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ENDOGENOUS CHEMICAL CONSTITUENTS IN HARDWOOD STEM CUTTINGS OF GUAVA (*Psidium guajava* L.) IN RELATION TO ROOTING ABILITY.

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ABSTRACT

The present experiment included three growth and root promoting regulators, Indole butyric acid (IBA) solution at 4000 ppm, Hydrogen Peroxide (H_2O_2) solution at 3.5% and Vitamin B_{12} solution at 24mg/L. They were used either solely or in combination along with their interactions with split wounding process at the basal portion of hardwood stem cuttings (5cm) detached from fruiting guava trees (*Psidium guajava* L.). Just before inserted the non-wounded and wounded cuttings in planting medium (Sand and Peatmoss 1:1 v/v), they were dipped in each of the tested solutions for 30 second. The control was untreated cuttings just pre-planting dipped in distilled water for 30 second. The effect of treatments under study on certain chemicals content in basal portion of the treated cuttings was tested. Such chemicals included level of nitrogen and carbohydrate contents, C/N ratio and phenol contents. The relationship among these chemical constituents in cuttings basal and their rooting ability was the main target of the current research. Rooting ability was estimated through the measurement of 4 root parameters, rooting percentage, number of adventitious primary roots, adventitious primary root length and number of secondary (lateral) roots per cutting.

Results obtained in this experiment indicated that the chemical constituents in both non-wounded and wounded cuttings were significantly affected by various growth and root promoters along with the interactions between them. As for the estimated relationships, it was noticed that cuttings of T_5 [Dipping in (H_2O_2+IBA) and T_{12} (Wounded followed by Dipping in H_2O_2 and in IBA)], which were determined an appropriate level of N contents, the high value of carbohydrates and C/N ratio as well as low phenols content, were the most favorable cuttings to record higher rooting percentage and to form adventitious roots of good qualities compared with those of the other treatments. On the other hand, both non-wounded and wounded cuttings which had non-appropriate level of N contents, the lower values of carbohydrates and C/N ratio along with higher phenols either completely failed to induce adventitious roots or tabulated significantly lower rooting percentage and the induced roots were of poor characteristics.

INTRODUCTION

Research work carried out on the vegetative propagation of guava trees through stem cuttings has revealed that they are difficult to root and the less root formation is a problem in this case (Tahir *et al*., 1998). Consequently, the usual method to propagate guava trees is by seed. This method does not insure production of trees true to type and they take along time to start bearing.

Overcome this problem to enhance root formation was the subject of various investigators. They tried with certain vegetative propagation methods such as budding, grafting and air layering, but very little success is reported. However, they found that the applied stem cuttings with different types may be a suitable alternative to produce quality guava trees under the use of various root promoting hormones (Bleasdale, 1984; Hartmann and Kester, 1985; Luis *et al.,* 1986; Mukhopadhaya and Sen, 1998 and Mukhtar *et al*., 1998). In other experiments carried out to identify the relationship between rooting ability and endogenous rooting promoters and inhibitors extracted from cuttings, the investigators indicated that during rooting and primordial formation many biochemical and physiological changes were occurred such as an increase in chemical constituents and in activities of several root promoting hormones and enzymes (Um and Yeam, 1987; Shin *et al*., 1988 and YongKwean and KiSun, 1996).

The present research is a trail in this line. It was designed to spotlight on the relationship between rooting ability and endogenous level of nitrogen and carbohydrate contents, C/N ratio and phenols content in basal portion of guava wounded and non-wounded hardwood stem cuttings. The effect of pre-planting treatments with 3 solutions of root promoting chemicals on these chemical constituents was also considered.

MATERIALS AND METHODS

Endogenous levels of nitrogen, carbohydrates, C/N ratio and phenols content were determined in basal portion (5cm) of hardwood cuttings of guava trees (*Psidium guajava* L.) after 2 weeks from planting date (March 20). The source of cuttings in this study were shoots on guava trees at 15-year-old grown in a private orchard located at Om EL-Reda, Damietta governorate, Egypt during 2008 and 2009 seasons. The tested cuttings were made of uniform size 20 cm long and nearly 1 cm thick having at least 4 buds and 2 mature leaves. Pre-planting they were divided into 3 groups. Cuttings of one group were split wounded at the basal portion (5 cm) while they were still on mother trees in the first week of March, two weeks before they were taken; however those of the 2^{nd} group were left non-wounded. Both groups just before inserted in planting medium were subjected to dipping for 30 second in solutions of IBA at 4000 ppm, H_2O_2 at 3.5% and V_{B12} at 24mg/L solely or in combinations. The control was cuttings of the 3^{rd} group just pre-planting dipped in distilled water for 30 second. The cuttings were planted in polyethylene black bags 30cm in diameter at a depth of 5-6cm. Each contained planting medium of sand and peatmoss 1:1 (v/v) and 12 cuttings per bags were planted in March 20 of the 2 tested seasons. The planted bags were placed on the soil surface of greenhouse at a private nursery equipped with mist irrigation unit. Immediately after planting, the cuttings were irrigated.

Rooting percentage, number and length of adventitious primary roots and number of secondary (lateral) roots per cutting at 3-month-old from planting date were measured. To analyze nitrogen, carbohydrates, C/N ratio and phenols content in the basal portion of the treated cuttings, representative samples of wounded and non-wounded cuttings along with control ones at 2 weeks old from planting date their basal portions (5cm) were collected, washed with tap water, rinsed twice with distilled water, dried, ground to fine powder and used for the chemical analysis. Nitrogen contents were determined according to the method described by Pregle, (1945) using micro-kjeldahl procedure. Carbohydrate contents were determined using the method of Walkely and Black, (1934) as described by Jackson, (1967). The results of both nitrogen and carbohydrate contents were presented as percentage of dry weight (% D.W.). The C/N ratio was calculated from the value of nitrogen and carbohydrate contents. Phenols content were determined according to the method outlined by Malick and Singh, (1980). The results were presented as mg/100g dry weight.

The experiment in the 2 tested seasons was designed in a complete randomized block design. The obtained data were subjected to analysis of variance and the means were compared using the "Duncan Multiple Range Test" (Duncan, 1955).

RESULTS AND DISCUSSION

According to the great similarity almost among the results values in the 2 tested seasons of either root ability parameters or chemical constituents in basal portion of the treated cuttings, the obtained results in the present study were presented and discussed as average values of both tested seasons.

The relationship between rooting ability parameters measured on the treated wounded and non-wounded cuttings and chemical constituents in basal portion of these cuttings was the major objective of the present research. The determined chemical constituents were nitrogen and carbohydrate contents, C/N ratio and phenols content. The effect of tested treatments on such constituents was cleared from the results recorded in Table (1).

Effect on nitrogen contents (% D.W.)

It can be noticed from the concerned data in Table (1) that N level in basal portion of non-wounded cuttings were significantly higher with the combined "T_7" (IBA + V_{B12}) treatment (1.80%), followed by those of the combined "T_6" (H_2O_2 + V_{B12}) treatment (1.70%) as compared with those under the other treatments. The next major effect was to "T_4" (V_{B12}) treatment with an average N level of 1.68%. The control cuttings (T_1), relatively, were the least in that respect (1.61%). These results proved that effect of the combined treatments of V_{B12} was better than using either IBA "T_2" or H_2O_2 "T_3" solely on increasing N level, since the later 2 treatments, respectively, tabulated the average values 1.66 and 1.66% per cutting. Relatively, a higher N level of "T_4" (V_{B12}) treatment (1.68%) supported our finding herein.

As for wounded cuttings, the results in the same table on line with those of non-wounded ones. The highest average of N levels was in cuttings of "T_{13}" (H_2O_2 + V_{B12}) treatment (1.85%) and "T_{11}" (V_{B12}) one (1.83%).

The relationship between endogenous N level and rooting ability

Average N level in basal portion of non-wounded cuttings at 1.62% "T_5" and in wounded ones at 1.63% "T_{12}" illustrated a higher rooting percentage and induced adventitious roots of a higher number of adventitious primary roots. On the other hand, basal portion of cutting contained higher N level ("T_6", "T_7", "T_{11}", and "T_{13}") minimized these rooting ability parameters along with failed to induce secondary (lateral) roots (Figure 1). These results indicated that the presence of N contents in basal portion of both non-wounded and wounded guava cuttings in an appropriate level are necessary to increase rooting ability. Among the tested treatments, those determined N level of 1.62% "T_5" and "T_{12}" were the most effective ones. It is important to state herein that N is essential in synthesis of nucleic acids and proteins. These products in turn are necessary for cell division to root initiation. In that respect Breen and Muraoka, (1973) suggested that seasonal variation of nutrients in plant occur according to movement of nutrients connected with sink and source relationship depending on growth rate. Therefore, N move into sink, such as new shoots and result in higher level in new shoots during growing period.

The above findings are assumed that high nitrogen contents in cuttings basal portion repress rooting ability. This agreed with Kim *et al*., (1977) and Hambrick *et al*., (1985) who reported that if N level in cuttings decrease below a certain level, root formation was decreased in spit of a high level of carbohydrates. In addition, they stated that the effect of N on rooting was related to carbohydrates content in cutting.

Effect on carbohydrates content (% D.W.)

Endogenous carbohydrates in basal portion of non-wounded were significantly higher with T_5 (H_2O_2 + IBA) treatment (16.63%) than those of the other tratments. Cuttings of the treatments T_3 (H_2O_2), T_4 (V_{B12}) and T_6 (H_2O_2 + V_{B12}) contained also high levels of carbohydrate contents. The average levels of the treatments were 16.55, 16.55 and 16.52%, respectively. Minimum levels were in cuttings of T_7 (IBA + V_{B12}) treatment (16.35%) and T_2 (IBA) treatment (16.39%), whereas the least value (15.91%) was in control one (T_1). These findings pointed to H_2O_2 as the most effective tested chemical to increase endogenous carbohydrates in non-wounded cuttings followed by V_{B12}.

As for the treated wounded cuttings, the concerned results in the same table supported the superiority of H_2O_2, since among the tested treatments that of H_2O_2 and IBA (T_{12}) resulted in the treated cuttings significantly the highest level of carbohydrates (16.78%). The next major levels were in cuttings of T_{10} (H_2O_2) and T_{14} (IBA + V_{B12}) treatments, both with an average of 16.60% per cutting, followed by those of T_9 (IBA) and T_{13} (H_2O_2 + V_{B12}) treatments (16.41 and 16.39%, respectively). Wounding treatment only (T8) significantly recorded the least level in that respect (16.27%).

The relationship between endogenous carbohydrates and rooting ability

Results in the same table showed the contents of carbohydrate and those illustrated in Figures (1&2) of rooting ability parameters measured greatly pointed to T_5 treatment to determine significantly the highest level of carbohydrates in non-wounded cuttings (16.63%). Likewise, maximum carbohydrates level in wounded ones was under "T_{12}" treatment (16.78%). The highest carbohydrate contents in these cuttings tabulated significantly the highest rooting percentage, number of adventitious primary and secondary (lateral) roots as well as adventitious primary root length per cutting specially in case of wounded cutting. The tabulated values for these root characteristics respectively, were 43.00%, 16.65 adventitious primary roots, 4.70 secondary (lateral) roots and 5.77cm in non-wounded cuttings with "T_5" treatment. The corresponding values in wounded cuttings with "T_{12}" treatment were 70.67%, 24.96 adventitious primary roots, 8.58 secondary (lateral) roots and 8.38cm per cutting.

On the other hand, in this experiment minimum level of total carbohydrates were in non-wounded cuttings of T_1 and T_7 treatments with the values of 15.91 and 16.35%, respectively. Cuttings having such low level of carbohydrates either failing to form adventitious roots (T_1) or produced roots of very poor characteristics with 6.05% rooting percentage, 3.67 adventitious primary roots and no secondary (lateral) roots per cutting. As for wounded cuttings almost a similar trend was observed, the lowest carbohydrate levels were in cuttings of T_{11} and T_{13} treatments. Cuttings of the former treatment recorded 5.59% rooting, 3.50 adventitious primary roots, 3.70cm adventitious primary root length and no secondary (lateral) roots found. The corresponding values of the later treatment were 16.16%, 6.15 adventitious primary roots, 3.71cm adventitious primary root length and none secondary (lateral) roots.

The above mentioned results greatly proved that the high carbohydrate contents in basal portion coincided with the high rooting ability in the treated cuttings. This positive effect of carbohydrates is logically, basing on the statement that fructose and glucose are considered energy source for cell division in rooting. In addition storage carbohydrates is important for root formation not only as the main energy source but also as structural materials of cell to initiate root primordial (Nanda and Ananad, 1970; Greenwood and Berlyn, 1973). Our findings also agreed with Hartmann *et al*., (1990) who reported that the rooting capacity of many cuttings has been correlated with their carbohydrates content. YonKweon and KiSun, (1996) who worked on *Abeliophyllum disyichum* cuttings and Hussein, (2003) working on *Beaumontia grandiflora* cuttings indicated that cuttings of well rooting had relatively high content of total carbohydrates. More recent, Nag *et al*., (2004) with mung been cuttings in an attempt to identify some cellular contents at the base of hypocotyls cuttings that control adventitious root formation. They identified three phases of the adventitious root formation process, induction, initiation and expression. Each phase was characterized and controlled by endogenous certain chemical and biochemical compounds along with activities of some enzymes involving in rooting.

Effect on C/N ratio

The effect of tested treatments on endogenous C/N ratio in non-wounded cuttings under study came on line with that on endogenous carbohydrates in the same cuttings. Once again, non-wounded cuttings of "T_5" treatment (H_2O_2 + IBA) calculated an average C/N ratio (10.27) significantly higher than those of the other treatments. The next major ratio was in non-wounded cuttings of "T_3" treatment (H_2O_2) with an average of 9.97 followed by "T_2" (IBA) and "T_4" (V_{B12}) treatments (9.90 and 9.88, respectively). Minimum C/N ratio in that respect was in cuttings of "T_7" treatment (IBA + V_{B12}) with 9.08 (Table 1).

As for wounded cuttings, the concerned results in the same table also in harmony with those tabulated for carbohydrate contents. Among the tested treatments, T_{12} (H_2O_2 + IBA) was the best to calculate significantly the higher ratio (10.32). It was also noticed that using these 2 chemical promoters together in one treatment (T_{12}) much better than they applied solely (T_9 and T_{10}). On the other hand, minimum ratios were found in wounded cuttings of T_{13} (H_2O_2 + V_{B12}) and T_{11} (V_{B12}) treatments with the average ratios of 8.89 and 8.93, respectively.

The relationship between C/N ratio and rooting ability

According to the results in the table and those illustrated in Figures (1&2), it was found that the relationship between C/N ratio in cutting and its rooting ability was very similar to that between carbohydrates and rooting ability. Maximum C/N ratio in non-wounded cuttings of "T_5" treatment and in wounded cuttings of "T_{12}" treatment makes these cuttings succeeded to form adventitious root of the highest qualities. They tabulated significantly higher rooting percentage (43.00 and 70.67%), number of adventitious primary roots (16.65 and 24.96 roots), number of secondary (lateral) roots (4.70 and 8.58 roots) and adventitious primary root length (5.77 and 8.38cm), per cutting respectively. In this experiment, minimum C/N ratios were in non-wounded cuttings of "T_7" treatment (9.08) and in wounded cuttings of "T_{11}" and "T_{13}" treatments (8.93 and 8.89). Cutting having these lowest ratios showed very poor rooting ability. Minimum rooting percentage (6.05, 5.59 and 16.16%), number of adventitious primary roots (3.67, 3.50 and 6.15 roots), adventitious primary root length specialy with the later 2 treatments (3.70 and 3.71cm) and completely failed to induce secondary (lateral) roots.

The present part of study revealed that, the relationships among calculated C/N ratios in basal portion of the treated non-wounded and wounded cuttings in relation to their rooting ability parameters measured obviously showed very similar behaviour to that of carbohydrate contents in the same cuttings. Therefore, it could be generally reported that high C/N ratio in hardwood stem cuttings of guava is favorable to form good rooting. This finding was previously reported by YongKwean and KiSun, (1996) working on *Abeliophyllum distichum* cuttings; Mahros, (2000) on bougainvillea cuttings and Hussein9, (2003) on *Thunbergia grandiflora* cuttings. They indicated that the C/N ratio may be an important factor influencing the root ability of cuttings, since the values of C/N ratio were positively related to rooting percentage.

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Effect on phenols content (mg/100g dry weight)

Effect of the tested treatments on phenols content in basal portion of the treated cuttings was indicated from the concerned data in Table (1). From this table, it was cleared that among the tested cuttings those untreated control ones were determined significantly the highest phenols content (0.222 mg/100g D.W.). As for the effect on non-wounded cuttings, it can be arranged the treatments with respect to their effects on the amount of phenols content in descending order as T_3 (H_2O_2), T_7 (IBA + V_{B12}), T_5 (H_2O_2 + IBA), T_2 (IBA), T_4 (V_{B12}) and T_6 (H_2O_2 + V_{B12}). The tabulated average phenols content for these treatments, respectively, were 0.118, 0.104, 0.081, 0.066, 0.054 and 0.044 mg/100g D.W. These results indicated that phenols content in the basal portion of non-wounded cuttings were significantly affected by various growth and root promoters as well as the interactions among them.

The effect of the same treatments with wounding process as presented in the same table showed that cuttings of wounding treatment only (T_8) contained significantly the greatest amount of phenols (0.152 mg/100g), followed by those of "T_{10}" (H_2O_2) treatment (0.104 mg/100g). The wounded cuttings subjected to the treatments of "T_9" (IBA) and "T_{13}" (H_2O_2 + V_{B12}) came to the next order in that respect with the average values of 0.085 and 0.083 mg/100g, respectively. Otherwise, minimum amount was determined in cuttings of T_{12} (H_2O_2 + IBA) treatment (0.059 mg/100g).

The relationship between phenols content and rooting ability

The results of phenols content in the cutting bases indicated that the root parameters of rooting ability measured were adversely affected by the total phenols in the treated cuttings, since the higher values were associated with the lower phenols content. This relationship was strongly cleared with cuttings of the control treatment "T_1" which were tabulated significantly the highest value of phenols content in cuttings base portion and they completely failed to induce adventitious roots. Otherwise, the lower phenols in cuttings of T_5 treatment were succeeded to form adventitious roots having rooting ability parameters of higher values.

As for wounded cuttings a similar relationship was detected. Maximum values of root characteristics measured were recorded for cuttings of "T_{12}" treatment which were determined the lowest amount of phenols content in the basal portion of these cuttings. These findings are in agreement with the results of Hussein, (2003) who mentioned that the highest rooting percentage of *Beaumontia grandiflora* cuttings was associated with the lowest level of total phenols in the basal parts of cuttings.

The above negative relationship between phenols content in the treated cuttings and their root ability can be explained as the appropriate amount and kind of phenols in non-wounded and wounded cuttings of the best treatments are efficient to act with auxins. The workers in this subject concluded that the regulatory effect of phenols is not primarily through their effect on IAA-oxidation. Kefeli and Kadyrov, (1971) suggested that the effect of phenols are primarily on metabolic systems rather than on hormonal systems. Additional explanation was indicated from the study of Nitsch and Nitsch, (1962) who reported that monophenolics and o-diphenolics are likewise, respectively stimulants and inhibitors of IAA-oxidase.

Figure (1): Diagram showing the effect of various growth and root promoter treatments on rooting ability parameters of non-wounded and wounded hardwood stem cuttings of guava trees at 3-month-old from planting date: rooting % (A), Adventitious primary roots number (B), Adventitious primary root length (C) and secondary (lateral) roots number (D) per cutting as an average value of the 2 tested seasons.

Figure (2): Photograph showing the effect of T_{12}, T_5, T_1, T_7 and T_{13} treatments on adventitious primary roots number per hardwood stem cutting of guava trees at 3 months from planting date.

T_1 = Dipping cutting in water for 30 second (control).
T_5 = Dipping non-wounded cutting in H_2O_2 at 3.5 % and in IBA at 4000ppm for 30 second each.
T_{12} = Dipping wounded cutting in H_2O_2 at 3.5 % and in IBA at 4000ppm for 30 second each.

The polyhydroxy phenolics are in many instances stimulators of growth at low concentration and become inhibitory at higher concentrations. In the same line, Pridham, (1965) indicated that the inhibitory effects of phenols on growth and rooting are commonly attributed to the enhancement of indoleacetic oxidase, but it is very probable that other actions such as interference with oxidative phosphorylation are involved.

Regarding the chemical composition of the basal portion in hardwood stem cuttings sourced from guava trees, it is worthy to note that the increase in rooting percentage and root characteristics was affected by the presence of nitrogen contents in appropriate level, low phenol contents and strongly associated with the increase in the total carbohydrates content and the C/N ratio. Generally, it can be also concluded that increasing percentage and other root parameters are directly and indirectly affected by the chemical constituents of cuttings basal portion. In that respect, no reason to believe that auxins are ordinarily a rate limiting factor in root induction and growth (Leopold and Kriedemann, 1975).

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المكونات الكيميائية الداخلية في العقل الساقية الخشبية للجوافة وعلاقتها بالقدرة التجذيرية

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أجرى هذا البحث موسمين متتالين ٢٠٠٨ و٢٠٠٩م بهدف دراسة تأثير ثلاث منظمات للنمو واستحداث التجذير على عقل ساقية خشبية من أشجار الجوافة وهذه المنظمات هي محلول أندول حامض البيوتريك عند تركيز ٤٠٠٠ جزء فى المليون ومحلول فوق أكسيد الهيدروجين عند تركيز ٣.٥ % ومحلول فيتامين ب ١٢ عند تركيز ٢٤ ملجم/لتر وهذه استخدمت إما منفردة أو متجمعة أو متداخلة مع عملية تجريح لقواعد العقل المختبرة (٥سم). تمت عملية التجريح على الأفرخ مصدر العقل قبل فصلها من الأشجار بمدة أسبوعين وقد جهزت العقل بطول ٢٠سم تقريباً وسمك حوالي ١سم وقسمت لثلاث مجموعات واحدة تم تجريح قواعدها وأخرى تركت بدون تجريح وكلاهما قبل الزراعة مباشرة تم غمس قواعد العقل في محاليل المنظمات السابق ذكرها أما منفردة أو متداخلة لمدة ثلاثون ثانية في كل محلول على حدة أما المجموعة الثالثة تم غمس قواعدها في ماء مقطر فقط لمدة ثلاثون ثانية لتكون معاملة مقارنة (كنترول). زرعت العقل المختبرة والمقارنة في أكياس سوداء من مادة البولي إيثيلين ذات قطر ٣٠سم تحتوى على بيئة زراعة مكونة من خليط من

رمل مع بيتموس بنسبة١:١ بالحجم بمعدل ١٢ عقلة بالكيس. ووضعت الأكياس داخل صوبة مزودة بوحدة ري رذاذى فى مشتل خاص يقع في منطقة أم الرضا بمحافظة دمياط.

وبعد أسبوعين من الزراعة تمت دراسة تأثير هذه المعاملات على المحتوى الكيميائي في قواعد العقل المعاملة وتمثل ذلك فى المكونات النيتروجينية والكربوهيدراتية والنسبة بينهما وكذلك المحتوى من المواد الفينولية. كذلك تمت دراسة العلاقة بين هذه المكونات الكيميائية وقدرة العقل التجذيرية التي تم تقديرها من خلال قياس لأربعة معايير جذرية هي النسبة المئوية للتجذير ومتوسط عدد الجذور العرضية الأولية وطولها وعدد الجذور الثانوية الجانبية عليها. أوضحت النتائج المتحصل عليها ما يلي:

١- يتأثر محتوى المكونات الكيميائية تحت الدراسة في قواعد العقل المعاملة في كلا المجموعتين الأولى والثانية إيجابياً بمنظمات النمو والتجذير المختلفة المختبرة.
٢- اتضح من دراسة العلاقة بين المكونات الكيميائية والقدرة التجذيرية أن العقل تحت معاملة النقع في محلول فوق أكسيد الهيدروجين عند تركيز ٣.٥% ثم في محلول إندول حامض البيوتريك عند تركيز ٤٠٠٠ جزء/المليون ولمدة ٣٠ ثانية لكل منهما وبدون عملية تجريح (معاملة رقم "٥") وكذلك العقل تحت المعاملة بالنقع في نفس المحلولين مع التجريح قبل الزراعة (معاملة رقم "١٢") والتي احتوت قواعدها على مستوى مناسب من المكونات النيتروجينية وقيم عالية من المكونات الكربوهيدراتية والنسبة بينهما كانت مرتفعة وكذلك مستوى منخفض من المواد الفينولية الكلية للعقلة كانت أفضل العقل حيث سجلت أعلى نسبة مئوية للتجذير واستحداث جذور عرضية ذات الصفات الأفضل وذلك مقارنة بنفس القياسات على العقل تحت المعاملات الأخرى والمعاملة القياسية.
٣- وجد على الجانب الآخر أن العقل من المجموعتين الأولى والثانية والتي إحتوت قواعدها على مستوى غير مناسب من المكونات النيتروجينية ومستوى منخفض من المكونات الكربوهيدراتية وقيمة منخفضة من النسبة بينهما ؛هذه إما فشلت تماما في إنتاج جذور عرضية (المعاملة "١") أو سجلت نسبة مئوية منخفضة للتجذير كما استحدثت جذور عرضية فقيرة الصفات (المعاملتان "٧ و ١١").

توضح النتائج المتحصل عليها من هذه الدراسة أن المحتوى الكيميائي في قواعد العقل الخشبية الساقية للجوافة أن زيادة النسبة المئوية للتجذير وصفات الجذور العرضية المستحدثة تتأثر إيجابياً بوجود المكونات النيتروجينية والكربوهيدراتية والنسبة بينهما وكذلك المحتوى من المواد الفينولية وأنه يوجد علاقة واضحة بين زيادة المكونات الكربوهيدراتية الكلية وإرتفاع النسبة بينها وبين المكونات النيتروجينية والقدرة التجذيرية للعقل. وعلى العكس من ذلك زيادة المكونات الفينولية يؤثر سلبياً على القدرة التجذيرية. لذلك يمكن القول أن الاعتقاد بأن الأوكسينات هي العامل المحدد المألوف في إستحداث الجذور العرضية على العقل يحتاج إلى مزيد من التوضيح من خلال الدراسات الفسيولوجية. وان المعاملة للعقل قبل الزراعة التي تحقق التوازن في مستوى النيتروجين وإرتفاع مستوى الكربوهيدرات وكذلك قيمة النسبة بينهما مع خفض الفينولات هي الأفضل في رفع القدرة التجذيرية للعقل الساقية الخشبية للجوافة تحت ظروف هذه التجربة.

قام بتحكيم البحث

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Table (1): Effect of various growth and root promoting regulators along with wounding process on nitrogen, carbohydrate, C/N ratio and phenol contents in basal portion (5cm) of guava cuttings after 2 weeks from planting date during2008 and 2009 Seasons.

Cutting Treatment	Sym- -bol	Nitrogen (%D.W.)			Carbohydrate (%D.W.)			C/N ratio			Phenols (mg/100g)		
		2008	2009	Aver.	2008	2009	Aver.	2008	2009	Aver.	2008	2009	Aver.
Non-wounded													
Dipping in water (control)	T_1	1.61e*	1.61 e	1.61	15.90 h	15.91 h	15.91	9.88 f	9.88 f	9.88	0.222 a	0.222 a	0.222
Dipping in IBA	T_2	1.67 d	1.64 de	1.66	16.39 e	16.38ef	16.39	9.81 g	9.99 d	9.90	0.065 f	0.066 f	0.066
Dipping in H_2O_2	T_3	1.66 d	1.66 cd	1.66	16.55cd	16.54 c	16.55	9.97 d	9.96 e	9.97	0.118 c	0.118 c	0.118
Dipping in V_{B12}	T_4	1.68 cd	1.67 cd	1.68	16.55cd	16.54 c	16.55	9.85 f	9.90 f	9.88	0.054 g	0.053 g	0.054
Dipping in(H_2O_2+IBA)	T_5	1.62 e	1.62 de	1.62	16.63 b	16.62 b	16.63	10.27 b	10.26 b	10.27	0.081 e	0.081 e	0.081
Dipping in(H_2O_2+V_{B12})	T_6	1.70 c	1.69 c	1.70	16.52 d	16.52 c	16.52	9.72 h	9.78 g	9.75	0.044 h	0.043 h	0.044
Dipping in(IBA+V_{B12})	T_7	1.80 b	1.80 b	1.80	16.34 f	16.35 f	16.35	9.08 i	9.08 h	9.08	0.103 d	0.104 d	0.104
Wounded													
Wounding only	T_8	1.62 e	1.64 de	1.63	16.26 g	16.28 g	16.27	10.04 c	9.93 e	9.99	0.151 b	0.153 b	0.152
Wounding + IBA	T_9	1.65 d	1.65ce	1.65	16.41 e	16.41 d	16.41	9.95 de	9.95 e	9.95	0.084 e	0.085 e	0.085
Wounding + H_2O_2	T_{10}	1.67 d	1.65ce	1.66	16.59 c	16.60 b	16.60	9.93 e	10.06 c	10.00	0.104 d	0.103 d	0.104
Wounding + V_{B12}	T_{11}	1.82 ab	1.83 ab	1.83	16.28 g	16.30 g	16.29	8.95 j	8.91 i	8.93	0.067 f	0.069 f	0.068
Wounding+(H_2O_2+IBA)	T_{12}	1.62 e	1.63 de	1.63	16.77 a	16.78 a	16.78	10.35 a	10.29 a	10.32	0.058fg	0.059 g	0.059
Wounding+(H_2O_2+V_{B12})	T_{13}	1.84 a	1.85 a	1.85	16.39 e	16.39de	16.39	8.91 k	8.86 j	8.89	0.082 e	0.083 e	0.083
Wounding+(IBA+V_{B12})	T_{14}	1.62 e	1.62 de	1.62	16.59 c	16.61 b	16.60	10.24 b	10.25 b	10.25	0.065 f	0.066 f	0.066

*Means sharing one or more letters within the column are insignificantly differed at 5% level according to the "Duncan Least Significant Value".