Effect of Different Auxin Concentrations on Virginia Creeper 
(*Parthenocissus quinquefolia*) Rooting

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**Abstract:** Parthenocissus plant is one of the most attractive outdoor deciduous vines; provides deep green cover to most any object, rapidly climbing by means of tendrils and adhesive disks, can be espaliered against a wall and provides great visual appeal during winter when the leaves have fallen. Rooting the cutting of this plant is difficult without using a rooting hormone, so the present research project was investigated to find out the optimum auxin (NAA) hormone concentration on rooting of this plant. Six treatments (0, 1000, 2000, 3000, 4000 and 5000 ppm NAA) were used in a completely randomized design (CRD) with four replicates. Results showed that in most cases cuttings treated with 1000 ppm NAA produced the best results or results which are not significantly different from the higher concentrations of NAA, so it's better to save in using the auxin hormone and use the lowest concentration in rooting the parthenocissus hard wood cuttings.

**Key words:** Auxin · NAA · Parthenocissus · Rooting · Callus

**INTRODUCTION**

Virginia creeper (*Parthenocissus quinquefolia*) is one of the most attractive outdoor deciduous vines; provides deep green cover to most any object, rapidly climbing by means of tendrils and adhesive disks [1]. The palmately divided leaflets turn a beautiful scarlet color in fall and the bluish-black berries, usually hidden by foliage, are quite attractive to birds [2].

The principal attraction of Virginia creeper is its fall color. The leaves turn fiery shades of purple, red and scarlet after the first frost [3]. The blue-black fruits and their stems (which turn red also) add color and interest after the leaves have fallen. The species are planted to cover building walls, run up tree trunks and form trellises and arbors. It also makes a fine ground cover [4]. The fruits are reported to be poisonous by reason of the oxalic acid they contain [5]. The seeds germinate readily in the landscape and the plant often becomes weedy [1].

The auxin indole-3-acetic acid (IAA) was the first plant hormone to be used in rooting in 1935. In the same year, several new synthetic auxins including indole-3-butyric acid (IBA) and naphthalene acetic acid (NAA), were found to promote rooting [6].

One of the most important uses of synthetic plant growth regulators in horticulture is the use of auxin for the induction of root formation in cuttings [7].

The promoting effect of IBA on rooting is mainly the result of its conversion to IAA in plant tissue [8]. However, IAA which is needed for the rooting process, is oxidized readily in the plant by peroxidases, whereas free IAA released from IBA is not oxidized by peroxidase and remains at the base of the cutting [8].

According to Eriksen and Mohammed [9] the process of root formation could be divided into two phases: (1) initiation phase and (2) growth phase. This conclusion was based on an experiment on pea cuttings where auxin (IAA) application promoted root formation in the early stage of the initiation phase and was active only in the first part of that phase. However, it has been proposed that an accumulation of IAA in the root-forming part of the cutting will function as the triggering factor for root initiation, whereas in the later stage primordial development is believed to be favored by lower auxin content [10]. On the other hand, species vary in their response to auxin. In the case of cuttings of *Azukia* [11] pea [12] and *Pinus radiata* [13] auxin was necessary for 2, 3 and 8 days, respectively for root initiation to occur.
One important early effect of auxin treatment may be the increased sugar accumulations at the site of root formation due to stimulation of assimilate transport by auxin [14]. Also, auxin treatment is connected with cell division and RNA and protein synthesis and activation [15].

Parthenocissus hardwood cutting plants are difficult to root without using a rooting hormone [16], so the present research project was investigated to find out the optimum Auxin (NAA) hormone concentration on Parthenocissus quinquefolia rooting of hardwood cuttings under plastichouse conditions.

MATERIALS AND METHODS

Source of Plant Material: Ten years old Parthenocissus quinquefolia climbing trees, in the dormant phase of their life cycle, grown under irrigation in the orchard at Amman - Jordan, were used as a source of cuttings in this research.

Preparation of the Cuttings: Dormant Hardwood Parthenocissus quinquefolia cuttings with about 5 mm in diameter, were taken at the beginning of November/2009 and cut horizontally in small pieces (15 - 20 cm long with 3 - 4 buds/cutting), cutting were done at the base 2-3 mm below a node and tendrils were removed to facilitate soaking in the rooting hormone.

A stock solution of 5000 ppm was prepared by dissolving a 1.5 gm 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 per 100 ml distilled water) were prepared. The bases of the cuttings were soaked for 7 seconds in the prepared treatments; each treatment was replicated four times with 10 cuttings per replicate.

Rooting Conditions: The experiment was conducted in a greenhouse at Al-Balqa applied university. Average air temperature was 20 - 25 °C and average relative humidity was 90 %, horticultural Perlite and Peatmoss 1:1 ratio (v:v) was used as a rooting medium in benches. Cuttings were watered once every 2 - 3 days up to 40 days, then observations on rooting response were recorded after the 40 days of insertion.

Parameters Measured: The following measurements and readings were taken after 40 days from insertion (planting) date:

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

Callus Percentage: It was determined by counting the number of cuttings that formed callus without roots and 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 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 rooted cuttings.

Average Root Dry Weight per Rooted Cutting (MG): Freshly harvested roots per replicate were dried in an oven at 60°C for 48 hours to a constant weight and then placed in desiccators until their temperature dropped [16]. Weight was taken by digital scale balance and average readings were considered per rooted cutting.

Experimental Design and Statistical Analysis: Six treatments were conducted in a completely randomized design (CRD) with four replicates. All data obtained were statistically analyzed according to the design used in this experiment as outlined by Steel and Torrie [18]. Differences between treatment means were compared by using Least Significant Difference at 5 % significant level.

RESULTS AND DISCUSSION

Rooting Percentage: Rooting percentage during this collection date ranged from 47.5 to 82.5 % (Table 1). Cuttings treated with 2000 ppm (NAA) treatment gave significantly higher rooting percentage than the control, 3000 and 5000 ppm of NAA, however 1000, 2000 and 4000 ppm NAA treatments were at the same level of significance. On the other hand, the control treatment resulted in the least rooting percentage (47.5%), although without being significantly different from 3000, 4000 and 5000 ppm of NAA treatments.

Eventhough, the highest rooting percentages were obtained by the 2000 ppm NAA treated cuttings, no statistical differences were observed with cuttings treated
Table 1: Effect of Auxin concentrations on rooting and callus percentages of Parthenocissus plant

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Rooting %</th>
<th>Callus %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppm NAA* (Control)</td>
<td>47.5 c*</td>
<td>19.75 a</td>
</tr>
<tr>
<td>1000 ppm NAA</td>
<td>77.5 ab</td>
<td>8.25 b</td>
</tr>
<tr>
<td>2000 ppm NAA</td>
<td>82.5 a</td>
<td>7.5 b</td>
</tr>
<tr>
<td>3000 ppm NAA</td>
<td>60.0 bc</td>
<td>13.0 a</td>
</tr>
<tr>
<td>4000 ppm NAA</td>
<td>65.0 abc</td>
<td>12.5 b</td>
</tr>
<tr>
<td>5000 ppm NAA</td>
<td>55.0 c</td>
<td>12.75 b</td>
</tr>
<tr>
<td>LSD a b c d</td>
<td>17.78</td>
<td>6.76b</td>
</tr>
</tbody>
</table>

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

Table 2: Effect of Auxin concentrations on average number of roots, average root length and average root dry weight (mg) per rooted cutting of Parthenocissus plant:

<table>
<thead>
<tr>
<th>Treatments</th>
<th>No. of roots per rooted cutting</th>
<th>Root length per rooted cutting (cm)</th>
<th>Root dry wt. per rooted cutting (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppm NAA* (Control)</td>
<td>2.47 b*</td>
<td>9.68 d</td>
<td>5.44 c</td>
</tr>
<tr>
<td>1000 ppm NAA</td>
<td>6.03 ab</td>
<td>31.00 a</td>
<td>26.4 a</td>
</tr>
<tr>
<td>2000 ppm NAA</td>
<td>3.61 ab</td>
<td>26.76 ab</td>
<td>22.86 ab</td>
</tr>
<tr>
<td>3000 ppm NAA</td>
<td>7.88 a</td>
<td>19.35 bc</td>
<td>10.77 bc</td>
</tr>
<tr>
<td>4000 ppm NAA</td>
<td>7.64 a</td>
<td>19.38 bc</td>
<td>16.12 abc</td>
</tr>
<tr>
<td>5000 ppm NAA</td>
<td>7.02 a</td>
<td>16.52 cd</td>
<td>17.84 ab</td>
</tr>
<tr>
<td>LSD a b c d</td>
<td>4.54</td>
<td>9.38 cd</td>
<td>12.4</td>
</tr>
</tbody>
</table>

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

with 1000 ppm NAA and so it is better to use the lowest NAA concentration, in order to save in using the Auxin hormone.

Callus Percentage: Callus percentage ranged from 7.5 to 19.75 % (Table 1). Control treated cuttings gave significantly the highest callusing percentage over 1000, 2000, 4000 and 5000 ppm NAA treatments. However, control cuttings were in the same level of significance with the 3000 ppm NAA treatment. Cuttings treated with 2000 ppm NAA, gave the least callusing percentage with being significantly different from all other treatments except the control. On the other hand results of callusing percentages showed that; treatments produced the highest rooting percentages (2000 ppm NAA), produced the lowest callusing percentages, so results of callus percentages are opposite to that of rooting percentages.

Average Number of Roots per Rooted Cutting: No significant differences were observed between all the used NAA concentration treatments (Table 2); cuttings treated with 3000 ppm NAA produced the highest number of roots (7.88) per rooted cutting, while control treated cuttings produced the lowest number of roots (2.47) per rooted cutting without being significantly different from 1000 and 2000 ppm NAA treatments.

These results suggest that any NAA concentration can be used, but it's better to save in using the hormone and use the lowest concentrations.

Average Root Length per Rooted Cutting: The longest roots (31 cm) were obtained by 1000 ppm NAA treatment (Table 2), without statistical differences with the 2000 ppm NAA treatment, while the shortest roots (9.68 cm) were obtained by the control treatment, with statistical different with all other treatments.

Average Root Dry Weight per Rooted Cutting (MG): Cuttings treated with 1000 ppm NAA gave the highest average root dry weight (26.4 mg) per rooted cutting (Table 2), which were significantly higher than the control and 3000 ppm NAA treatments, however without being significantly different from the rest of the treatments.

Control treatment gave the lowest average dry weight (5.44 mg) per rooted cutting without being significantly different from 3000 ppm and 4000 ppm NAA treatments.

CONCLUSION

Cuttings treated with 2000 ppm (NAA) produced the best results of rooting percentage, without being significantly different from cuttings treated with 1000 ppm NAA. On the other hand callus results are opposite to that of rooting percentage. The highest number of roots per rooted cutting was obtained by 3000 ppm NAA treatment without being significantly different from the control treatment, which produced the lowest number of roots. The longest roots and the highest average root dry weight per rooted cutting were obtained by 1000 ppm NAA treatment, while the shortest roots and the lowest average root dry weight per rooted cutting were obtained by the control treatment.

In most cases cuttings treated with 1000 ppm NAA gave the best results or produced results which are not significantly different from the higher concentrations of NAA, so it's better to save in using the auxin hormone and use the lowest concentration which is 1000 ppm NAA in rooting the parthenocissus hard wood cuttings.
REFERENCES


