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Analysis of the Effect of the Use of a Phytohormone on the Growth of Avocado Seedlings (*Persea Americana* Mill.). Case of (*Salix Babylonica* l.)

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Abstract

The objective of this study was to test the effect of the use of a plant-based hormone on the growth of young shoots of avocado (*Persea Americana* Mill.). The experiment consists in studying the effect of the phytohormone extracted from the branches of (*Salix babylonica* L.) on a number of growth parameters in avocado seedlings (*Persea americana* Mill.), obtained after sowing seeds in four different mixtures of substrates and raised in two different sites namely; the botanical garden and the breeding greenhouse. The growth parameters were tested: the number of leaves, the number of branches (New branches) and the height of the main stem. The results showed significant variations in the growth parameters of avocado seedlings between the different treatments and the two experimental sites. The best results were those obtained in avocado seedlings treated with phytohormone, planted in substrates: S3 (25% sand + 55% earth + 20%peat) and S4 (55% sand + 25% earth + 20% peat). For substrates S1 (80% earth + 20% peat) and S2 (80% sand + 20% peat), the difference between the results was not significant; the difference in growth between untreated and phytohormone-treated seedlings was found to be negligible.

Keywords: *Phytohormone; Growth; Substrates; Persea Americana Mill; Skikda.*

1. INTRODUCTION

Algeria has a growing interest in exotic fruits. The cultivation of exotic species in Algeria has attracted increasing interest in recent years due to the growing demand for unique and diverse flavors. Successful trials have been carried out for growing guava, lychee and passion fruit in some parts of the country. Although these crops are still limited, they offer new prospects and pave the way for increased diversification of Algerian agriculture.

It is important to note that the cultivation of exotic fruits in Algeria remains limited due to climatic conditions. However, with technological advances and investments in agricultural infrastructure, it is possible that the cultivation of exotic fruits will develop further in the future.

Algerian farmers, researchers and agricultural institutions are actively working to overcome challenges related to climate limitations, limited knowledge and expertise, and infrastructure constraints. Their objective is to promote the growth of the cultivation of exotic fruits in the country and to enhance the agricultural potential of Algeria.

The specific potential of certain regions and innovative agricultural practices have allowed the cultivation of various citrus fruits, dates, mangoes, papayas and pineapples. This diversification of agriculture provides economic opportunities for local farmers. With continued efforts and advances in agricultural practices, it can be expected that the cultivation

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of exotic fruits in Algeria will continue to develop and contribute to the agricultural landscape of the country.

Among these exotic species are avocado, the subject of our study. The avocado (*Persea Americana* Mill.), is a tropical tree of American continent; belongs to the family of lauraceae. This species of tropical origin adapts perfectly to climates. This species of tropical origin adapts perfectly to subtropical climates with mild winters. This species, which is the subject of an important crop in the United States, deserves further study of its behavior and its adaptability, propagation and production abilities in order to clarify its possible economic interest in the North-American orchard; African and especially the Algerian orchard.

For a profitable avocado orchard, better growth and good tree development are essential; these are only possible with a very good adaptation of the subjects with the climate and soil conditions. The use of new agricultural techniques and new biotechnological methods can help this species to better grow and produce under our climate; among these techniques, we proposed in our study the use of phytohormones.

We have proceeded to test the effect of treatment of young shoots of Avocado by a natural phytohormone on the growth of the aerial part (Stem, Ramifications and Leaves). Using different growing substrates and rearing media.

2. MATERIALS AND METHODS

2.1. Equipment Used

2.1.1. Biological Material

The trial focused on avocado seeds (*Pesrsea Americana* Mill.); collected locally from the exotic garden that is part of the botanical garden of the University of August 20, 1955- Skikda (Algeria).

2.1.2. Substrates

Three basic elements were used for the preparation of the mixtures to be used as growing substrates, which are ordinary earth, sand and peat. The three elements were mixed with different proportions giving rise to different substrates.

2.1.3. Phytohormone

The phytohormone used for our tests originates from the branches of the trees of the species: *(Salix babylonica* L.).

2.1.4. Non-organic Material

- Planting bags;
- Plastic lid;
- Trowel;
- Transplanter to fill planting bags;
- Manual watering can;
- Pelle.

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2.2. Working Methodology

2.2.1. Study Sites

Our experiment was carried out within the Department of Agronomy (Botanical Garden and Breeding Greenhouses) of the University of August 20, 1955 – Skikda.

The university 20 August 1955 is located on the former grounds of the regional school of agriculture. It is located south of the Wilaya of Skikda (formerly Philippeville), equidistant from the cities of Skikda and El Hadaiek (formerly Saint Anthony) about 2 km from these localities.

It is located in the part of the Zeramna Valley on the northern flank of M'siouene. It occupies an area of 246 ha and is limited by mountains and forests in the North, the EAC (Collective Agricultural Operation) No. 66 from the former DAS (Socialist Agricultural Estate) Beni Messous in the West, the EAC No. 2 from the former DAS Bedaï Chaabane in the East and the national road No. 3 in the South (Chalabi, 2014).

2.2.2. Period of Experimentation

The experiment was conducted during the period from mid-February to the end of June 2023. That is, a study period of more than four months (137 Days).

2.2.3. Conditions for Experimentation

We carried out our experimental study over several stages ranging from the preparation of the test conditions to the follow-up of the variables chosen for our study.

2.2.3.1. Seed Collection and Preservation

The seeds were collected locally in the university's botanical garden, extracted from their fruit and washed disinfected and stored in the freezer until use.

2.2.3.2. Preparation of Substrates

We used four types of substrates prepared from three basic elements, whichare:sand, ordinary earth and peat. The proportion of each of the basic elements in the mixture varies from substrate to substrate:

- **Substrate S1**: based on 80% ordinary earth and 20% peat.
- **Substrate S2**: based on 80% sand and 20% peat.
- **S3 substrate**: based on 55% soil, 25% sand and 20% peat.
- **Substrate S4**: based on 55% sand, 25% soil and 20% peat.

2.2.3.3. Planting of Seeds

Before planting, the preserved seeds are thawed, washed and dried in the open air. Sowing was carried out in plastic bags. For each type of culture substrate we have assigned 60 bags, a total of 240 bags for all substrates. Each bag contains 15 units (Shovels) of substrate. The bags were evenly distributed on the two experimental sites (Garden and Greenhouse).

After sowing the seeds, the bags were placed in the shade and watered three times a week.

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2.2.3.4. Preparation of the Phytohormone Solution

The origin of our phytohormone was indeed the species:*Salix babylonica* L. Commonly called the willow. Using sterile scissors, we collected young twigs that served samples rich in water and sap necessary for our experiment.

The collected twigs were the subject of a series of manipulations namely: sorting good twigs, cutting into small pieces, washing, and weighing the fresh material. The objective of the weighing was to determine the amount of fresh matter equivalent to the ratio: 1/3 of plant biomass per 2/3 of tap water of back volume equal to 5L.

The mixture: Willow twigs – Tap water was then macerated for 3 to 4 weeks in a container. After maceration we proceeded to a filtration of the mixture. The resulting solution was subsequently used for watering young avocado seedlings after germination of seeds.

2.2.4. Follow-up of the Test

During the period of our experimentation, we have well followed the growth parameters of the aerial part of the young shoots obtained. Biometric measurements of the average height of the main stems of the shoots, the number of leaves per plant and the number of branches took place on a daily and regular basis.

2.2.5. Processing and Analysis of Results Obtained

The results on the evolution of the height of the main stem and the number of leaves and twigs per treatment and per experimental site were analyzed quantitatively and another statistic aimed at showing the difference between the two different treatments adopted for our growth quality test, including the effect of phytohormone on the growth and development of young avocado.

3. RESULTS

The results obtained reflect the effect of hormonal treatment on the growth of young avocado plants. The effect of phytohormone appears from the comparison of the results of measurement of growth parameters retained for our study obtained in treated plants and those that have not undergone any treatment with phytohormone and this, in the two experimental stations (Breeding greenhouses/Botanical garden).

3.1. Effect of Phytohormone on Stem Growth

a. Breeding Greenhouse

Analysis of the results obtained, for the substrate 1 show that there is a significant increase in the stem height of avocado seedlings after the application of the phytohormone in most bags with an average of 07.21 cm with the exception of the bag n°: 12 that showed the same development of plants with and without hormonal addition.

For substrate 2, stem height values in Avocado seedlings reflect a clear improvement in stem growth in seedlings that have been watered by hormonal solution, in the majority of planting bags except for bags: 3; 4; 5; 7; 9 where almost the same values were noted with and without hormonal treatment. The average height of the main stem of the treated young shoots was about 05.31 cm.

The application of the phytohormone from the willow tree also had a remarkable effect on the growth of the stems of the young shoots in almost all the planting bags with the exception

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of bags 2 and 3, which had a neutral reaction vis-à-vis with regard to hormonal therapy. The average height of the stems we recorded was: 04.72cm. The results of watering the plants with the phytohormone solution were also representative for the plants raised on the bags containing substrate 4; we recorded an average height of stems of the order of 02.87 cm. The results of bags n°: 2; 6; 8; and 14 were less representative.

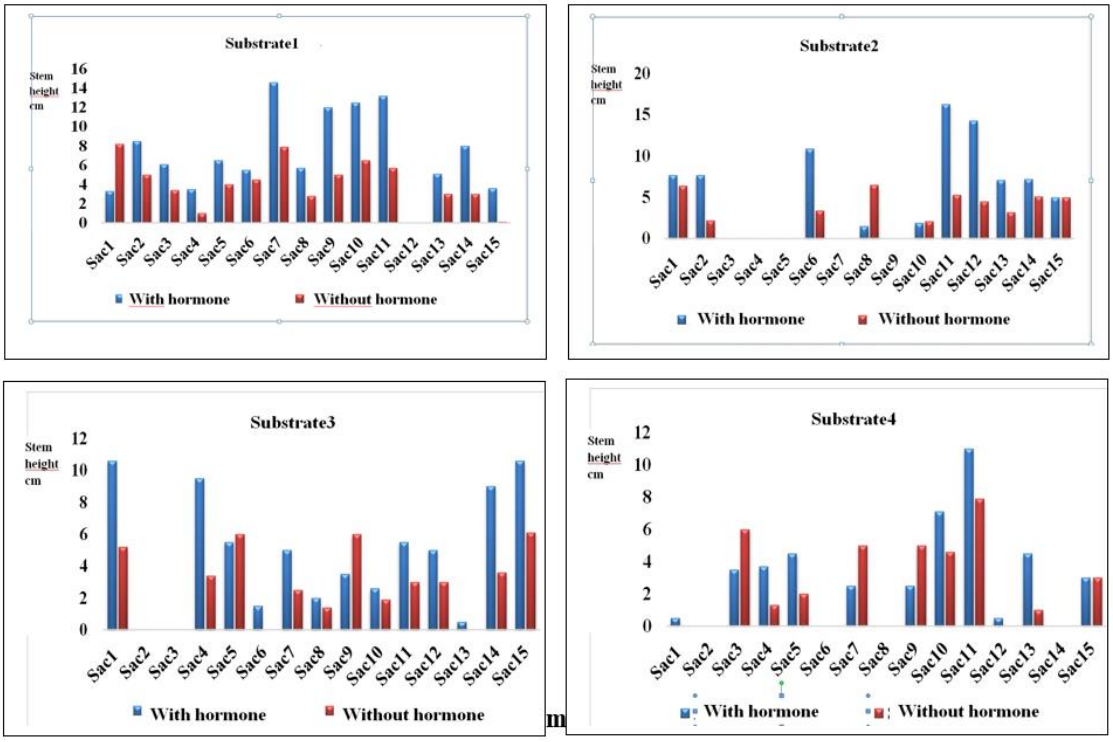

Figure 01: Effect of Hormone Treatment on Stem Growth of Avocado Seedlings (*Presea Americana* Mill.) Grown in the Greenhouse in the Four Substrate Mixtures

b. In the Botanical Garden

In general, analysis of the data collected from the experimental tests carried out in the botanical garden showed that there is no significant difference between the seedlings raised in the different planting bags on the four growing substrates. The height of the main stem was substantially the same and the average height is significantly less representative than that recorded in seedlings raised in greenhouse (Figure 2).

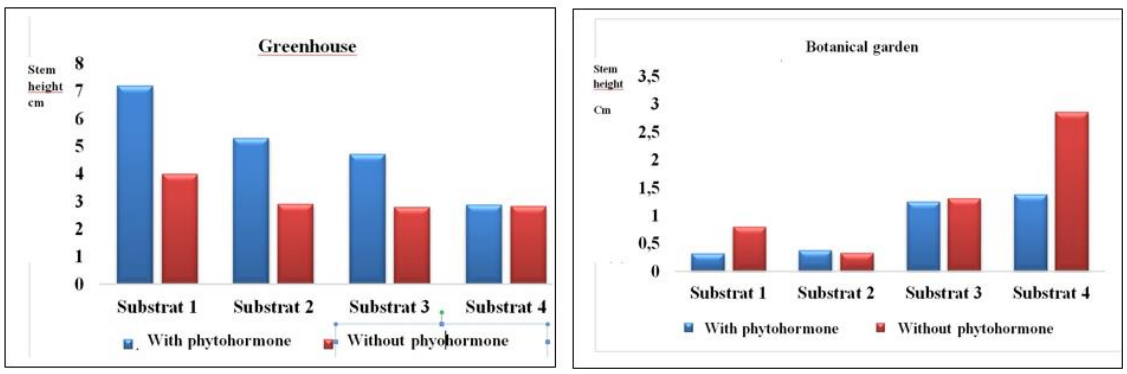

Figure 02: Comparison of Stem Growth in Avocado Seedlings with and without Hormonal Treatment in Greenhouse and Botanical Gardens

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3.2. Effect of Phytohormone on Leaf Count

a. Breeding Greenhouse

Analysis of the data collected for substrate 1 shows that there is a significant increase in the number of leaves per plant after phytohormone application in the majority of planting bags with an average of 2. In the bags: 4; 7; 10; 12; 13 and 15; plants treated with phytohormone and plants that did not undergo hormonal treatment had the same development, the reaction of the seedlings to the application of the hormonal solution was neutral. For substrate 2; the number of leaves per plant was also positively affected by phytohormone. The number of leaves in seedlings watered with hormonal solution was higher than in seedlings watered with plain water. Results were less representative for substrate 3. The difference between treated and untreated seedlings was not significant. The average number of leaves per seedling was generally relatively acceptable at 3.26. As for substrate 4, the bags watered with hormonal solution showed a remarkable superiority of the results obtained in comparison with the bags that were watered with ordinary water. The average number of leaves per Avocado seedling was of the order of: 2.53.The bags: 1; 2; 6; 8; 12 and 14 showed no difference in seedling behavior compared to different watering solutions; the number of leaves was almost the same (Figure 3).

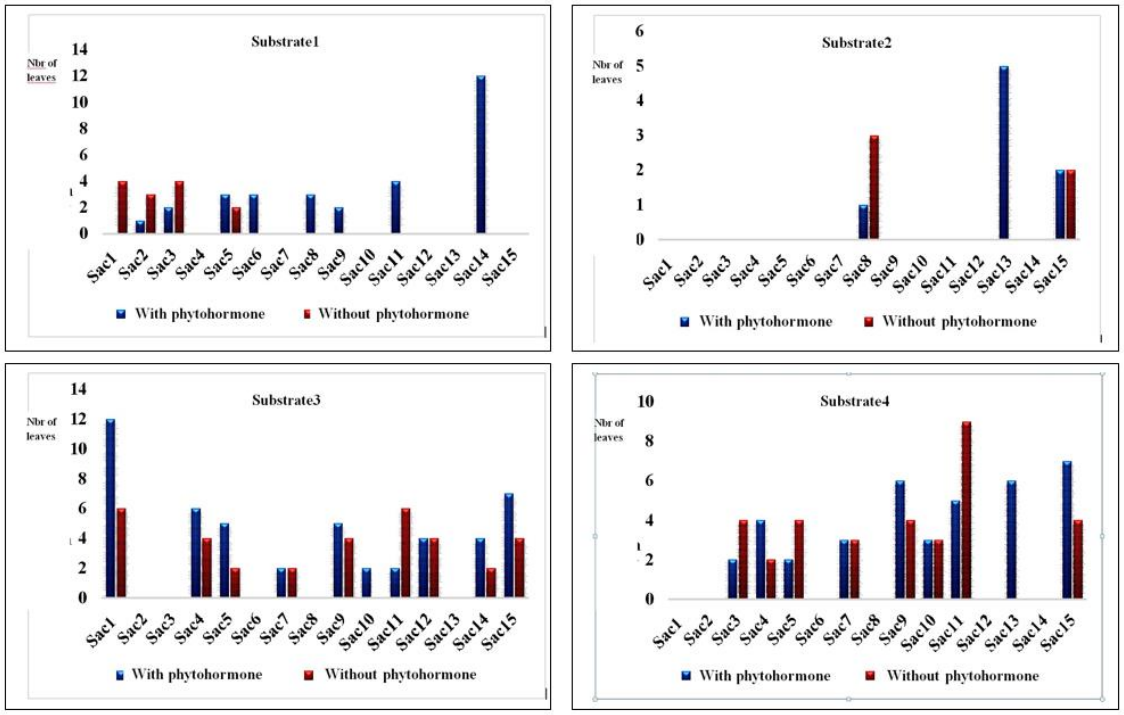

Figure 03: Effect of Hormonal Treatment on the Number of Leaves of Avocado Seedlings (*Presea Americana* Mill.) in the Four Substrate Mixtures

b. In the Botanical Garden

Examination of the results collected during our experimental test carried out at the botanical garden, showed that there is no development in the number of leaves of the seedlings followed in the four substrates after the application of plant phytohormone in the majority of bags; except in substrate 3 where we noticed a significant increase in the number of leaves in bags 11 and 9; and bags 10 and 2 containing substrate 4. The results obtained related to the evolution of the number of leaves per Avocado seedling according to hormonal treatment and

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substrate type were significantly more representative of the seedlings raised in greenhouse compared to those raised in the botanical garden (Figure 4).

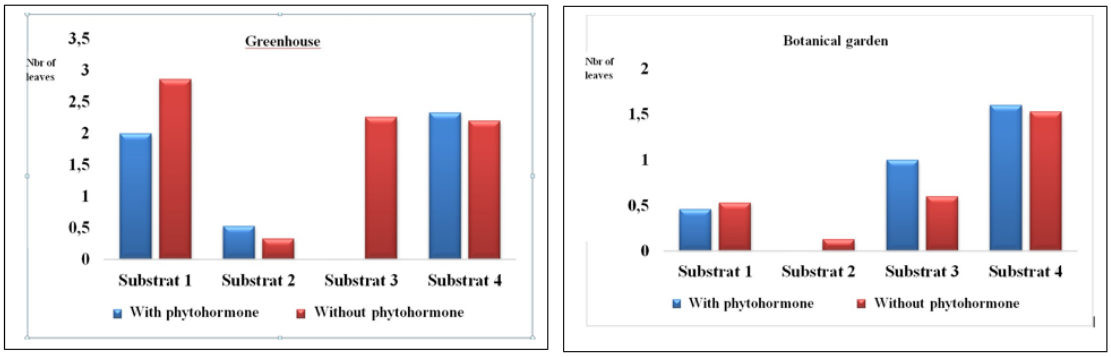

Figure 04: Comparison of the Evolution of the Number of Leaves of Avocado Seedlings with and without Hormonal Treatment in Greenhouse and Botanical Garden

3.3. Effect of Phytohormone on the Number of Branches

The results of the monitoring of the evolution of the number of branches under the effect of the phytohormone in the two experimental stations show that there is no significant difference of growths and with application of the phytohormone and this, in most substrate mixtures with the exception of substrate 3 (bags 6 and 13) and substrate 4 (bags 1 and 12) which showed a slight increase in the number of branches in seedlings watered by phytohormone solution at both stations with an average of: 0.2. Almost none of the young shoots of Avocado had emitted branches on the main stem; the number of twigs for the majority of treatments and experimental sites was of the order of 0. The reaction of the seedlings towardsthe application of the hormonal solution, the substrate type and rearing medium were neutral (Figure 5).

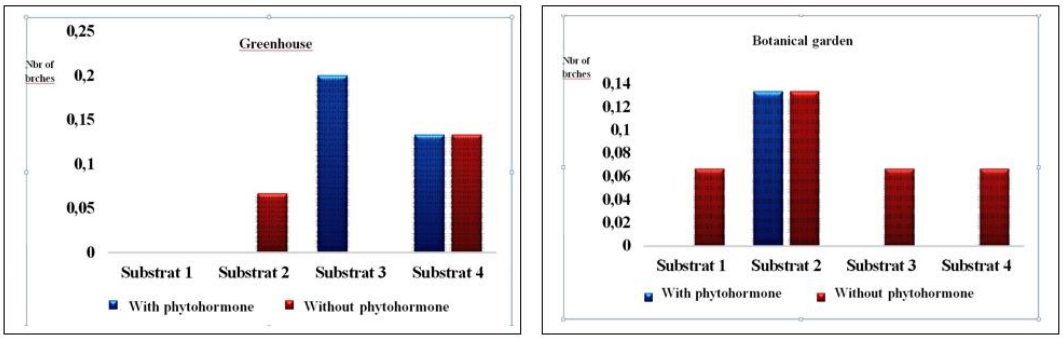

Figure 05: Comparison of the Evolution of the Number of Branches of Avocado Seedlings with and without Hormonal Treatment in Greenhouse and Botanical Garden

4. DISCUSSION

Breeding Greenhouse

The experiment consisted in studying the effects of a phytohormone on the growth of avocado plants in different substrates. The results show interesting variations in growth before and after the use of phytohormone, depending on the substrates used in the greenhouse. In substrate 1, no significant difference was observed between growth with and without phytohormone application. This suggests that the use of this phytohormone has not had a

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significant impact on avocado growth in this context. It is possible that the physico-chemical quality of substrate 1 has already promoted optimal growth, which limits the effect of phytohormone. In substrate 2, similar results were observed, with the exception of bag 10 where an improvement in growth was observed before the application of phytohormone. This may indicate that bag 10 had less favorable initial parameters for avocado growth, and that the introduction of phytohormone helped to improve its growth. However, the difference observed in the other bags of substrate 2 was not significant, suggesting that the growing conditions were already optimal in these cases.

In substrate 3, a significant increase in growth was observed after the addition of phytohormone, especially in bags 6 and 13. These results suggest that phytohormone has played a positive role in stimulating avocado growth in this specific substrate. It is possible that the physicochemical quality of substrate 3 was less favorable to the growth of Avocado, and that the addition of phytohormone helped to overcome these constraints and promote increased growth. In substrate 4, growth increased after the application of phytohormone in bags n° :10 and 2, but growth was better before the addition of phytohormone in bah n° : 12. This observation suggests that the complex interactions between the initial parameters of substrate, the chemical composition of the phytohormone and the response of the avocado can vary considerably. Although growth was improved in bags 10 and 2 after the addition of phytohormone, bag 12 showed a different response, with better regrowth before the application of phytohormone.

5. CONCLUSION

The overall objective of this experiment is to evaluate the effect of the application of plant phytohormone on the growth of avocado seedlings (*Persea americana* Mill.); which was carried out in the breeding greenhouse of the University of Skikda and in the botanical garden. The results of this study indicate that the effects of phytohormone on the growth of avocado depend closely on the initial parameters of the substrate. In some cases, the addition of phytohormone resulted in a significant improvement in growth, while in other cases, no significant effect was observed. These results underline the importance of taking into account the complex interactions between environmental factors and chemicals in the study of plant growth and the effectiveness of phytohormones. Further research is needed to further understand the underlying mechanisms and optimize the use of these phytohormones to promote plant growth.

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