Improving Survival and Orchard Performance of “Costata” Persimmon Seedlings by K-NAA and IBA Applications

Shaimaa Fakhry, HassanA. Kassem, Hend A. Marzouk, Samy M. El-Rakshy and Hoda A. Khalil

Pomology Department, Faculty of Agriculture (El-Shathy), Alexandria University, Alexandria, Egypt

ABSTRACT

The present investigation was conducted during the 2018 and 2019 growing seasons on one-year-old persimmon seedlings cv. “Costata” grafted on “Seedy” and “Tarabouls” rootstocks in order to improve its survival percent and orchard performance. The Seedlings were treated with K-NAA or IBA either by dipping at 3000 mg l⁻¹ for 5 seconds or soaking at 500 mg l⁻¹ for 24 hours. Obtained results generally showed significant increase in vegetative growth, root biomass and leaf chlorophyll and mineral content by all K-NAA and IBA applications compared to the water treated ones. A highest values of sprouting buds percent (during April, June and August), average shoots number, trunk cross-sectional area, leaf area and canopy volume were recorded with the K-NAA soaking at 500 mg l⁻¹ for 24 h. Leaf chlorophyll content was highest with K-NAA and IBA soaking in the first season, while K-NAA soaking at 500 mg l⁻¹ for 24 h gave the highest values of leaf N, P, K, Fe, Mn and Zn in both seasons. Also, the K-NAA soaking or dipping applications recorded the highest values of average shoot length, increment percents of shoot length and stem diameter and highest seedlings survival in both seasons. The K-NAA soaking at 500 mg l⁻¹ for 24 h gave the highest significant values of root biomass in the first season. Results also showed that seedlings on “Seedy” rootstock surpassed the ones on “Tarabouls” rootstock in all vegetative growth parameters and root biomass, but contained lower leaf N, P, Mn and Zn.

Keywords: Persimmons, Biomass, Auxins, Survival, Field Performance.

INTRODUCTION

Persimmon is a nutritious fruit commonly consumed in several parts of the world. The trees (Diospyros kaki L.) are deciduous that grow well in temperate regions. However, it appears to be readily adapted to a wide range of climatic conditions from warm temperate to sub-tropical. Thus, nowadays trees are found to be cultivated in many countries known with its long warm summer such as Egypt. Egyptian climate is suitable for persimmons production, and the summer season helps for favorable fruit growth and maturation. Recently, persimmons production and consumption increased significantly worldwide. The Food and Agriculture Organization (FAO) recorded a global production increase from 2417602 tons in 2000 to 3263021 tons in 2005, reaching 4711458 tons in 2018, with China considered as the largest world producer followed by Korea, Japan, Brazil, Azerbaijan and Italy. In Egypt persimmon production has reached 33232 tons in 2017 on total area of 22642 hectares (FAO). The most commonly cultivated cultivar in Egypt is the astringent “Costata” which possess certain advantages, such as adaptability to wide range of climatic conditions, excellent taste and other fruit quality characteristics (Llacer and Badenes, 2001). The common propagation method of this cultivar in Egypt is by grafting or budding onto the “Tarabouls” rootstocks (root suckers grown from the root system of the mother tree) in February and March below the mother tree, then seedlings separation and planting after one year in the permanent field. As any other deciduous seedlings, they are transported with bare root and thus lose part of the root mass during transplanting, besides its weak rooting, it is expected that a large part of the seedling’s root mass dies after planting. This prompted persimmon growers to use “Seedy” rootstocks (directly grown from seed planting) for grafting instead of the “Tarabouls”. Seedlings with Seedy rootstocks are mostly transported in containers with soil covering the root system similar to evergreen ones. This ensures safe transporting with less root damages. However, it increases the cost of seedlings production. Never the less, science persimmons normally produce weak and small portion of root biomass, it is expected that the newly transplanted seedlings show weak and slow growth performance during the first growing season in the permanent orchard and even though after that. Thus, several investigations studied the exogenous treatment with auxins such as indole-3-butric acid (IBA), indole-3-acetic acid (IAA) and naphthalene acetic acid (NAA) for stimulating and encouraging root initiation, growth and development due to the activation of cambium regeneration, cell division and cell multiplication (Fumuro, 2011; Chaudhary et al., 2018; Mehra and Awasthi, 2019). Therefore, the essential role of auxins in promoting cell division, root initiation and formation in several horticultural crops specially the difficult-to-root ones is reported (Ludwig-Muller, 2000; Fin et and Jailleis, 2012).

In respect of the above facts, the present study aimed to enhance the seedlings survivability and field growth performance of “Costata” persimmons grafted either on “Seedy” (Diospyros kaki) or “Tarabouls” (Diospyros lotus) rootstocks after
treatment with IBA or K-NAA. The obtained results would be also economically beneficial in reducing the seedlings production costs.

MATERIALS AND METHODS

Plant materials and treatments

The present investigation was conducted during 2018 and 2019 growing seasons in order to study the effect of potassium α-naphthalene acetate (K-NAA) and indole butyric acid (IBA) on orchard performance of one year old “Costata” persimmon seedlings grafted on “Seedy” (Diospyros kaki) and “Tara Bouls” (Diospyros lotus) rootstocks. Fifty seedlings (25 grafted onto “Seedy” and 25 grafted onto “Tara Bouls”) were selected as uniform as possible for this study and their root systems were either water treated, dipped for 5 seconds in 3000 mg l⁻¹ IBA or K-NAA or soaked for 24 hours in 500 mg l⁻¹ IBA or K-NAA. Then seedlings were individually planted in February of both growing seasons in the ground of a private orchard at El-Tarbheh region, El-Behera Governorate and were irrigated with tap water containing systemic fungicide for protection from the roots rotting. The experiment was designed as split plot, with the rootstocks being the main plot and chemical treatments are the subplot. Thus, 2 rootstocks × 5 treatments × 5 replicates = 50 seedlings were used in each experimental season. The effect of all treatments on survival and field growth performance of the “Costata” seedlings in 2018 and 2019 seasons was studied.

Measured parameters

Vegetative growth

Buds sprouting percent, average shoots number and length, shoot length increment, stem diameter, stem diameter increment, leaf and trunk cross sectional areas, canopy volume according to the following equations:

\[
\text{Buds Sprouting} \% = \frac{\text{Number of sprouted buds}}{\text{Total number of dormant buds}} \times 100
\]

\[
\text{Shoot Length Increment} \% = \frac{\text{Final shoot length} - \text{Initial shoot length}}{\text{Initial shoot length}} \times 100
\]

\[
\text{Leaf Area} = \frac{1}{2} \text{length} \times \text{width}
\]

\[
\text{TCSA (cm²)} = \pi \times (D^2/4)
\]

\[
D: \text{trunk diameter}; \pi: 3.14
\]

\[
\text{Canopy Volume (m³)} = 0.5238 \times H \times D^2
\]


Rooting biomass

The above ground biomass of each seedling was measured at the end of the growing season according to Werner and Murphy (2001). The root biomass was calculated with the following equation according to Woomer (2003).

\[
\text{Root biomass} = \text{Above ground Biomass} \times 35%
\]

Seedlings survival

At the end of the growing seasons, the number of survived seedlings out of the total number of seedlings per treatment was counted, and the percentage of survival was calculated.

Leaf chlorophyll and mineral content

Leaf chlorophyll was measured using a Minolta SPAD chlorophyll meter according to the method described by Yadava (1986), and the results were expressed as SPAD units. In addition, leaf N, and P were calorimetrically determined using spectrophotometer according to Evenhuis (1976) and Murphy and Riley (1962), respectively. Leaf K content was determined using a flame photometer. Leaf Fe, Mn, and Zn were measured by Perkin Elmer Atomic Absorption Spectrophotometer (model α1502 LAXCO, made in USA). The concentrations of nitrogen, phosphorus, and potassium were expressed as percent on a dry weight basis, while those of iron, manganese and zinc were expressed in mg l⁻¹ on a dry weight basis.

Statistical Analysis

The analysis of variance (two-way ANOVA) according to Petersen (1985) was carried out using the statistical analysis system (SAS Institute, 2001). Comparisons among means of the studied treatments for each parameter were obtained according to the least significant difference test (LSD) at 0.05 level of significance according to Snedecor and Cochran (1989). The sprouting bud’s percent, average shoot’s length increment, stem diameter increment and survival offered as a percentage in Tables only.

RESULTS

Main effect of K-NAA and IBA

Regarding the main effect of K-NAA and IBA on vegetative growth, the obtained results in Table (1). The data showed a significant increase in all vegetative growth parameter sand root biomass of the “Costata” seedlings by all K-NAA and IBA applications as compared with the water in both seasons.

The results of the present study showed that the highest average shoots number of the “Costata” seedlings resulted in the soaking in K-NAA 500 mg...
Concerning the main effect of K-NAA and IBA applications on the leaf chlorophyll content of “Costata” seedlings in 2018 and 2019 seasons are shown in Table (3). The findings of the present investigation, generally, indicated that all applications of K-NAA and IBA significantly increased leaf chlorophyll content as compared with the water treatment. In addition, the results of the first season showed that SPAD readings were higher in the soaking method of K-NAA at 500 mg l⁻¹ for 24 h. On the other hand, the results of the second season showed that all K-NAA and IBA applications did not significantly differ among each other and resulted in higher leaf chlorophyll content than the water treatment.

The effect of K-NAA and IBA applications on leaf mineral content of “Costata” seedling is presented in Table (3). Regarding the main effect of K-NAA and IBA, and regardless of the rootstock effect, the obtained results showed a significant increase in the leaf mineral content of the “Costata” seedlings by all K-NAA and IBA applications as compared with the water in both seasons, except the IBA dipping treatment did not significantly differ between them in the leaf nitrogen and potassium ‘in the first season’ and iron content ‘in the second season’.

The leaf nitrogen content of the “Costata” scions increased by the dipping and soaking treatments of both K-NAA and IBA compounds as compared to the water treatment in both seasons, with the different not to be significant enough for the IBA dipping treatment in the first season only. While, in the second season the K-NAA soaking resulted in significantly the highest leaf nitrogen content compared to all other treatments. Similar trend was obtained in leaf phosphorus content of “Costata” scions in both seasons. The highest significant value of leaf potassium content was recorded with soaking K-NAA at 500 mg l⁻¹ for 24 h in first season. The soaking and dipping K-NAA resulted in similar leaf potassium content in the second season. Data in both seasons indicated that no significantly different occurred between the soaking treatment of K-NAA and the soaking treatment of IBA. In addition, the findings of the present study, generally, indicated that the leaf manganese content was higher in the soaking method of K-NAA at 500 mg l⁻¹ for 24 h than the dipping method in 3000 mg l⁻¹ of K-NAA and the dipping or the soaking of IBA in both seasons. Moreover, the results showed that the soaking method of K-NAA at 500 mg l⁻¹ for 24 h recorded the highest value of the leaf zinc content of the “Costata” scion when compared to the other chemical treatments and water treatment in both growth seasons.

As for the effect of K-NAA and IBA applications on the percentage of sprouting buds, average shoot length increment, stem diameter increment and survival of “Costata” seedlings during 2018 and 2019 is presented in Table (2). Regardless the rootstock influence, obtained results showed a gradual increase in the sprouting buds, average shoot length increment, stem diameter increment and survival percent of “Costata” scion. The results also showed that the highest sprouting buds percent was recorded with the soaking method of K-NAA at 500 mg l⁻¹ for 24 h followed by soaking in IBA at 500 mg l⁻¹ for 24 h in April, June and August of both seasons. In addition, the highest average shoot length increment value was obtained with dipping in K-NAA at 3000 mg l⁻¹ for 5 s in both experimental growth seasons, followed by soaking in K-NAA at 500 mg l⁻¹. The results obtained of the stem diameter increment indicated that the highest increase was recorded with K-NAA at 500 mg l⁻¹ by soaking method for 24 h followed by dipping in K-NAA at 3000 mg l⁻¹ for 5 seconds. Moreover, the results generally indicated that the most effective treatments for increasing the survival percentage of “Costata” seedlings were in the K-NAA treatments as well as the soaking treatment of IBA in both experimental seasons.
Table 1: Main effect of K-NAA and IBA applications on the average shoots number, average shoot length, leaf area, trunk cross sectional area, canopy volume and root biomass of “Costata” seedlings during the 2018 and 2019 growing seasons.

<table>
<thead>
<tr>
<th>Application</th>
<th>Average shoots number</th>
<th>Average shoot length (cm)</th>
<th>Leaf area (cm²)</th>
<th>Trunk cross sectional area (cm²)</th>
<th>Canopy volume (m³)</th>
<th>Root biomass (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>4.0d</td>
<td>6.21d</td>
<td>67.61d</td>
<td>1.815d</td>
<td>0.028d</td>
<td>0.195d</td>
</tr>
<tr>
<td>IBA 3000 mg l⁻¹ for 5 s.</td>
<td>6.7c</td>
<td>24.95b</td>
<td>110.16ab</td>
<td>2.855c</td>
<td>0.090c</td>
<td>0.334b</td>
</tr>
<tr>
<td>IBA 500 mg l⁻¹ for 24 h.</td>
<td>8.7b</td>
<td>23.59b</td>
<td>102.65b</td>
<td>2.942bc</td>
<td>0.121b</td>
<td>0.339b</td>
</tr>
<tr>
<td>K-NAA 3000 mg l⁻¹ for 5 s.</td>
<td>9.4b</td>
<td>34.78b</td>
<td>113.27ab</td>
<td>3.118b</td>
<td>0.159b</td>
<td>0.366b</td>
</tr>
<tr>
<td>K-NAA 500 mg l⁻¹ for 24 h.</td>
<td>10.6a</td>
<td>34.70a</td>
<td>116.07a</td>
<td>3.804a</td>
<td>0.171a</td>
<td>0.457a</td>
</tr>
</tbody>
</table>

Table 2: Main effect of K-NAA and IBA applications on the sprouting bud’s, average shoot’s length increment, stem diameter increment and survival of “Costata” seedlings during the 2018 and 2019 growing seasons.

<table>
<thead>
<tr>
<th>Application</th>
<th>Sprouting bud’s (%)</th>
<th>Average shoot length increment (%)</th>
<th>Stem diameter increment (%)</th>
<th>Survival percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>April</td>
<td>June</td>
<td>August</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>15.85</td>
<td>19.23</td>
<td>25.08</td>
<td>521</td>
</tr>
<tr>
<td>IBA 3000 mg l⁻¹ for 5 s.</td>
<td>23.58</td>
<td>27.68</td>
<td>38.15</td>
<td>2395</td>
</tr>
<tr>
<td>IBA 500 mg l⁻¹ for 24 h.</td>
<td>32.5</td>
<td>36.23</td>
<td>57.65</td>
<td>2259</td>
</tr>
<tr>
<td>K-NAA 3000 mg l⁻¹ for 5 s.</td>
<td>29.93</td>
<td>33.43</td>
<td>53.65</td>
<td>3378</td>
</tr>
<tr>
<td>K-NAA 500 mg l⁻¹ for 24 h.</td>
<td>37.18</td>
<td>42.24</td>
<td>63.73</td>
<td>3370</td>
</tr>
</tbody>
</table>

Table 3: Main effect of K-NAA and IBA applications on the leaf chlorophyll, N, P, K (%) and Fe, Mn and Zn (Mg l⁻¹) of “Costata” seedlings during the 2018 and 2019 growing seasons.

<table>
<thead>
<tr>
<th>Application</th>
<th>Chlorophyll</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Fe</th>
<th>Mn</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chlorophyll</td>
<td>N</td>
<td>P</td>
<td>K</td>
<td>Fe</td>
<td>Mn</td>
<td>Zn</td>
</tr>
<tr>
<td>Water</td>
<td>50.18b</td>
<td>1.81c</td>
<td>0.175c</td>
<td>1.23c</td>
<td>134.75c</td>
<td>55.00d</td>
<td>21.00c</td>
</tr>
<tr>
<td>IBA 3000 mg l⁻¹ for 5 s.</td>
<td>59.72c</td>
<td>2.02bc</td>
<td>0.215b</td>
<td>1.27c</td>
<td>140.00b</td>
<td>59.50c</td>
<td>24.00b</td>
</tr>
<tr>
<td>IBA 500 mg l⁻¹ for 24 h.</td>
<td>63.93ab</td>
<td>2.26ab</td>
<td>0.230b</td>
<td>1.33b</td>
<td>144.75ab</td>
<td>63.75b</td>
<td>24.75b</td>
</tr>
<tr>
<td>K-NAA 3000 mg l⁻¹ for 5 s.</td>
<td>63.41b</td>
<td>2.20ab</td>
<td>0.265a</td>
<td>1.37b</td>
<td>141.25b</td>
<td>63.50b</td>
<td>25.50b</td>
</tr>
<tr>
<td>K-NAA 500 mg l⁻¹ for 24 h.</td>
<td>65.84a</td>
<td>2.47a</td>
<td>0.270a</td>
<td>1.48a</td>
<td>149.00a</td>
<td>67.00a</td>
<td>30.00a</td>
</tr>
</tbody>
</table>

Means followed by the same letter(s) in the same column or row are not significantly different according to the least significant difference (LSD) at 0.05 level.
Main effect of rootstocks

As for the main effect of rootstocks, regardless of the K-NAA and IBA applications, the obtained results in Tables (4) and (5) showed that the persimmon seedlings on “Seedy” rootstock surpassed “Tarabouls” rootstock in all vegetative growth parameter sand root biomass. Additionally, the obtained results in Table (6) showed that the persimmon seedlings on “Tarabouls” rootstock surpassed “Seedy” rootstock in their leaf nitrogen, phosphorus, manganese and zinc content. Also, the findings of both seasons showed no statistically significant difference between both rootstocks in their effect on the leaf chlorophyll, leaf potassium and iron content of the “Costata” scion.

DISCUSSION

K-NAA and IBA effect

Results of the present study recorded improvement in the vegetative growth of “Costata” seedlings by all K-NAA and IBA applications as indicated by their positive influence in enhancing buds sprouting percentage, increasing the number of sprouted buds, shoot number and length, as well as, stem diameter, trunk cross sectional and leaf areas and canopy volume. Also, significant increases in leaf chlorophyll and mineral content of the Costata seedlings were recorded by the NAA and IBA applications. In the mean time, the seedlings root biomass was clearly superior by K-NAA and IBA compared to the water treatment. Similar findings for other fruit species were previously accredited (Kaur et al., 2002; Rymbai and Reddy, 2010; Bemkaireima et al., 2012; Mewar and Naithani, 2016; Kaur, 2017). Dhatrika Rani et al. (2018) working on guava, attributed the acceleration of photosynthesis activity to the increased leaf chlorophyll content due to increasing in leaf area by IBA treatment. Exogenous application of NAA and IBA is reported to enhance absorption activity of the roots (Yusnita et al., 2018). Accordingly, the high root biomass obtained in the present study might have helped in better water and nutrients uptake, which led to increasing leaf mineral content and leaf area, thus increasing the efficiency of the photosynthesis process, resulting in enhancing the different vegetative growth parameters studied in the present investigation.

The positive effects of NAA and IBA on enhancing rooting would be cleared by the explanations mentioned by Weaver (1972) who stated that the increase in roots number by IBA treatment might be due to the IBA influence on cell wall plasticity and acceleration of cell division thus, the development and growth of roots. Also, Nanda (1975) reported the important role of IBA in mobilizing reserved food materials, elongation of meristemic cells, as well as, the differentiation of cambial initials into root primordial. The mechanisms by which IBA and NAA stimulate root formation could be explained as stated by Yan et al. (2014). They mentioned that, IBA effect could be through its conversion to IAA, the increase of internal free-IBA, the enhancement of tissue sensitivity to IAA, enhancement of the endogenous IAA synthesis or the action of IAA synergistically, while, the stimulatory effect of NAA to induce root formation would probably be associated with a remarkable increase of polyphenol oxidase (POD) and inhibition of IAA-oxidase (IAAO), thus preventing IAA degradation and increasing its activity. IAA-oxidase is an enzyme that catalyzes oxidation of IAA, or breaks down endogenous auxin. Polyphenol oxidase is stated to be implicated in an important step of the root formation, during the metabolism of auxins and the process of lignification.

Rootstock effect

Results of the present study showed superiority of the “Seedy” rootstock in encouraging growth and survival of the “Costata” seedlings compared to “Tarabouls” stock. This is clear in the better enhancement of the measured growth parameters during both growing seasons. The growth and development of a grafted plant is inherently a function of scion genotype, but also the rootstock plays a critical role. A “hormone message concept” dictates that hormones are produced in one part of the plant and affect a remote part. Auxin is produced in shoot apexes and is translocated to the root where it affects root development, morphology and functioning. Auxin has also been shown to affect the production and activity of cytokinins which are known to be produced in the root and translocated to the shoot where they control important developmental processes such as shoot growth and productivity (Albacete et al., 2008; Aloni et al., 2010). Accordingly, obtained findings of the present study might probably reveal to the possibility of a better hormonal message obtained between the “Costata” scions and “Seedy” rootstock, than between the “Costata” scions and the “Tarabouls” stock. Therefore, there might have been better rootstock-scion interelation, better rootstock-scion union and better rootstock-scion communication between “Costata” scion on “Seedy” rootstock than the ones on “Tarabouls”. This means that both “Costata” scion and “Seedy” rootstock compatibly and positively affected the growth and development of each other. This is evident in the obtained results as “Costata” scions had high shoots number, shoot length, stem diameter, trunk cross sectional and leaf areas, when grafted on “Seedy” rootstock compared to the “Tarabouls”. In accordance, this vegetative growth improvement appeared in the more root biomass recorded in the “Seedy” stocks than “Tarabouls”.
Table 4: Main effect of rootstock on the average shoots number, average shoot length, Leaf area, trunk cross sectional area, canopy volume and root biomass of “Costata” seedlings during the 2018 and 2019 growing seasons.

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>2018</th>
<th></th>
<th>2019</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average shoots number</td>
<td>Average shoot length (cm)</td>
<td>Leaf area (cm²)</td>
<td>Trunk cross sectional area (cm²)</td>
<td>Canopy volume (m³)</td>
</tr>
<tr>
<td>Tarabouls</td>
<td>6.52b</td>
<td>23.71b</td>
<td>85.56b</td>
<td>2.059b</td>
<td>0.069b</td>
</tr>
<tr>
<td>Seedy</td>
<td>9.24a</td>
<td>25.98a</td>
<td>118.26a</td>
<td>3.754a</td>
<td>0.159a</td>
</tr>
<tr>
<td>Tarabouls</td>
<td>4.8b</td>
<td>8.12b</td>
<td>85.92b</td>
<td>2.562b</td>
<td>0.075b</td>
</tr>
<tr>
<td>Seedy</td>
<td>7.28a</td>
<td>10.73a</td>
<td>113.84a</td>
<td>3.754a</td>
<td>0.192a</td>
</tr>
</tbody>
</table>

Means followed by the same letter(s) in the same column or row are not significantly different according to the least significant difference (LSD) at 0.05 level.

Table 5: Main effect rootstock on the sprouting bud’s percent, average shoot’s length increment percent, stem diameter increment percent and survival percent of “Costata” seedlings during the 2018 and 2019 growing seasons.

<table>
<thead>
<tr>
<th>Application</th>
<th>Sprouting bud’s (%)</th>
<th>Average shoot’s length increment (%)</th>
<th>Stem diameter increment (%)</th>
<th>Survival percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>April</td>
<td>June</td>
<td>August</td>
<td></td>
</tr>
<tr>
<td>Tarabouls</td>
<td>23.95</td>
<td>28.74</td>
<td>46.79</td>
<td>2271</td>
</tr>
<tr>
<td>Seedy</td>
<td>31.66</td>
<td>34.78</td>
<td>48.51</td>
<td>2498</td>
</tr>
<tr>
<td>Tarabouls</td>
<td>13.94</td>
<td>18.34</td>
<td>36.81</td>
<td>712</td>
</tr>
<tr>
<td>Seedy</td>
<td>18.88</td>
<td>25.78</td>
<td>47.22</td>
<td>973</td>
</tr>
</tbody>
</table>

Table 6: Main effect rootstock on the leaf chlorophyll, N, P, K (%) and Fe, Mn and Zn (Mg l⁻¹) of “Costata” seedlings during the 2018 and 2019 growing seasons.

<table>
<thead>
<tr>
<th>Application</th>
<th>Chlorophyll</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Fe</th>
<th>Mn</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tarabouls</td>
<td>60.75a</td>
<td>2.38a</td>
<td>0.252a</td>
<td>1.35a</td>
<td>144.90a</td>
<td>64.30a</td>
<td>27.00a</td>
</tr>
<tr>
<td>Seedy</td>
<td>60.47a</td>
<td>1.94a</td>
<td>0.210a</td>
<td>1.32a</td>
<td>139.00a</td>
<td>59.20a</td>
<td>23.10a</td>
</tr>
<tr>
<td>Tarabouls</td>
<td>62.63a</td>
<td>2.35a</td>
<td>0.254a</td>
<td>1.36a</td>
<td>151.40a</td>
<td>62.40a</td>
<td>25.00a</td>
</tr>
<tr>
<td>Seedy 61.28a</td>
<td>1.95b</td>
<td>0.220b</td>
<td>1.27b</td>
<td>146.80b</td>
<td>55.90b</td>
<td>22.00b</td>
<td></td>
</tr>
</tbody>
</table>

Means followed by the same letter(s) in the same column or row are not significantly different according to the least significant difference (LSD) at 0.05 level.

CONCLUSION

Finally, according to the enhancement of growth performance of the Costata seedlings obtained in the present study by the different K-NAA and IBA treatments, especially the soaking method of K-NAA at 500 mg l⁻¹ for 24 h. Costata growers might be guided for the possibility of transporting the seedlings from the nursery bare rooted and planting in the permanent orchard after treating with either K-NAA or IBA, which would in turn lower the production costs of seedlings.

REFERENCES


Mewar, D., & Naithani, D. C. (2016). Effect of different IBA concentrations and planting time on stem cuttings of Wild Fig (Ficus palmata Forsk.). Plant Archives, 16(2): 959-962.


الملخص العربي
تحسين النجاح والأداء البستاني لشتلات الكاكي 'كوستارا' بواسطة البوتاسيوم+N في الخليط وحمض الادول بيونتریک

أجريت هذه الدراسة خلال موسمين نمو 2017-2018 على شتلات كاكي عمر سنة، لدراسة تحسين نسبة النجاح والأداء البستاني لشتلات الكاكي صنف كوستارا المطحنة على الأصل البذري والطبرليس في الحقل المُستَمَد، بواسطة حمض الادول بيونتریک (IBA) والبوتاسيوم+N في الخليط (K-NAA) (أبام عن طريق غنم المجموع الجذري لمدة 5 توان 500 ملليجرام في النيتر أو نفعه لمدة 24 ساعة بتركيز 500 ملليجرام في النيتر في هذه المركبات. استخدم تصميم القطع المتكافئة في تغذية النحتية، مع اعتبار الأصل هو القطع الرئيسية ومعاملات مفترضات النمو في القطع المتكافئة. وبالتالي، تم استخدام أربعة مختطفات × 5 معاملات = 20 شتلة في كل موسم تجربة.

وأوضح النتائج للمتصدر عليها من الدراسة الحالية أنه في بعض النتائج، فإن جميع معاملات (K-NAA) أدت إلى زيادة في قياسات النمو الخضري، الكتلة الحيوية للجذر، محتوى الأوراق من الكلوروفيل، وعناصر المعدنية مقارنة بمعاملة الماء في كل المواسم. باستثناء، معاملة الغس في K-NAA، لم تختلف مععيا مع معاملة الماء في محتوى الأوراق من البذريات والبوتاسيوم في الموسم الأول. وحمض الخليط في K-NAA (500 جزئ لكل مليون لمدة 24 ساعة أعلى قيم نسبة البراعم النامية في أشهر أبريل وبوبو وأغسطس، ومتوسط عدد الأوراق، ومساحة مقطع الجذع وحجم المجموع الحضري. كما أشارت نتائج كل المواسم إلى أن معاملات النفع أو الغس في K-NAA سجلت أعلى قيم لتموز طول الفرع ومتوسط نسبة النزيل في طول الفرع ونسبة النزيل في قطر الفرع ونسبة قطع الشتلات حياة. كما أذا معاملات الغس والتفع في IBA و K-NAA (بكل الغس في IBA) إلى زيادة معنوية في مساحة الورقة. بالإضافة إلى ذلك، أعطت معاملات النفع في 500 ملليجرام في النيتر K-NAA مدة 24 ساعة أعلى قيم للكتلة الحيوية (IBA) للمجذ للجذر في الموسم الأول. وتم تسجيل أعلى قيمة لمتوسط النمو من الكلوروفيل عند النقع في K-NAA في IBA في الموسم الأول. أما بالنسبة للمحتوى المعدني للأوراق من عناصر (البروتونات والبسيكلوسوفور والبوتاسيوم وحمض الخليط والمنجنيز والزنك) فان أعلى قيم لتموز الأوراق من هذه العناصر كانت في معاملة النقع في (K-NAA) بتركيز 500 ملليجرام في النيتر لمدة 24 ساعة في كل المواسم. بغض النظر عن تأثير المعاملات، تحقق شتلات الكاكي المتعاطفة على الأصل 'البذيء' على الشتلات المطحنة على أصل 'الطبرليس' في جميع قياسات النمو الخضري والكتلة الحيوية للجذر. بينما توقفت الشتلات المطحنة على أصل 'الطبرليس' على الشتلات المطحنة على الأصل 'البذيء' في محتوى الورقة من البذريات والبسيكلوسوفور والمنجنيز والزنك.