.5a | 23.75d | 2.63b | 1.1a |
| 5000 | 11.0c | 73.75a | 1.50cd | 0.38b |

*NAA: Naphthalene acetic acid (Auxin Hormone). **Means within each column having different letters are significantly different according to LSD at 5% level

inhibited at 5000 ppm NAA treatment but cuttings treated with this concentration only showed the callus formations and that means callus results are opposite to that of rooting percentage. The highest average numbers of roots per rooted cutting were obtained by the 3000 ppm NAA but without statistical differences with all other NAA concentrations except with the 0 ppm (control) treatment. The longest average root length per rooted cutting was observed by the 1000 ppm treatment, while no significant differences were observed between all other treatments.

These results are in agreement with that obtained by Blythe and Sibley (2003) in which positive response to the auxin applied to stem cuttings was observed over a range of different ornamental species. Also the use of a different auxin rates could have produced greater or lesser results.

**Gardenia rooting results:** Rooting percentage was ranged from 8-57.5%, best results were obtained by the 3000 and 4000 ppm treatments with 52.5 and 57.5%, respectively but without significant differences between the two treatments (Table 2), also results showed that rooting percentage was decreased at the higher NAA concentrations (5000 ppm). Callus percentages showed an opposite results to that of rooting percentage, since 5000 ppm treatment showed the highest callus percentage, whereas control treatment do not produce any callus percentage. Average number of roots per rooted cutting was the highest at 2000 ppm Auxin treatment, while average root length per rooted cutting was the tallest at 4000 ppm Auxin treatment.

Best results were obtained by Lai *et al.* (2007) who used different auxin forms and concentrations and found that IBA treatment with 7500 ppm gave maximum rooting percentage (96.67%), average number of roots per shoots (46.93), average root length (8.45 cm) and survival (75%) after transplanting in the field.

**Hedera rooting results:** Results of rooting percentage (Table 3); showed that best results were obtained by the 3000 ppm Auxin treatment with 68.75 rooting percentage,

Table 3: Influence of Auxin concentrations on hedera plant rooting

| Auxin concentrations (ppm) | Rooting (%) | Callus (%) | Average No. of roots per rooted cutting | Average root length per rooted cutting (cm) |
|---|---|---|---|---|
| 0 | 0.00e | 0.00c | 0.00d | 0.00d |
| 1000 | 19.25d | 0.00c | 1.13c | 0.98c |
| 2000 | 21.00 d | 0.00c | 3.50a | 1.23bc |
| 3000 | 68.75a | 0.00c | 2.13b | 2.10a |
| 4000 | 56.25b | 31.25a | 2.15b | 1.90a |
| 5000 | 41.00c | 8.75 b | 2.38b | 1.65ab |

*NAA: Naphthalene acetic acid (Auxin Hormone). **Means within each column having different letters are significantly different according to LSD at 5% level

Table 4: Influence of Auxin concentrations on syngonium plant rooting

| Auxin concentrations (ppm) | Rooting (%) | Callus (%) | Average No. of roots per rooted cutting | Average root length per rooted cutting (cm) |
|---|---|---|---|---|
| 0 | 0.00d | 0 | 0.00c | 0.00c |
| 1000 | 77.5a | 0 | 5.50a | 1.40a |
| 2000 | 35.8b | 0 | 1.40b | 0.68b |
| 3000 | 34.5b | 0 | 1.93b | 0.36bc |
| 4000 | 23.8c | 0 | 1.53b | 0.83b |
| 5000 | 0.00d | 0 | 0.00c | 0.00c |

*NAA: Naphthalene acetic acid (Auxin Hormone). **Means within each column having different letters are significantly different according to LSD at 5% level

while control treatment does not produce any rooting. Callus was only produced with 4000 and 5000 ppm treatments, while all other treatments do stimulate any callus production. Average number of roots per rooted cutting was the highest in the 2000 Auxin concentration treatment, while average root length per rooted cutting was the tallest in the 3000 ppm treated cuttings.

Results obtained Memon *et al.* (2013) revealed that all the traits related with rooting potential of stem cuttings were significantly influenced by various NAA concentrations. The best results obtained from the treatment where NAA was applied at the concentration of 6000 mg $L^{-1}$.

**Syngonium rooting results:** Rooting percentage was the highest (77.5%) with the 1000 ppm Auxin treated cuttings (Table 4) in compare to all other Auxin concentrations. Callus was not formed in all of the used Auxin concentrations. Otherwise, results of average number of roots per rooted cutting and average root length per rooted cutting showed the same results of that of the rooting percentage; in which the highest number and longest root was also obtained by the 1000 ppm Auxin concentration.

All obtained results proved that Auxin hormone is essential for rooting in the used cuttings of the treated cuttings of ornamental plants, since control treatment do not produce any roots in all of the used cuttings, these results are in agreement to that obtained by Pijut *et al.* (2011) in which the addition of Auxin is

essential in promoting adventitious rooting. Also, there is a wide variation for rooting capacity between the different used plant cuttings, which coincide with results obtained by Polat and Caliskan (2009) and Melgarejo *et al*. (2000).

## CONCLUSION

The use of Auxin hormone is essential for rooting; since it promoted rooting and improved root quality in all of the used NAA concentrations, in compare to the control treated cuttings. Three thousand ppm NAA was resulted in the highest rooting percentages of the Rosemary and Hedera cuttings and in most cases it produced the best results of rooting in compare to other NAA concentrations. While in Gardenia cuttings 4000 ppm NAA produced the best results of rooting percentage. On the other hand best results of Syngonium rooting was obtained by the 1000 ppm of NAA treatment concentration. Otherwise; callus results are opposite to that of rooting percentage in most NAA treated cuttings.

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