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Using Some Natural Substances and Wounding to Enhance Fig Cutting Rooting and Vegetative Characteristics

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ABSTRACT
The success of propagation by cutting depends on stimulating root development. Therefore, this study's objective was to determine the effects of three natural substances (Turmeric, Cinnamon, and Licorice in powder form and control) with wounding the cuttings from the basal of the cutting at two different levels of 1 and 2 cm on the vegetative and root properties of" Rizhawi" fig cuttings. The results showed that using turmeric and cinnamon with 1 or 2 cm basal wounding was better than the control. Generally, they recorded the highest root and vegetative characteristics than the other treatments. For the wounding impact, the 2cm basal wounding significantly enhanced root and vegetative characteristics compared to the 1 cm basal wounding. Cuttings treated with turmeric and 2cm basal wounding recorded the significantly highest results in both vegetative characteristics such as (shoot number, leaves number, shoot length, shoot diameter, leaf area, wet vegetative weight, and dry vegetative weight of fig cuttings) and root characteristics such as (root number, root length, root diameter, wet root weight, and dry root weight of fig cuttings) compared to the control. Therefore, turmeric can be advised, followed by cinnamon, and then licorice following organic farm regulations.

إستخدام بعض المواد الطبيعية والتجريح لتحسين تجذير وخصائص النمو الخضري لعقل التين

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الخلاصة
يعتمد نجاح الإكثار بالعقل على تحفيز نمو الجذور. لذلك تهدف هذه الدراسة الى تحديد تأثير ثلاث مواد طبيعية (الكركم والقرفة والعرق سوس على شكل مسحوق والمقارنة) مع تجريح قاعدة العقل على مستويين مختلفين 1 و2 سم على الخصائص الخضرية والجذرية لعقل تين "ريَذاوي". أظهرت النتائج أن استخدام كل من الكركم والقرفة مع تجريح 1 أو 2 سم في القاعدة كان أفضل مقارنة بمعاملة المقارنة، وبشكل عام سجلا أعلى خصائص جذرية وخضرية من المعاملات الأخرى. بالنسبة لتأثير التجريح، فإن التجريح القاعدي بطول 2 سم حفز بشكل معنوي خصائص الجذرية والخضرية مقارنة بالتجريح القاعدي بطول 1 سم. سجلت القطع المعاملة بالكركم وجرح قاعدي 2 سم أعلى النتائج بشكل ملحوظ في كل من الصفات الخضرية مثل (عدد الأفرع وعدد الأوراق وطول الأفرع وقطر الأفرع ومساحة الأوراق والوزن الخضري الرطب والوزن الخضري الجاف لقطع التين) وخصائص الجذور مثل (عدد الجذور وطول الجذور وقطر الجذور والوزن الجذري الرطب والوزن الجذري الجاف لقطع التين) مقارنة بالشاهد. لذلك يمكن نوصي باستخدام مسحوق الكركم يتبعها القرفة من ثم عرق السوس وفقًا لنظام المزارع العضوية.
الكلمات المفتاحية: الكركم ، القرفة، عرق السوس، عقل التين.

INTRODUCTION

Ficus carica L. fig tree is widely distributed around the world. It's one of the major economic plants regarded as valuable since it can increase the variability of climatic conditions and soil types (Rodrigues et al., 2012). Hardwood cuttings are typically obtained from the basal and median regions of the branches (Karadeniz, 2003; Sousa et al., 2013). Low rooting of hardwood cuttings may be caused by exogenous factors like the cutting's growing environment or intrinsic factors like the age of the tissue, time of cutting collection, and phytohormone concentration (Han et al., 2009).

There is a desire to propagate cuttings with alternative rooting hormones that encourage rooting because synthetic rooting hormones like indole-3-acetic acid (IAA) and indole-3-butyric acid (IBA) are getting more expensive and harder to obtain (Dunsin et al., 2016). The novel method for enhancing the yield, fruit quality, and storage potential of fruit crops was a natural plant extracts use. Use completely natural compounds like turmeric, cinnamon, and licorice root in powder form instead of synthetic rooting hormones because they are both safe and affordable.

Turmeric (*Curcuma longa*) is a perennial herbaceous plant. The 2 to 9% curcuminoids found in the turmeric rhizome, which is comprised of 60% curcumin and produces vanillin, are present. The extract of turmeric contains a lot of essential oils, pigments, arabinogalactan, potassium salt, and carbs (of which 50% are starch). Curcumin's free radical scavenger effect, specifically the hydroxyl radical, prevents DNA damage and inhibits lipid peroxidation (Srimal, 1997; Alonso, 2004). The increased concentration of curcumin, a yellow coloring pigment, and volatile oils in turmeric (Peter, 1999) motivate researchers to conduct several studies to employ it as a significant plant extract. Fruit trees' development and fruiting are stimulated by turmeric extract's higher level of antioxidants, particularly phenolic compounds, minerals, and plant pigments (Srimal, 1997; Pons, 2003). Additionally, Aljabary et al. (2023) reported that spraying pomegranate trees with turmeric extract significantly increased the leaf area and the leaf dry mass as compared to the control. One of the most significant medicinal plants cinnamons (*Cinnamomum verum*) has a high concentration of chemically active substances. Pilot oil, cinnamon aldehyde, cinnamyl alcohol, cinnamic acid, cinnamyl acetate, tannin, eugenol, and minerals are among the active chemicals found in cinnamon, which is a significant medicinal plant (Sharma & Nautiyal, 2009). According to Xing et al. (2010), cinnamon powder is thought to have a great deal of promise as an organic control agent, and as a rooting agent that may help plants form roots. In a bottle brush plant, rooting behavior was enhanced by mixing the growth regulators solution with cinnamon extract (IBA + NAA + cinnamon) instead of growth regulators alone (Hameed & Adil, 2019).

One of the richest sources of physiologically active substances, including phenolics and flavonoids, is the root of licorice (Glycyrrhiza glabra). Because they can quench free radicals due to hydroxyl groups, phenolics are a group of antioxidant chemicals that are particularly important for plants (Elmastas et al., 2006). According to Aljabary

and AL-Jabari (2021), Salakhani pomegranate cuttings treated with antioxidants and licorice root extract had longer shoots and roots, vegetative and root dry weight, and larger leaves than the control. Moreover, Alsalhy, and Aljabary, (2020) indicated that spraying with 2.5 g l^{-1} of licorice root extract significantly increased leaf area and chlorophyll content. Wounding has been demonstrated to promote the rooting of jackfruit stem cuttings (Chatterjee & Mukherjee, 1983). It is thought to encourage cell proliferation, the formation of root tissue, and higher absorption of applied growth regulators. Hartmann et al. (1990) indicated that after the wounding process is complete, a callus form, and subsequently, dense roots grow along the location of the wound.

Cutting propagation success depends on stimulating root development. Natural root stimulators are sustainable, biodegradable, and environmentally friendly tools. To be the natural substances easy to use and more attention by farmers. Therefore, this study's objective was to determine the effects of three natural substances (Turmeric, Cinnamon, and Licorice) on wounding the cuttings from the basal at two different levels as long as 1 and 2 cm on the root and vegetative characteristics of" Rizhawi" fig cuttings.

MATERIALS AND METHODS

The experiment was conducted in the Chamchamal Research Station, Agricultural Research Center greenhouse in Sulaimani governorate, Iraq Kurdistan Region, in March 2022.

The investigation was conducted to show the impacts of some natural substances such as Turmeric, Cinnamon, and Licorice in powder form on the rooting and some vegetative characteristics of" Rizhawi" fig cuttings, with wounding the cuttings from the basal at two different levels as long as (1cm and 2cm) by using a sharp sterile blade. The hardwood of fig cuttings Rezhawi cultivar prepared from vigor and disease-free branches of mature trees (6) years old plants, uniform length 30 cm and a diameter ranging from 20 to 23 mm, from a private orchard in Halabja City. The base of the cuttings was previously dipped according to the wounding levels (1 and 2cm) in distilled water for 10 seconds (quick dip) and then dipped in natural substances in powder form (turmeric, cinnamon, and licorice), while the control treatment was treated with distilled water only (Turmeric + 1 cm wounding, Turmeric + 2 cm wounding, Cinnamon + 1 cm wounding, Cinnamon + 2 cm wounding, Licorice + 1 cm wounding, Licorice + 2 cm wounding, Control + 1 cm wounding and Control + 2 cm wounding). After that, the cuttings were immediately planted in polyethylene bags filled with sand and farm yard manure (FYM) as a rooting medium in a ratio of 2:1 respectively.

Plant extract powder preparation:

The powders were prepared by grinding 250 g of the following natural substances (Cinnamon, Turmeric, and Licorice root) fresh using an electric mill and then placing them in separate containers until used.

Studied Properties

In late August 2022, some parameters were taken from the cuttings such as root length (cm), root number, root diameter (mm), shoot length (cm), shoot diameter (mm), shoot number, leaf area (cm^2) ten leaves from each replicate were randomly collected to estimate leaf area using Image J software as mentioned by Aljabary et al., (2023), the portable device (SPAD-502 PLUS/KONICA MINOLTA /Japanese company) was used to measure the chlorophyll content in leaves. Vegetative and root dry weights were measured.

Statistical analysis

The treatments were duplicated three times using the randomized complete block design. The data were analyzed using XLSTAT software for variance and the Duncan test was used to compare means at 0.05.

RESULTS AND DISCUSSION

Although the root number in the fig seedlings in the current study did not significantly differ between the turmeric or cinnamon + 2 cm basal wounded compared to the control, they significantly differ with all other treatments. But, the cinnamon and control with a 1 cm basal wound had the lowest number (see Figure 1A).

The results in (see Figure 1B) demonstrate that cuttings treated with turmeric or cinnamon with 1 or 2 cm basal wound had root lengths longer than those treated with the other treatments. Cuttings treated with licorice plus a 2 cm basal incision had the shortest root length among natural substances treatments. Natural substances and basal wounding had

a considerable impact on the fig seedlings' root diameter (see Figure 1C). The results demonstrated that the maximum root diameter was substantially larger in the cuttings treated with turmeric or cinnamon + 1 or 2 cm basal wounded than the control and licorice. As for the results of the current study, seedlings treated with turmeric or cinnamon + 2 cm basal wounded had wet root weight/g and dry root weight/g that were noticeably higher than control seedlings + 1 or 2 cm basal wounded. Figures 1D & E demonstrate that compared to all other treatments, the seedlings resulting from control cuttings with 1 cm basal wound had the lowest wet root weight/g and dry root weight/g. Data in (see Figures 1A, C, D, and E) showed, that the cuttings basal wounding with 2 cm significantly increased the root number, root diameter, wet root weight/g, and dry root weight/g as compared to cutting wounded with 1 cm.

Natural substances and basal wounding had a considerable impact on the fig seedlings' root diameter (see Figure 1C). The results demonstrated that the maximum root diameter was substantially larger in the cuttings treated with turmeric or cinnamon + 1 or 2 cm basal wounded than the control and licorice. According to the results, seedlings that were created in cuttings treated with turmeric or cinnamon + 2 cm basal wounded had wet root weight/g and dry root weight/g that were noticeably higher than control seedlings with 1 or 2 cm basal wounded. Figures 1D & E demonstrate that compared to all other treatments, the seedlings resulting from control cuttings with 1 cm basal wound had the lowest wet root weight/g and dry root weight/g. In the current study, though there was no significant difference between the natural substance treatments for the shoot number of fig seedlings, there is 2 cm basal wounded seedlings showed higher significance than the 1 cm, but the lowest number was shown in the control +1 cm basal wounded (see Figure 2A). The comparison of mean by the Duncan test revealed that the cuttings treated with turmeric or cinnamon + 2 cm basal wounded had significantly higher leaves number/cuttings than all other treatments, but the lowest number showed in control + 1 cm basal wounded (see Figure 2B).

Cuttings treated with turmeric or cinnamon + 1 or 2 cm basal wounded had a significantly higher shoot length than the rest. Among natural substance treatments, a greater shoot length was achieved with turmeric + 2 cm basal wounded (see Figure 2C). The shoot diameter of fig seedlings was significantly influenced by natural substances and basal wounding (see Figure 2D). The results showed that the cuttings treated with turmeric or cinnamon + 2 cm basal wounded had a significantly higher shoot diameter than the control treatments, especially with control cuttings 1 cm basal wounded.

The results showed that the leaf area of cuttings treated with all plant extracts + 1 cm basal wounded had a significantly higher leaf area than the control cuttings with 1 cm basal wounded. Also, cuttings treated with turmeric or cinnamon + 2 cm basal wounded had a significantly higher leaf area than the control cuttings with 2 cm basal wounded. Amongst natural substance treatments, a greater leaf area was achieved with cinnamon + 1 cm basal wounded (see Figure 2E). Plant extract and basal wounding had a substantial impact on the leaf chlorophyll content (SPAD) of fig seedlings (see Figure 2F). The findings demonstrated that cuttings treated with turmeric plus 1 cm basal wounded had the highest chlorophyll content that was significantly higher than control treatments and all other treatments.The findings of the current study showed that the seedlings resulting from cuttings treated with turmeric or cinnamon + 2 cm basal wounded had considerably greater wet vegetative weight/g and dry vegetative weight/g than the control seedlings with 1 or 2 cm basal wounded. Figure 2 G & H shows that seedlings treated with turmeric plus a 1 cm basal wound had considerably higher dry vegetative weight/g than the control seedlings with a 1 or 2 cm basal wound.Results in (see Figures 2 A, B, C, D, E, F, G, and H) showed, that the cuttings basal wounding with 2 cm significantly increased in all vegetative properties as compared to cutting wounded with 1 cm except leaf chlorophyll content.

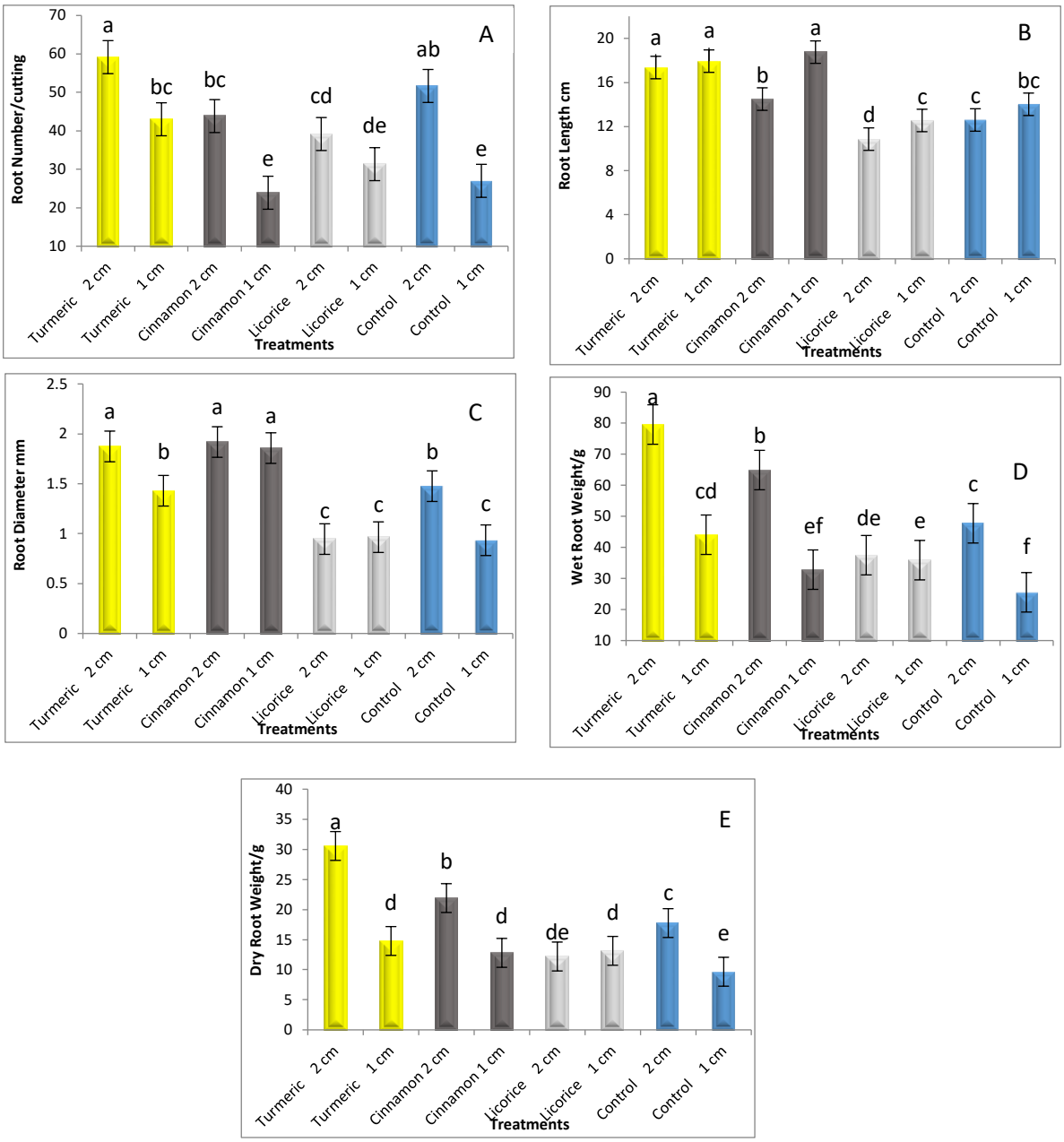

Figure 1. Effect of Natural Substances and Wounding on Root Characteristics, (A) Root No., (B) Root length, (C) Root Diameter, (D) Wet Root Weight, and (E) Dry Root Weight of Fig Cuttings

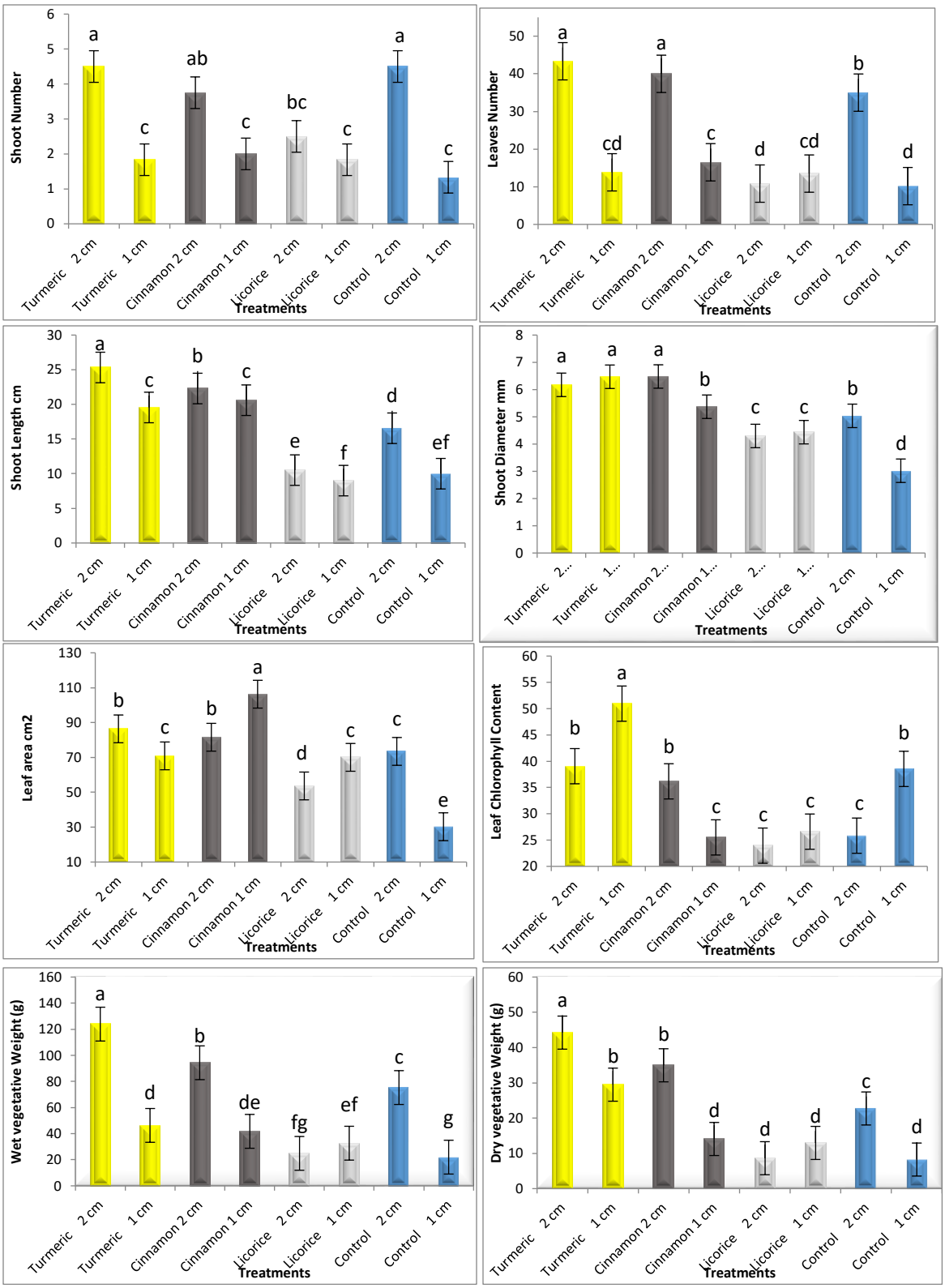

Figure 2. Effect of Natural Substances and Wounding on Vegetative Characteristics (A) Shoot No., (B) Leaves No., (C) Shoot Length, (D) Shoot Diameter, (E) Leaf Area, (F) Leaf Chlorophyll Content, (G) Wet Vegetative Weight, and (H) Dry Vegetative Weight of Fig Cuttings

The process of the root primordial cell division is known to be activated by auxins; this fact may be concluded from the rate at which the rooting co-factor accumulates in the bases of cuttings (Hartmann et al., 1990). Alternative rooting hormones, such as natural substances (coconut water an moringa leaf extract), have a greater influence than synthetic rooting hormones, according to (Dunsin et al., 2016). This is because they are simpler to manage, less expensive, and have a stimulating effect on rooting. Since the ancient theory suggested that higher phenolic content was associated with lower rooting percentages (Abdel Hameed, 2018; Wojtania et al., 2019; Abdel-Rahman et al., 2020), the new theory contends that higher phenol content encourages cuttings rooting. Thinking concluded that the kind and concentration of phenols affect their effects. By protecting IAA from degradation during the induction and initiation phases, chromogenic acid, rutin, and quercetin have a significant impact on the rooting of 'Arbequina' cuttings, as mentioned by (Denaxa et al., 2021), while lower concentrations of these compounds in 'Kalamata' cuttings have a less significant impact on rooting.

Turmeric natural extract was one of this study's most promising natural compounds. Treated cuttings with turmeric improved all root and vegetative characteristics of fig cuttings, as a role of the stimulating influence of turmeric extract is returned to its rich antioxidant effect on cell division, likewise, the enhancing effects of turmeric extract may be attributed to its stimulating effects on carbohydrates biosynthesis and plant pigments (Pons, 2003; Prakash & Majeed, 2006). On the other hand, the positive impact of turmeric extracts could be attributed to the substantial role of this extract that contains a potassium salt, carbohydrates, arabinogalactan, (50 % starch), essential oils, pigments, and antioxidants content, especially phenolic (Srimal, 1997; Pons, 2003; Alonso, 2004) which plays a substantial role in improving root and vegetative characteristics. These results are agreed with a previous study which showed an improvement in leaf area using 0.05 to 0.8 % of turmeric extract when Taimour mango trees sprayed one to four times (El- Masry & Abd El- Rahman, 2012). Given that it includes naturally occurring stimulant ingredients that may be used in place of artificial growth boosters like phenolic chemicals, the cinnamon extract may have a stimulating effect (Hiraddate et al., 2005) that affects plant growth and development. Furthermore, Carmello and Cardoso (2018), noticed that the using of cinnamon increases the number of leaves and the growth of the plant's aerial parts. This is probably because cinnamon contains bioactive compounds like eugenol oil and cinnamaldehyde, which have an allopathic effect that promotes vegetative growth. Powder of cinnamon is also believed to have a high ability for use as an agent of biological control and to function as an agent of rooting, which helps promote the growth of roots in almost all plant varieties (Xing et al., 2010). Contrary to our results, Hameed and Adil (2019) discovered that cinnamon extract, at 4 mg 100 ml^{-1} without the addition of auxins, inhibited the rooting of *Melaleuca viminalis*. Additionally, Rashedy, (2022) showed that licorice was more effective than cinnamon extract which had little to no beneficial impact on the rooting of olive cuttings. Thus, the results of this study indicated that the response to the cinnamon extract may differ based on the plant type treated, the extract application method, and the chemical compound content of the extract according to the area production. Additionally, Ojaghian et al.

(2014) mentioned that cinnamon possesses antifungal properties and stimulates plant stems to generate additional stems.

Although phenolic compounds, biotin, folic acid, amino acids, vitamins, and pantothenic acid in the licorice extract (Eid et al., 2018), as well as counted sources of phytohormones (Rady et al., 2019). While non-significantly influence showed in most root and vegetative properties of fig cuttings in the current study, except in some properties such as shoot diameter, leaf area, wet vegetative weight, and dry root weight. These results follow the finding by Aljabary and AL-jabbari (2021) that the licorice root extract increased the vegetative and root dry weight, and leaf area in the pomegranate cuttings cv. Salakhani as compared to the control. Cuttings basal wounding caused an increase in root properties by damaging the sheath of materials presented between wood tissue and bark tissue. This sheath has the power to prevent root growth (Wells, 1962). A kind of mechanical or chemical impairment of cell division and the escape of the roots incidental across that ring may be formed by fiber and sclereid cell clusters beyond the area of the creation of the adventitious roots (Pontikis, 1979; Sultan, 1974). By performing wounding, which ultimately results in cell division, development, and the appearance of adventitious roots on cuttings. Another explanation for the reaction of cuts to wounding was presented by Hartmann et al. (1990), who claimed that following the wounding, callus is generated and the roots develop, thick along the wound area. Our results are in harmony with the findings by Saumitro and Jha, (2014) that the severe wounds enhanced the root initiation, root number per cutting, and mean root length when performing the light and severe wounds on *Taxus wallichiana* shoot cuttings.

CONCLUSION

Turmeric and cinnamon with 1 or 2 cm basal wounding were more efficient than water, which gave the best results for root and vegetative characteristics of cuttings. The 2 cm basal wounding significantly enhanced root and vegetative characteristics than the 1 cm basal wounding. An organic farm can safely employ turmeric and cinnamon powder to encourage the root and vegetative characteristics of fig cuttings. According to our results, we can suggest using these natural substances on other fruit cuttings, given they are safe and friendly to the environment.

Author's contribution

All of them contributed to all parts of this article.

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Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

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