Influence of Garlic Powder and GA_3 on Growth Traits of Orange Seedlings

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Abstract

The study was carried out on orange seeds of local cultivar under plastic house condition in the Shamamk area, Erbil, Iraq, to investigate the influence of substituting Gibberellic Acid (GA_3) powder with garlic powder to promote the growth of orange seeds, providing a natural and cost-effective alternative and to investigate the comparative influence of different rooting media on the rooting development of orange seeds using easily accessible local materials for large-scale production of healthy and high-quality orange seedlings. In this experiment, a total of 81 orange seeds were randomized and assigned to three treatment groups: control, garlic powder, and GA_3 powder. Each group was further subdivided and cultivated in three growing media: soil, peatmoss, and a mixture of soil and peatmoss, with three replications per treatment. Results showed that seeds treated with Garlic powder had a superior impact on rooting characteristics such as: seed germination, root length, and fresh and dry weight of roots. However, GA_3 recorded the best value of plant height since it is mostly used as a plant elongation hormone. Furthermore, the rooting medium (soil+peatmoss) reduced mortality, plant height, root length, and fresh and dry weight of roots. Whereas, the rooting medium (peatmoss) enhanced plant area, and fresh and dry weight of leaves.

Keywords: Citrus fruits, Orange, GA_3, Garlic, Plant extracts, Rooting media.

Introduction

Citruses (Citrus spp.) are widely grown as fruit crops due to their rich, tasty flavor and notable nutritional value, contributing to a global production that has surpassed 157 million tons annually. They belong to the Rutaceae family, which has about 1300 species [16]. Oranges (Citrus sinensis) are commonly consumed and valued for their pleasing taste and several health-promoting components, including heteropolysaccharides, phenolics, ascorbic acid, and folate. They come in fifth place in the world for fruit crop production, with global production reaching 48.8 million tons. At present, China, Brazil, and the United States of America are the top three regions that produce oranges [12]. Oranges are mostly eaten as fresh fruit, slim dry slices, or concentrated juice; both orange-juice-producing industries and consumers often dispose the seeds [1].

Garlic (Allium Sativum) is an extract with a high nutritional value containing about 200 biochemical components, including antioxi-dants and vitamins, as well as a large number of enzymes [11]. Particularly, high levels of Sulfur and volatile chemicals, such as Vinyl-dithiines, Ajoene, Aliin, Allicin, Allylpropyl, Diallyl, Sallylcysteine, Sallylmercaptocystei-ne, and Trisulfide, are among its constituents. It is also recognized as a source of antioxida-nts, flavonoids, vitamins, including the B complex and C, and minerals like Se, P, and K [2].

As a growth regulator, garlic promotes better growth and lowers the death rate. Significant-ly, prominent alkaloids found in it including Allicin, Allyl disulphide, Diallyl sulphide, sulphuric compounds, and Allin.

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Moreover, bioactive compounds found in garlic consist of anti-oxidative, anti-microbial, and anti-hypertensive characteristics [5]. It is worth noting that, given its substantial antifungal behavior and anti-microbial characteristics, garlic is quite beneficial [13].

Gibberellic Acid (GA_3) is a hormone that reg-ulates plant growth properties by stimulating various plants developmental processes like seed germination, blossoming, division of cells, initiation of roots, and so forth. It influences a number of physiological and biochemical activities in plants, particularly in environments where plant development is challenged [3]. Furthermore, it functions to break dormancy and boost the rate at which seeds from a variety of species germinate [10].

Previous studies have demonstrated that nat-ural compounds and organic rooting agents, such as garlic extract, have a profound influe-nce on the improvement of root formation in horticultural crops [14]. In citrus seedlings, the application of garlic extract has been shown to significantly enhance the number of leaves, leaf area, and dry weight of the veget-ative organs [6]. Likewise, GA_3 plays a critical role in breaking bud dormancy and activating essential physiological processes, including stimulating cell division and increasing cell elongation, which collectively contribute to increased plant height [9].

The aim of this study is to substitute GA_3 with garlic powder to promote the growth of orange seedlings, providing a natural and cost-effective alternative and to investigate the comparative influence of different rooting media on the rooting development of orange seeds using easily accessible local materials for large-scale production of healthy and high-quality orange seedlings.

Materials and Methods

The study was carried out on orange seeds of local cultivars. Seeds were taken from local mature orange trees aged over 25 years in early December 2022, located in our house garden, Erbil, Kurdistan region. The experiment was conducted during the period October 17th 2023 – March 6th 2024 under plastic house condition in Shamamik area, located 21 kilometers southwest of Erbil, Kurdistan region, Iraq. The coordinates of the site are: N 36°1'7.1094" Latitude, E 43°54'51.68628" Longitude, with an Altitude of 1096 ft above sea level.

In this study, field soil was taken from Grdarasha (Collage of Agricultural Engineering Sciences Field) then sieved, the stone, gravels, and weeds were removed manually. Moreover, a total of 81 orange seeds were collected and randomized. They were then divided into three equal groups, each containing 27 seeds. Two of these groups were exposed to different treatments: one group was treated with garlic powder, while the other was treated with Gibberellic Acid (GA_3) powder. The third group functioned as the control and received no treatment. Following treatment, each group of seeds was further divided into three sub-groups, each containing 9 seeds. These sub-groups were then planted in different growing media: soil (S), peatmoss (P), and a mixture of soil and peatmoss (S+P). Finally, each treatment and growing medium combination has three replications and each pot is considered as an experimental unit which contains 3 seeds. Also, peatmoss is used as a growing medium beside soil. The study was conducted from October to February. Average monthly temperature ranged from 17.4°C in January to 27.4°C in October, while relative humidity varied between 68.4% and 80.3%, peaking in January and lowest in October. The experiment was laid out as factorial in the form of a Randomized Complete Block Design (RCBD) including three treatments of control, garlic powder and Gibberellic Acid (GA_3) powder with three replications.

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After 3 months of planting, we measured the following measurements, Seed germination (%), mortality (%), leaves per plant. leaf area per plant (cm^2). leaf fresh and dry weight (g). shoot length (cm). shoot thickness (cm). root length (cm). root fresh and dry weight (g). However, the treatments were **T1:** Control (0) **T2:** Garlic (powder) **T3:** Gibberellic Acid (powder). Data were tabulated and statistically analyzed with a computer using SAS program [15]. The variation between various treatment means were tested with Duncan Multiple Range test at the $P< 0.05$ level [4].

Results and Discussion

Results obtained from table (1) and illustrated in graph (1) revealed that there were no significant differences between seeds treated with Gibberellic Acid (GA_3), Garlic treatments and control on seed germination, mortality, leaf area, leaf per plant, shoot thickness, fresh and dry weight of leaves, and fresh and dry weight of roots. However, seeds treated with GA_3 produced the tallest plants, with a mean height of 23.26 cm, in comparison with 9.45 cm in the control and 5.5 cm in the garlic treatment, indicating superior growth. On the other hand, seeds treated with GA_3 recorded the lowest mean root length of 12.63 cm compared to 14.65 cm in the control and 15.41 cm in the garlic powder treatment.

Table 1. The effect of Garlic powder with GA_3 on Orange seeds growth

Treatments	Parameters										
	Seed germ. (%)	Mortality (%)	Leaf area (cm2)	Leaf per plant	Plant height (cm)	Shoot thickness (mm)	Root length (cm)	F.W. Leaf (g)	D.W. Leaf (g)	F.W. Root (g)	D.W. Root (g)
Control (wate)	1.66 a	2.05 a	4.11 a	9.83 a	9.45 b	2.09 a	14.65 a	0.52 a	0.17 a	0.31 a	0.21 a
Garlic	1.83 a	2.22 a	3.76 a	9.5 a	5.5 b	1.51 a	15.41 a	0.28 a	0.12 a	0.33 a	0.24 a
GA_3	1.77 a	1.8 a	3.84 a	10.05 a	23.26 a	1.63 a	12.63 b	0.26 a	0.1 a	0.25 a	0.11 a

Means of each factor and their interactions followed by the same letters are not significantly different from each other, according to Duncan's multiple ranges test at 5% level

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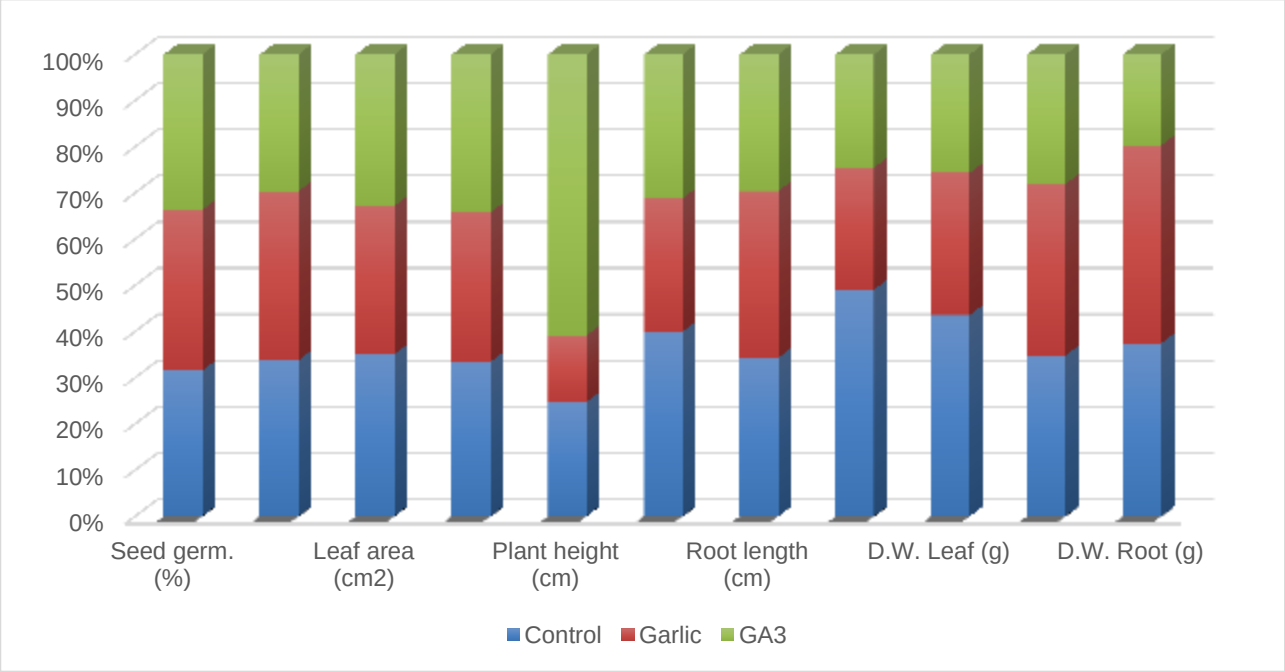

Graph 1. The effect of Garlic powder with GA_3 on Orange seeds growth

Outcomes gained from table (2) and demonstrated in graph (2) showed that there were no significant differences between seeds cultivated in soil, peatmoss and soil+peatmoss on seed germination, seedling mortality, leaf area, plant height, shoot thickness, leaves fresh and dry weight, and roots fresh and dry weight. Nevertheless, seeds cultivated in soil exhibited the greatest mean number of leaves per plant at 12.16 compared to 7.69 in peatmoss and 9.52 in the soil+peatmoss mixture. In contrast, seeds planted in peatmoss had the minimum mean root length of 11.81 cm, whereas those in the soil+peatmoss combination showed the maximum at 17.31 cm, compared with 13.57 cm in soil.

Table 2. The effect of rooting media on orange seeds growth

Growing Media	Parameters										
	Seed germ. (%)	Mortality (%)	Leaf area (cm2)	Leaf per plant	Plant height (cm)	Shoot thickness (mm)	Root length (cm)	F.W. Leaf (g)	D.W. Leaf (g)	F.W. Root (g)	D.W. Root (g)
Soil	1.77 a	2.33 a	3.31 a	12.16 a	14.61 a	1.91 a	13.57 b	0.16 a	0.07 a	0.26 a	0.15 a
Peatmoss	1.72 a	2.16 a	4.72 a	7.69 b	8.91 a	1.91 a	11.81 c	0.56 a	0.21 a	0.26 a	0.18 a
Soil+ Peatmoss	1.77 a	1.66 a	3.69 a	9.52 ab	14.69 a	1.42 a	17.31 a	0.34 a	0.11 a	0.37 a	0.22 a

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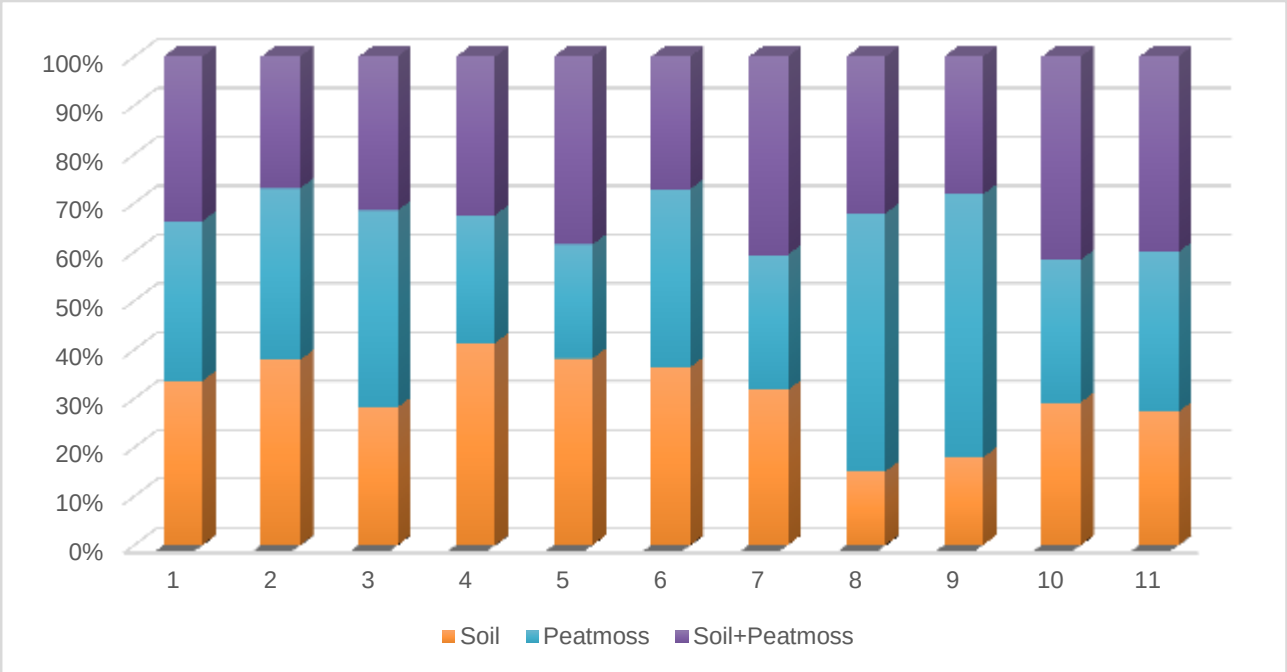
Means of each factor and their interactions followed by the same letters are not significantly different from each other, according to Duncan's multiple ranges test at 5% level



Graph 2. The effect of rooting media on orange seeds growth

The results acquired from our research disclosed that the use of Garlic powder treatments had a positive influence on seed germination and root formation generally, more specifically, root length, and fresh and dry weight of roots. Our results were in agreement with results recorded earlier by [8] who found that Garlic powder stimulated root formation and growth quality of ornamental plants. Also, [14] concluded that natural compounds and organic rooting elements such as Garlic powder had a profound influence on the improvement of root formation of horticulture crops. Notably, garlic acts as an effective growth regulator, promoting better growth due to its bioactive compounds, such as allicin, allyl disulphide, and diallyl sulphide, which exhibit strong antioxidant, antimicrobial, and antifungal properties that contribute to its beneficial effects.

Furthermore, in our study results showed that the usage of GA_3 powder caused the greatest impact on overall plant growth characteristics, particularly plant height since GA_3 is mostly used as a plant elongation hormone. Such results were in agreement with results found previously by [9] which revealed that GA_3 enhanced the vegetative growth characteristics and caused substantial rises in the number of leaves. Similarly, [7] discovered that gibberellin hormones can affect growth parameters and accelerate reproduction of pineapple seedlings. Importantly, GA_3 regulates overall plant growth by stimulating various developmental processes, particularly plant height, as it primarily acts as a plant elongation hormone. It also influences physiological and biochemical activities, enhancing vegetative growth and increasing leaf number.

Conclusions

Based on the results that have been reached, we concluded that: Garlic powder was shown to be comparable to Gibberellic Acid (GA_3) powder in terms of improving rooting

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characteristics in general such as: seed germination, root length, and fresh and dry weight of roots. However, GA_3 had the best effectiveness on other plant growth characteristics, especially plant height since it is mainly used for plant elongation hormones. Moreover, the rooting medium (soil+peatmoss) reducced mortality, plant height, root length, and fresh and dry weight of roots. Finally, the peatmoss rooting medium improved leaf area, as well as fresh and dry weight of leaves.

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