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Studies on Propagation of New Almond × Peach Hybrids by Hard Wood Cuttings

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THIS experiment was conducted on 2019 & 2020 to study the effect of root hormones within two different water irrigation pH. on five new almond ×peach hybrids that are nematode resistance and salt tolerance. Rootstock trees are nine years old grown in Horticulture Research Institute, A.R.C. and received the same recommended horticultural practices. This experiment consisted of eight treatments using Indole Butyric Acid (IBA) at concentrations of 1000&2000ppm with or without 500ppm Naphthalene Acetic Acid (NAA) under pH5&7 of water irrigation. Results cleared that hybrid genotype No.5 recorded the highest significant values in growth and chemical measurements followed by hybrid genotype No.4 while Hybrid genotype No.3 recorded the lowest significant values. The greatest rooting percentage (56.28&59.76) and root length (4.01&4.23 cm.) recorded with 1000ppmIBA+ 500ppmNAA, as auxins enhanced the formation of callus, promotes root primordia. IBA delays the leaf abscission that increase the partitioning of photo-assimilates towards the leaves to reach great leaf area (32.98&34.34), fresh (2.11& 2.53) and dry (0.89&0.97) weight. Great leaf area and introduce more C/N ratio. Irrigation by pH5 improves nutrient availability and solubility of soil anions than pH7 of irrigation water. The interaction between hybrid No.5 under 1000ppmIBA+500ppmNAA within pH5 of water irrigation recorded the highest significant values of all growth measurements (rooting % 67.2&58.8, root number 5.95&6.03, shoot length 7.30&7.51cm. and leaf area 8.3&38.9 cm^2.) and chemical measurements fresh (2.59&2.71), dry (1.12&1.28) weight and total indoles (0.471&0.483). Moreover normal water pH reached the good rooting measurements with the high concentration of IBA (2000 ppm).

Keywords: Almond ×Peach hybrids, Hard wood cuttings, Indole Butyric Acid (IBA), Naphthalene Acetic Acid (NAA), Water irrigation pH.

Introduction

Peaches [*Prunus persica* (L.) Batsch] are the most worldwide known stone fruits and are highly appreciated by consumers. Peach is the most important temperate and deciduous fruit tree grown in the world, after apples. There are 29225 feddan which produced 276608 ton in Egypt (Economic Affairs Sector, Agri, Gov. Egypt 2021)

Peaches are commercially propagated by grafting; hence peach trees consist of two different parts, scion and rootstock. The right choice of that combination is the most important factor of the peach cultivation success. Rootstocks are selected based on criteria, such as salt tolerance, resistance to soil pathogens, root-knot nematodes and lime-induced chlorosis. The rootstock also affects the tree (scion) vigor, precocious, yield and fruit quality. The effects of rootstock on the grafted cultivar characteristics are mainly attributed to the change in the hormone balance induced by the rootstock, the uptake and the translocation of nutrients and water, (Soliman, 2020).

Almond × peach hybrids (*Prunus amygdalus* × *P. persica*) are largely used as rootstocks for peach trees in the Mediterranean countries. They are tolerant to lime induced iron chlorosis and alkaline soil conditions, and they are graft-

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compatible with peach and almond cultivars. They are vigorous and suitable for use in poor dry soils. In recent years, new selections hybrids have also been developed with resistance to biotic stresses, such as root-knot nematodes (*Meloidogyne spp*.), (Gemma et al., 2016 and Ntanos et al., 2021).

Rooting of cuttings is not always successful and the reasons for rooting failure are not clearly understood. Factors such as cultivar, age of the source tree, the collection date, length& diameter of the cutting, degree of hardening, injury& heat treatments of the cuttings and the treatment with auxin-or auxin like compounds can affect rooting (Ibrahim and Aram 2020). The plant growth regulator indole butyric acid (IBA), a synthetic auxin, induces rooting in peach cuttings, but its effect can vary with the type of cutting used. IBA at concentrations of 2000 mg L^{-1} stimulated rooting of hardwood and semi-hardwood cuttings but rooting success varied with peach cultivar. In contrast, softwood cuttings treated for 24 h with 25 mg L^{-1} solution of IBA had high rooting (Tworkoski and Takeda, 2007).

Hartmann et al. (2002) cleared that propagation from cuttings produce true to type plants. The hardwood cuttings are easy to prepare, handle and storing. Hard wood cutting preparation is easy as they have less actively growing tissue. The collection date of the cuttings is very important as it affect endogenous content of sugars, sucrose, starch, indol-3-acetic acid (IAA) and abscisic acid (ABA). The best time for collecting cuttings to increase rooting percentage is the fall from October to January (Tsipouridis et al., 2006).

The optimum dose for the root initiation could be ranging between 2000 and 3000 ppm IBA. At higher dose it may reduce rooting performance as 2000 ppm IBA gave very good rooting. The local production of peach rootstocks to meet local demand have a high priority as Egypt imported rootstock seeds from USA and Europe which costing millions dollars yearly (Galal et al., 2018).

IBA uptake is affected by pH. Auxin enters a cell by a saturable carrier and by passive diffusion. If extracellular pH is below that of the cytoplasm, passive diffusion of auxin (in the protonated form) into cells continues even after the carrier mechanism becomes flooded, allowing for greater uptake of exogenous root-promoting substance. (Harbage et al., 1998).

The objectives of this study were to increase the hardwood cuttings rooting percentage of new peach rootstocks by treating the cutting by different concentrations of auxin at different pH of water irrigation, to speed up root initiation, increase the number and quality of roots per cutting and rise the survival percentage of rooted cuttings.

Materials and Methods

The current investigation was conducted at the Horticulture Research Institute, Agriculture Research Center, Giza, Egypt. during the two seasons of 2019 and 2020 to evaluate the effect of different concentrations of indole-3-butyric acid (IBA) alone or with Naphthalene acetic acid (NAA) under different water irrigation pH on rooting of five hybrid rootstocks hard wood cuttings.

Healthy 9-year-old mother plants of new almond× peach rootstocks which are resistant to nematode (Soliman, 2014) and tolerant to salt stress (Soliman and Farhan 2021) were used. Hard wood cuttings were collected from one-year-old branches in February. The middle cuttings were about 15-20 cm length and 1-1.5cm thickness with approximately 5 buds. Two tangential cuts of 0.5 cm depth were made on opposite sides of base of the cuttings.

Auxin solutions were prepared by dissolving indole-3-butyric acid IBA and Naphthalene acetic acid (NAA) in 50% ethanol (Evert and Smittle, 1990). IBA prepared at different concentrations 1000 and 2000 ppm while NAA prepared at 500 ppm to NAA. After treating cuttings with hormones, cuttings were kept in polyethylene bags filled with peat moss irrigated with different pH water (pH 5&7) and the bags were sealed to prevent moisture loss in cold storage (4-7°c). After 30 days, cutting were planted in plastic boxes filled with a mixture of sand: peatmoss: vermiculite (1:1:1 v/v) treated with fungicide (benlate) (1g/kg mixture). All pots were placed in a greenhouse and irrigated with water with same pH (5 or 7), to reach 20 % moisture (Tsipouridis and Thomidis, 2004). The pH of irrigation water was adjusted by HCl and NaOH. The experiment treatments were as follows:

1-1000ppm IBA at pH5
2-1000ppm IBA at pH7
3-1000ppm IBA+500ppmNAA at pH5
4-1000ppm IBA+500ppmNAA at pH7
5-2000ppm IBA at pH5
6-2000ppm IBA at pH7
7-2000ppm IBA+500ppmNAA at pH5
8-2000ppm IBA+500ppmNAA at pH7

After 90 days of planting (approximately in June) data were recorded as follows

Vegetative growth parameters

- Rooting percentage (number of rooted cuttings/ total cuttings per treatment (24) x100.
- Average root number (number of roots per treatment/ total cuttings per treatment).
- Average root length (cm.) (all root length/ total cuttings per treatment).
- Average shoot length (cm.) (all new shoots length / total cuttings at each treatment).
- Average leaf number (number of all new leaves total cuttings at each treatment).
- Average leaf area (cm^2) were calculated ((leaf length (cm.) × leaf width (cm.) for all leaves on all shoots)/ number of leaves)

Chemical analysis

- Fresh and dry weight (g.) rooted plantlets were selected randomly after 120 day of planting in greenhouse and they were washed then weighted to get the fresh weight. The used plantlets then dried at 70ºC till constant weight to reach the dry weight. Samples were grinded and stored for analysis.
- C/N ratio Total carbohydrates was determined according to Dubois et al., (1956) and total nitrogen was determined using the method described by Wilde et al (1985) then C/N ratio were calculated.
- Total indoles: Was determined according to Larsen et al., (1962) as mg per g. dry weight.
- Total phenols: Was determined according to (A.O.A.C., 2000) as mg per g. dry weight.

Statistical analysis

The data were statistically analyzed as a factorial experiment (two factors, hybrid genotype and auxin treatments (1000& 2000ppm IBA concentrations ± 500ppm NAA within irrigation water pH 5&7) in completely randomized design with four replicates each replicate consists of six cuttings in two seasons. Data in this study were statistically analyzed according to the method of Snedecor and Cochran (1990) in each season L.S.D at 5% level and Duncan multiple range test (Duncan 1955) were used for comparison between means of each treatment.

Results

Effect of different auxin treatments under different pH of irrigation water on rooting percentage, root number and length (cm.) of different almond× peach rootstocks

Data in Tables (1&2) recorded the effect of different auxin treatments under two different pH of irrigation water on rooting%, root number and root length (cm.) of new almond ×peach rootstock hardwood cuttings in two seasons. Data showed significant differences between rootstocks, the significant highest values were recorded with hybrid No.5 followed by hybrid No.4 while the significant lowest values were recorded with hybrid No.3. Tables (1&2) cleared that using 1000ppm IBA+500ppm NAA under pH5 of irrigation water was better than other treatments to record the highest measurement values while using 1000ppm IBA with the ordinary pH recorded the lowest measurement values among all other hormone and pH treatments.

As for the effect of genotype, data cleared that hybrid No.5 reached the highest rooting% (37.8& 40.95), root number (3.47&3.79) and root length (2.10&2.32cm.) in both seasons, while hybrid No.3 recorded the significant lowest values(rooting% 18.9&22.05, root number 1.61&1.92 and root length 0.77&0.91 cm.) in the two season, respectively.

As for the effect of different auxin treatments under different pH of irrigation water, it was clear that the superiority of using 1،00ppm IBA+500ppm NAA within pH5 of irrigation water on recording the significant highest values (56.28 &59.76 for rooting%, 4.76& 5.08 for root number and 4.01 &4.23 cm. for root length). On the other hand using 1000ppm IBA within pH7 of irrigation water recorded the significant lowest values (3.36 &5.88 for rooting%, 0.35&& 0.41 for root number and 0.03 &0.3 cm. for root length).

As for the interaction between the two factors, data showed that hybrid No.5 within 1000ppmIBA +500ppmNAA under pH5 of irrigation water recorded the highest rooting measurements (67.20& 58.80 for rooting%, 5.95 &6.03 for root number and 5.66& 5.73cm. for root length). Rooting measurements were similar between hybrid No.4 and hybrid No.5 in most treatments. On the other hand hybrid No.3 recorded the lowest rooting measurements under all treatments.

TABLE 1. Effect of different auxin treatments under different pH of irrigation water on rooting percentage, root number and length (cm.) of different almond ×peach rootstocks genotype in 2019.

Treatment	Hybrid number					
	1	2	3	4	5	Mean
			Rooting percentage %			
1000ppm+pH5	29.4ef	25.2f	21.0fg	33.6de	37.8de	29.40D
1000ppm+pH7	00.0i	00.0i	00.0i	04.2hi	12.6gh	03.36G
1000ppm+500NAA+pH5	54.6bc	54.6bc	42.0cd	63.0a	67.2a	56.28A
1000ppm+500NAA+pH7	12.6gh	08.4h	08.4h	16.8g	25.2f	14.28F
2000ppm+pH5	50.4bc	42.0cd	37.8de	54.6bc	58.8ab	48.72B
2000ppm+pH7	21.0fg	16.8g	12.6gh	25.2f	33.6de	21.84E
2000ppm+500NAA+pH5	46.8c	33.6de	29.4ef	50.4bc	50.4bc	42.12C
2000ppm+500NAA+pH7	4.2hi	00.0i	00.0i	08.4h	16.8g	05.88G
Mean	27.37C	22.57D	18.9D	32.03B	37.8A	
			Root number			
1000ppm+pH5	3.61d-f	2.64f-g	2.00g-i	4.06c-e	4.23b-e	3.31B
1000ppm+pH7	0.00k	0.00k	0.00k	0.59j	1.16i-k	0.35E
1000ppm+500NAA+pH5	4.64b-d	4.58b-d	3.30ef	5.32ab	5.95a	4.76A
1000ppm+500NAA+pH7	1.42ij	0.94i-k	0.61jk	1.67g-i	2.53f-h	1.43CD
2000ppm+pH5	4.14b-e	3.46d-f	3.07ef	4.72a-c	5.11a-c	4.10AB
2000ppm+pH7	2.11g-i	1.53g-i	1.24i-k	2.79fg	2.85fg	2.10C
2000ppm+500NAA+pH5	3.61d-f	2.64f-h	2.00g-i	4.06c-e	4.23b-e	3.31B
2000ppm+500NAA+pH7	0.78i-k	0.53k	0.66k	1.23i-k	1.72g-i	0.75DE
Mean	2.56B	1.97C	1.75C	3.06A	3.47A	
			Root length (cm.)			
1000ppm+pH5	0.89i-k	0.74i-k	0.67j-l	1.38h-j	1.55g-i	1.05D
1000ppm+pH7	0.00l	0.00l	0.00l	0.04kl	0.08l	0.03E
1000ppm+500NAA+pH5	3.81cd	3.60cd	2.21fg	4.77b	5.66a	4.01A
1000ppm+500NAA+pH7	0.41kl	0.37kl	0.25kl	0.49l	0.60j-l	0.42DE
2000ppm+pH5	3.00de	2.15fg	1.74f-h	3.79cd	4.35bc	3.01B
2000ppm+pH7	0.71j-l	0.65j-l	0.34kl	0.92i-k	1.23h-j	0.77D
2000ppm+500NAA+pH5	2.40ef	1.38h-j	0.92i-k	3.11de	3.00de	2.16C
2000ppm+500NAA+pH7	0.05l	0.00l	0.00l	0.15kl	0.28kl	0.10E
Mean	1.41B	1.11BC	0.77C	1.84A	2.10A	

Values followed by the same letter (s) of each column are not significantly different at 5% level
IBA Indole Butyric Acid, NAA Naphthalene Acetic Acid, ppm part per million.

TABLE 2. Effect of different auxin treatments under different pH of irrigation water on rooting percentage, root number and length (cm.) of different almond ×peach rootstocks in 2020.

Treatment	Hybrid number					
	1	2	3	4	5	Mean
			Rooting percentage %			
1000ppm+pH5	37.8de	21.0fg	21.0fg	37.8de	42.0d	31.92C
1000ppm+pH7	00.0i	00.0i	00.0i	12.6gh	16.8g	05.88F
1000ppm+500NAA+pH5	63.0ab	58.8ab	42.0d	67.2a	58.8ab	59.76A
1000ppm+500NAA+pH7	16.8g	16.8g	12.6gh	21.0fg	29.4ef	19.32D
2000ppm+pH5	46.4cd	42.0d	42.0d	58.8ab	63.0ab	50.44B
2000ppm+pH7	29.4ef	21.0fg	12.6gh	29.4ef	37.8de	26.04D
2000ppm+500NAA+pH5	54.6bc	37.8de	42.0d	54.6bc	63.0ab	50.40B
2000ppm+500NAA+pH7	12.6gh	12.6gh	04.2h	12.60gh	16.8g	11.76E
Mean	32.58C	26.25D	22.05D	36.75B	40.95A	
			Root number			
1000ppm+pH5	3.69ef	2.66hi	2.05jk	4.19de	4.51b-d	3.41CD
1000ppm+pH7	0.00n	0.00n	0.00n	0.83m	1.21lm	0.41F
1000ppm+500NAA+pH5	4.91bc	4.92bc	3.71ef	5.81a	6.03a	5.08A
1000ppm+500NAA+pH7	1.72kl	1.03m	0.83m	2.02jk	2.73hi	1.67E
2000ppm+pH5	4.43cd	3.71ef	3.42fg	5.02b	5.62a	4.44AB
2000ppm+pH7	2.34ij	2.01jk	1.97jk	3.11gh	3.25fg	2.54D
2000ppm+500NAA+pH5	3.95de	3.04gh	2.56hi	4.43cd	4.96b	3.79BC
2000ppm+500NAA+pH7	0.91m	0.82m	0.75mn	1.88jk	2.03jk	1.23E
Mean	2.77B	2.28BC	1.91C	3.40A	3.79A	
			Root length (cm.)			
1000ppm+pH5	0.92g-i	0.78h-j	0.71h-j	1.57gh	1.45gh	1.09D
1000ppm+pH7	0.00j	0.00j	0.00j	0.60h-j	0.91g-j	0.30E
1000ppm+500NAA+pH5	3.94b-d	3.81cd	2.76ef	4.91ab	5.73a	4.23A
1000ppm+500NAA+pH7	0.44ij	0.41ij	0.38ij	0.60h-j	0.67h-j	0.50DE
2000ppm+pH5	3.21de	2.76ef	1.89fg	4.12b-d	4.52bc	3.30B
2000ppm+pH7	0.87h-j	0.82h-j	0.44ij	1.22g-i	1.45gh	0.96DE
2000ppm+500NAA+pH5	2.57ef	1.56gh	1.07g-i	3.34de	3.77cd	2.46C
2000ppm+500NAA+pH7	0.60h-j	0.02j	0.01j	0.22ij	0.26ij	0.22E
Mean	1.57BC	1.27CD	0.91D	2.07AB	2.35A	

Values followed by the same letter (s) of each column are not significantly different at 5% level
IBA Indole Butyric Acid, NAA Naphthalene Acetic Acid, ppm part per million.

Effect of different auxin treatments under different pH of irrigation water on shoot length (cm.), leaf number/shoot and leaf area (cm^2) of different almond × peach rootstocks

Data in Tables (3&4) cleared the effect of different auxin treatments under different pH of irrigation water treatments and hybrid genotype on shoot length (cm.) leaf number/shoot and leaf area (cm^2) of different almond ×peach rootstocks. Data cleared that, the significant highest values of growth measurements were recorded with hybrids number 4 and 5 under the same treatment (1000ppm IBA within pH5 of irrigation water) for either shoot length cm. and leaf number per shoot.

As for the effect on hybrid genotype, data cleared that the significant highest values of shoot length and leaf number per shoot were recorded with hybrid No.5 (2.98&3.19cm. for shoot length and 1.78&1.94 for leaf number/shoot) and hybrid No.4 (2.70&2.83cm. for shoot length and for leaf number/ shoot 1.62 &1.80). Moreover hybrid No. 3 recorded the significant lowest values of shoot length (1.53& 1.68cm.) and leaf number/ shoot (0.93& 1.01). As for leaf area (cm^2) data cleared that hybrid No 5 and No.4 recorded the highest value (35.99&37.12cm^2 for hybrid No.5 and 34.60 &35.46cm^2 for hybrid No.4). On the other hand, hybrid No.3 recorded the significant lowest value of leaf area (20.26&21.45cm^2)

As for the effect of different auxin treatments under different pH of irrigation water, data cleared that 1000ppm IBA+ 500ppm NAA within pH5 of irrigation water recorded the significant highest values of growth measurements (5.80& 6.13cm. for shoot length and 3.58 &3.74 for leaf number/ shoot) while 1000ppm IBA within pH7 of irrigation water recorded the lowest values of shoot length (0.19&0.26 cm), leaf number/ shoot (0.11 &0.14) and leaf area (13.92 &14.48 cm^2)

As for the interaction between the two factors on growth measurements, data cleared that hybrid No.5 treated with 1000ppm IBA+ 500ppm NAA within pH5 of irrigation water recorded the significant highest values of shoot length (7.30&7.51 cm.. leaf number/ shoot 4.38&4.46 and leaf area 38.30&38.9 cm^2). Moreover hybrid No. 1 under treatment with 2000ppm IBA+ 500ppm NAA +pH7 of irrigation water recorded the lowest significant growth measurements values (shoot length 0.3&0.38cm., leaf number/ shoot 0.16& 0.19 and leaf area 22.5&26.1cm^2) in the two seasons respectively.

Effect of different auxin treatments under different pH of irrigation water on fresh weight (g.), dry weight (g.) and C/N ratio of different almond× peach rootstocks

Tables (5&6) showed the effect of different auxin concentrations and pH of irrigation water and hybrid genotype on fresh weight (g.), dry weight (g.) and C/N ratio of different almond ×peach rootstocks which take the same trend as in rooting and growth measurements. Date showed that hybrid No.5 recorded the significant highest values when using 1000ppm.IBA +500ppmNAA within pH5 of irrigation water

As for the effect of the treatments on hybrid genotype, data cleared that hybrid No.4 and No.5 recorded the significant highest values. Hybrid No.4 recorded 1.38&1.53g. for fresh weight, 0.59 &0.67g. for dry weight and 13.41&13.81 for C/N ratio. While hybrid No.5 recorded 1.55 &1.72g. for fresh weight, 0.66 &0.73g. for dry weight and 13.83&14.26 for C/N ratio. On the other hand, the significant lowest values were recorded with hybrid No.3 (0.84& 1.15g. for fresh weight, 0.34 &0.39g. for dry weight and 11.97 & 13.03 for C/N ratio).

As for the effect of different auxin concentrations with different pH of irrigation water data showed that the superiority of using 1000ppm IBA +500ppmNAA within pH5 of irrigation water. (2.11&2.53g. for fresh weight, 0.89&0.97g. for dry weight and28.77&29.68 for C/N ratio). On the other hand, using 1000ppm IBA within pH7 of irrigation water recorded the significant lowest values. (0.48&0.52g. for fresh weight, 0.19&0.22 for dry weight and 21.06&22.64 for C/N ratio.

As for the interaction between the two factors on fresh weight (g.), dry weight (g.) and C/N ratio of different almond× peach rootstocks, hybrid No.5 treated with 1000ppm IBA+ 500ppm NAA recorded the significant highest values (2.59& 2.71 for fresh weight (g.),1.12& 1.28 for dry weight and 15.11& 15.07for C/N ratio). On the other hand, hybrid No.3 treated with 1000ppm IBA recorded the significant lowest measurements of fresh weight (0.38&0.41g.), dry weight (0.15&0.16g.) and C/N ratio (9.85&10.9).

Effect of different auxin treatments under different pH of irrigation water on total indoles (mg/g d.wt.) and total phenols (mg/g d.wt.) of different almond × peach rootstocks

Data in Table (7) reveal that almond × peach hybrids rootstocks were significantly different

in their content of total indoles (mg/ g. dry weight) during the two seasons of study. The highest value of indoles was recorded with hybrid No.5 (0.299&0.308 mg/g d.wt in both seasons respectively) followed by hybrid No.4 (0.286&0.296 mg/g d. wt). On the other hand hybrid No.3 recorded the lowest significant values 0.207 &0.234 mg/g d.wt in both seasons respectively.

Moreover, data showed that the superiority of using 1000ppmIBA+500ppmNAA+pH5 of irrigation water than other treatments in recording the significant highest value (0.390 mg/g d.wt in 2019 &0.415 mg/g d.wt in 2020) as well as using 2000ppmIBA+pH5 of irrigation water which recorded 0.39&0.407 mg/g d.wt in both seasons respectively. On the other hand, 1000ppm IBA within pH of irrigation water recorded the lowest values in both seasons (0.14& 0.148).

As for the interaction between the two factors it was clear that hybrid No.5 treated with 1000ppmIBA +500ppmNAA and pH5 of irrigation water reached the highest total indoles value (0.471 and 0.483 mg/g d. wt.).

Rootstocks content of total phenols were showed in Table (7). It was clear that total phenols take the opposite trend of total Indoles as affected by hybrid genotype while it took no trend with hormone treatments. As for hybrid number data cleared that hybrid No.5 and 4 reached the lowest value of total phenols (1.80&1.70 mg/g d.wt for both seasons to hybrid No.5 and 1.85 &1.67 mg/g d. wt for hybrid No.4 in both seasons respectively. While the significant highest value was recorded with hybrid No.3 (2.15 for both seasons)

Moreover using 1000ppm IBA +500ppm NAA+pH5 of irrigation water recorded the significant lowest value in the two seasons (1.46& 1.41 mg/g d.wt respectively). On the other hand using 1000ppm IBA +pH7 of irrigation water recorded the significant highest value (2.53 and 2.51 mg/g d.wt)

As for the interaction between the two factors, it was clear from previous data that hybrid No.4 treated with 1000ppmIBA +500ppmNAA and pH5 of irrigation water recorded the significant lowest value of total phenols (1.34 &1.13 mg/g d.wt) while the significant highest value was recorded with hybrid No.3 treated with 1000ppm IBA with pH7 of irrigation water (2.67&2.91 mg/g d.wt).

Discussion

It is clear from the previous data that, rooting in almond ×peach new hybrids hard wood stem cuttings may be promoted by using IBA and NAA that stimulate meristematic activity in this region causing root formation. Moreover, using combination of 1000ppm IBA +500ppm NAA at pH5 of irrigation water enhanced the formation of root and increased rooting percentage.

In this respect Kaviani et al., (2023) confirmed this idea and reported that hormone combination (IBA and NAA) had the greatest effect on most of the growth measurements (rooting percentage, root number, root length, leaf number and fresh& dry weights of pear cuttings. Moreover, Seif El-Yazal et al., (2022) reported that indole butyric acid (IBA) and naphthalene acetic acid (NAA) at different concentrations as well as wounding had a positive effect on rooting percentage of fig stem cuttings and consequently produced better seedlings growth. Auxins enhance hydrolysis activity which increases the formation of high soluble carbohydrate and leads to the increment in root formation and better rooting. The good root formation led to good shoot growth and good internal elements. This is due to an increase in hormones and carbohydrates in root cells

Shagufi and Gurpinder 2018, reported that the emergence of longest plum shoots on cuttings treated with IBA may be attributed to the well develop of root system in such cuttings that enhanced the nutrient uptake, photosynthate production and provides required energy for cell division and elongation. Cuttings treated with IBA reached maximum fresh and dry weight, it could be due to increase in leaf area, cell division, leaf chlorophyll content, more starch, sugars and C/N ratio. This significant increment in average leaf area might be attributed to the fact that IBA delays the leaf abscission which increased the partitioning of photo-assimilates towards the leaves which favored the leaf area.

Increasing IBA concentrations produced more roots which increased nutrient uptake and aerial growth of the plants resulted in highest leaf area. Auxin increased rooting and ensured length of roots by increasing the translocation of metabolites to the growing apices and also enhanced the formation of callus and tissues and differentiation of vascular tissues. This increase in number of roots pertains to the fact that the auxin promotes the differentiation of cambial initials into root primordia and increases the mobilization of reserve food material to sites of root initiation. (Larsen, 1997).

TABLE 3. Effect of different auxin treatments under different pH of irrigation water on shoot length (cm.), leaf number/shoot and leaf area (cm^2) of different almond × peach rootstocks in 2019.

Treatment	Hybrid number					
	1	2	3	4	5	Mean
Shoot length (cm.)						
1000ppm+pH5	1.65hi	1.64hi	1.28i-k	2.75f	2.90ef	2.04BC
1000ppm+pH7	0.00m	0.00m	0.00m	0.41lm	0.53lm	0.19E
1000ppm+500NAA+pH5	5.40b	5.20b	4.30c	6.80a	7.30a	5.80A
1000ppm+500NAA+pH7	0.96j-l	0.63k-m	0.51lm	0.97j-l	1.15i-k	0.84DE
2000ppm+pH5	4.12c	3.91cd	3.27de	5.16b	5.60b	4.41A
2000ppm+pH7	1.03jk	0.96j-l	0.78k-m	1.53h-j	1.80h	1.22CD
2000ppm+500NAA+pH5	2.71f	2.57fg	2.06gh	3.41de	3.80cd	2.91B
2000ppm+500NAA+pH7	0.30m	0.00m	0.00m	0.55lm	0.72k-m	0.32DE
Mean	2.02B	1.87BC	1.53C	2.70A	2.98A	
Leaf number/shoot						
1000ppm+pH5	0.93i-k	1.05ij	0.75j-l	1.56gh	1.68g	1.20CD
1000ppm+pH7	0.00n	0.00n	0.00n	0.25lm	0.29lm	0.11F
1000ppm+500NAA+pH5	3.26b	3.40b	2.72cd	4.16a	4.38a	3.58A
1000ppm+500NAA+pH7	0.50lm	0.41lm	0.28lm	0.58k-m	0.76j-l	0.51EF
2000ppm+pH5	2.47de	2.32de	1.91fg	3.07bc	3.25b	2.60B
2000ppm+pH7	0.71j-l	0.65k-m	0.54k-m	0.93i-k	1.22hi	0.81DE
2000ppm+500NAA+pH5	1.66g	1.51gh	1.22hi	2.10ef	2.21ef	1.74C
2000ppm+500NAA+pH7	0.16n	0.00n	0.00n	0.32lm	0.42lm	0.18F
Mean	1.21BC	1.17BC	0.93C	1.62AB	1.78A	
Leaf area (cm^2)						
1000ppm+pH5	33.20c-e	29.8gh	24.80kl	31.90ef	35.20bc	30.98B
1000ppm+pH7	0.00m	0.00m	0.00m	34.10b-d	35.50bc	13.92D
1000ppm+500NAA+pH5	33.10c-e	30.10fg	27.60hi	33.60c-e	38.30a	32.54AB
1000ppm+500NAA+pH7	30.30fg	35.20bc	27.10ij	36.20ab	34.20b-d	32.60AB
2000ppm+pH5	28.70gh	31.70ef	29.10gh	32.40d-f	38.30a	32.04AB
2000ppm+pH7	31.80ef	32.40d-f	25.30jk	36.70ab	34.60b-d	32.16AB
2000ppm+500NAA+pH5	30.90fg	33.40c-e	28.20hi	34.80bc	37.60ab	32.98A
2000ppm+500NAA+pH7	22.50l	0.00m	0.00m	37.10ab	33.70c-e	18.66C
Mean	26.31B	24.08B	20.26C	34.60A	35.99A	

Values followed by the same letter (s) of each column are not significantly different at 5% level
IBA Indole Butyric Acid, NAA Naphthalene Acetic Acid, ppm part per million.

TABLE 4. Effect of different auxin treatments under different pH of irrigation water on shoot length (cm.), leaf number/shoot and leaf area (cm^2) of different almond × peach rootstocks in 2020.

Treatment	Hybrid number					
	1	2	3	4	5	Mean
			Shoot length (cm.)			
1000ppm+pH5	1.79g-i	1.69i-k	1.43i-k	2.78fg	3.48ef	2.24CD
1000ppm+pH7	0.00l	0.00l	0.00l	0.48k	0.79jk	0.26E
1000ppm+500NAA+pH5	5.71bc	5.73bc	4.78cd	6.91a	7.51a	6.13A
1000ppm+500NAA+pH7	0.88j	0.83jk	0.48k	1.01i-k	1.43gh	0.95DE
2000ppm+pH5	4.38de	4.08de	3.51ef	5.68bc	5.87b	4.70B
2000ppm+pH7	1.09i-k	1.00i-k	0.81jk	1.67i-k	1.91g-i	1.29DE
2000ppm+500NAA+pH5	2.78fg	2.69fg	2.41gh	3.66ef	3.78de	3.06BC
2000ppm+500NAA+pH7	0.38k	0.00l	0.00l	0.48k	0.79jk	0.33E
Mean	2.13B	2.00BC	1.68C	2.83A	3.19A	
			Leaf number/shoot			
1000ppm+pH5	0.98hi	1.38gh	0.81i	1.69fg	1.71fg	1.32BC
1000ppm+pH7	0.00l	0.00l	0.00l	0.31j-l	0.32jk	0.14D
1000ppm+500NAA+pH5	3.37b	3.51b	2.89c	4.45a	4.46a	3.74A
1000ppm+500NAA+pH7	0.62ij	0.56jk	0.33j-l	0.72ij	0.82i	0.61CD
2000ppm+pH5	0.68ij	2.48cd	2.05ef	3.42b	3.45b	2.42B
2000ppm+pH7	2.69cd	0.78i	0.64ij	1.03h	1.71fg	1.37BC
2000ppm+500NAA+pH5	1.73fg	1.79f	1.31gh	2.31de	2.57cd	1.94B
2000ppm+500NAA+pH7	0.19kl	0.00l	0.00l	0.45jk	0.51jk	0.23D
Mean	1.29BC	1.32BC	1.01C	1.80AB	1.94A	
			Leaf area (cm^2)			
1000ppm+pH5	33.5fg	30.1hi	29.1ij	32.3gh	36.8b-d	32.36B
1000ppm+pH7	0.00l	0.00l	0.00l	35.2d-f	37.2a-c	14.48D
1000ppm+500NAA+pH5	33.8fg	30.9hi	28.1j	34.1ef	38.9a	33.16B
1000ppm+500NAA+pH7	31.1hi	36.0c-e	27.8jk	33.8fg	35.0d-f	32.74B
2000ppm+pH5	29.5ij	31.9gh	29.6ij	37.8a-c	39.1a	33.58AB
2000ppm+pH7	33.6fg	33.4fg	27.9jk	35.8c-e	36.1b-d	33.36AB
2000ppm+500NAA+pH5	33.9fg	34.1ef	29.1ij	36.5b-d	38.1ab	34.34A
2000ppm+500NAA+pH7	26.1k	0.00l	0.00l	38.2ab	35.7c-e	20.00C
Mean	27.69B	24.55B	21.45C	35.46A	37.12A	

Values followed by the same letter (s) of each column are not significantly different at 5% level
IBA Indole Butyric Acid, NAA Naphthalene Acetic Acid, ppm part per million.

TABLE 5. Effect of different auxin treatments under different pH of irrigation water on fresh weight (g.), dry weight (g.) and C/N ratio of different almond ×peach rootstocks in 2019.

Treatment	Hybrid number					
	1	2	3	4	5	Mean
			Fresh weight (g.)			
1000ppm+pH5	1.28hi	1.17hi	0.95jk	1.46gh	1.62fg	1.30B
1000ppm+pH7	0.44n	0.45n	0.38n	0.49n	0.63l-n	0.48D
1000ppm+500NAA+pH5	2.15b-d	1.99de	1.39gh	2.42ab	2.59a	2.11A
1000ppm+500NAA+pH7	0.62l-n	0.68l-n	0.54mn	0.92jk	1.01ij	0.75CD
2000ppm+pH5	1.79ef	2.06cd	1.19hi	2.32a-c	2.38ab	1.95A
2000ppm+pH7	0.89j-l	0.83j-m	0.81j-m	1.00ij	1.19hi	0.95C
2000ppm+500NAA+pH5	1.45gh	1.58fg	0.95jk	1.76ef	1.99de	1.57B
2000ppm+500NAA+pH7	0.83j-m	0.58l-n	0.51n	0.69l-n	0.93jk	0.71CD
Mean	1.18B	1.17B	0.84C	1.38A	1.55A	
			Dry weight (g.)			
1000ppm+pH5	0.44hi	0.48gh	0.39h	0.63ef	0.71de	0.53BC
1000ppm+pH7	0.17k	0.18k	0.15k	0.21k	0.26jk	0.19E
1000ppm+500NAA+pH5	0.89b	0.85bc	0.57fg	1.04a	1.12a	0.89A
1000ppm+500NAA+pH7	0.24jk	0.28jk	0.22k	0.38hi	0.44hi	0.31DE
2000ppm+pH5	0.73cd	0.85bc	0.48gh	1.00a	1.03a	0.82A
2000ppm+pH7	0.37hi	0.35ij	0.33ij	0.41hi	0.49gh	0.39CD
2000ppm+500NAA+pH5	0.62ef	0.70de	0.39h	0.76cd	0.86b	0.67B
2000ppm+500NAA+pH7	0.33ij	0.23jk	0.21k	0.28jk	0.38hi	0.29DE
Mean	0.47B	0.49B	0.34C	0.59A	0.66A	
			C/N ratio			
1000ppm+pH5	13.00fg	13.35d-f	12.70fg	13.80cd	14.10b-d	13.39B
1000ppm+pH7	10.66kl	10.15lm	09.85m	10.80kl	11.50jk	10.59F
1000ppm+500NAA+pH5	14.07b-d	14.55bc	13.45d-f	14.80ab	15.11a	14.40A
1000ppm+500NAA+pH7	12.5gh	11.88hi	10.85kl	12.50gh	12.90fg	12.13DE
2000ppm+pH5	14.30bc	14.50bc	13.70c-e	14.90ab	15.10ab	14.50A
2000ppm+pH7	12.85fg	12.65fg	11.70jk	13.10fg	13.30ef	12.72CD
2000ppm+500NAA+pH5	13.75c-e	14.20b-d	13.10fg	15.10ab	15.80a	14.39A
2000ppm+500NAA+pH7	11.55hi	10.90kl	10.40lm	12.30gh	12.80fg	11.59EF
Mean	12.84B	12.77B	11.97B	13.41AB	13.83A	

Values followed by the same letter (s) of each column are not significantly different at 5% level
IBA Indole Butyric Acid, NAA Naphthalene Acetic Acid, ppm part per million.

TABLE 6. Effect of different auxin treatments under different pH of irrigation water on fresh weight (g.), dry weight (g.) and C/N ratio of different almond ×peach rootstocks in 2020.

	Hybrid number					
Treatment	**1**	**2**	**3**	**4**	**5**	**Mean**
			Fresh weight (g.)			
1000ppm+pH5	2.04de	1.28gh	1.07hi	1.53e-g	1.69ef	1.52B
1000ppm+pH7	0.51kl	0.49kl	0.41l	0.53kl	0.67j-l	0.52D
1000ppm+500NAA+pH5	2.35cd	2.12d	2.71ab	2.56bc	2.91a	2.53A
1000ppm+500NAA+pH7	0.72jk	0.73jk	0.62kl	0.98hi	1.28gh	0.87CD
2000ppm+pH5	1.83e	2.17d	1.73e	2.62ab	2.79ab	2.23A
2000ppm+pH7	0.94ij	0.89ij	0.89ij	1.25gh	1.41fg	1.07C
2000ppm+500NAA+pH5	1.58ef	1.60ef	1.07hi	1.83e	2.04d	1.62B
2000ppm+500NAA+pH7	0.92ij	0.76j-l	0.69ij	0.98hi	1.03hi	0.88CD
Mean	1.36BC	1.26BC	1.15C	1.53AB	1.72A	
			Dry weight (g.)			
1000ppm+pH5	0.53gh	0.51gh	0.41hi	0.69ef	0.73e	0.57C
1000ppm+pH7	0.18l	0.19lk	0.16l	0.29jk	0.29jk	0.22E
1000ppm+500NAA+pH5	0.93c	0.89cd	0.61fg	1.12b	1.28a	0.97A
1000ppm+500NAA+pH7	0.32ij	0.37ij	0.29jk	0.41hi	0.47gh	0.37D
2000ppm+pH5	0.89cd	0.91c	0.51gh	1.18ab	1.21ab	0.94A
2000ppm+pH7	0.45hi	0.51gh	0.41hi	0.48gh	0.49gh	0.47CD
2000ppm+500NAA+pH5	0.67ef	0.73e	0.45hi	0.79de	0.89cd	0.71B
2000ppm+500NAA+pH7	0.39hi	0.31ij	0.29jk	0.41hi	0.43hi	0.37D
Mean	0.55B	0.55B	0.39C	0.67A	0.73A	
			C/N ratio			
1000ppm+pH5	14.50b-d	14.60bc	13.30ef	13.90cd	14.40b-d	14.14B
1000ppm+pH7	12.00gh	11.40ij	10.90j	11.40ij	12.60gh	11.66E
1000ppm+500NAA+pH5	14.80a-c	14.70bc	14.10cd	15.00ab	15.70a	14.86A
1000ppm+500NAA+pH7	13.60de	12.50gh	11.40ij	13.50de	13.30ef	12.86D
2000ppm+pH5	14.60bc	14.90ab	14.50b-d	15.10ab	15.90a	15.00A
2000ppm+pH7	13.20ef	13.10ef	14.80ef	12.20gh	14.20cd	13.50C
2000ppm+500NAA+pH5	14.10cd	15.10ab	14.10cd	15.80ab	14.90ab	14.8AB
2000ppm+500NAA+pH7	12.70gh	11.90hi	11.50ij	13.60de	13.10ef	12.56D
Mean	13.70AB	13.53BC	13.07C	13.81AB	14.26A	

Values followed by the same letter (s) of each column are not significantly different at 5% level
IBA Indole Butyric Acid, NAA Naphthalene Acetic Acid, ppm part per million.

TABLE 7. Effect of different auxin treatments under different pH of irrigation water on total indoles (mg/g d.wt.) and total phenols (mg/g d.wt.) of different almond ×peach rootstocks.

Treatment	Hybrid number					
	1	2	3	4	5	Mean
Total Indoles (mg/gd.wt.) 2019						
1000ppm+pH5	0.271f-h	0.244g-i	0.205jk	0.277f-h	0.285f-h	0.26C
1000ppm+pH7	0.127m	0.142lm	0.117m	0.157k-m	0.163k-m	0.14E
1000ppm+500NAA+pH5	0.396bc	0.385cd	0.294fg	0.445ab	0.471a	0.39A
1000ppm+500NAA+pH7	0.197jk	0.186j-l	0.151lm	0.193j-l	0.213i-k	0.19DE
2000ppm+pH5	0.414bc	0.363cd	0.311ef	0.406bc	0.432ab	0.39A
2000ppm+pH7	0.250g-i	0.237h-j	0.188j-l	0.254g-i	0.266f-h	0.24CD
2000ppm+500NAA+pH5	0.316ef	0.302ef	0.262g-i	0.349de	0.371cd	0.32B
2000ppm+500NAA+pH7	0.165k-m	0.160k-m	0.132m	0.178k-m	0.188j-l	0.16E
Mean	0.267B	0.252B	0.207C	0.282AB	0.299A	
Total Indoles (mg/gd.wt.) 2020						
1000ppm+pH5	0.276g-i	0.259h-j	0.223j-l	0.286f-h	0.301f-h	0.269BC
1000ppm+pH7	0.131n	0.142mn	0.122n	0.169mn	0.175lm	0.148D
1000ppm+500NAA+pH5	0.401cd	0.391cd	0.341ef	0.461ab	0.483a	0.415A
1000ppm+500NAA+pH7	0.201kl	0.196kl	0.183lm	0.208kl	0.228i-k	0.203CD
2000ppm+pH5	0.440a-c	0.375de	0.354de	0.427bc	0.437a-c	0.407A
2000ppm+pH7	0.263h-j	0.245i-k	0.202kl	0.269g-i	0.273g-i	0.250C
2000ppm+500NAA+pH5	0.323ef	0.321e-g	0.287f-h	0.362de	0.372de	0.333AB
2000ppm+500NAA+pH7	0.172lm	0.171lm	0.159mn	0.189lm	0.193lm	0.177D
Mean	0.275AB	0.263BC	0.234C	0.296AB	0.308A	
Total phenols (mg/g d.wt.)2019						
1000ppm+pH5	2.05fg	1.91h	2.11fg	1.65ij	1.73i	1.89CD
1000ppm+pH7	2.56ab	2.63a	2.67a	2.48bc	2.31de	2.53A
1000ppm+500NAA+pH5	1.54jk	1.48kl	1.63ij	1.34l	1.31l	1.46E
1000ppm+500NAA+pH7	2.27de	2.17ef	2.40b-d	2.11fg	1.97gh	2.18BC
2000ppm+pH5	1.59jk	1.55jk	1.71ij	1.35l	1.39l	1.52E
2000ppm+pH7	2.25de	2.28de	2.34cd	2.01gh	1.94h	2.17BC
2000ppm+500NAA+pH5	1.77i	1.68ij	1.84hi	1.49kl	1.52k	1.66DE
2000ppm+500NAA+pH7	2.36cd	2.47bc	2.52ab	2.33cd	2.19ef	2.38AB
Mean	2.05AB	2.02B	2.15A	1.85C	1.80C	
Total phenols (mg/g d.wt.) 2020						
1000ppm+pH5	2.31de	2.17ef	1.95gh	1.85gh	1.59jk	1.98C
1000ppm+pH7	3.07a	2.54bc	2.91a	2.03fg	2.01fg	2.51A
1000ppm+500NAA+pH5	1.32lm	1.61ij	1.57jk	1.13m	1.40kl	1.41D
1000ppm+500NAA+pH7	2.11ef	2.41cd	2.64b	1.48jk	1.72hi	2.07BC
2000ppm+pH5	1.31lm	1.81hi	1.87gh	1.41kl	1.56jk	1.59D
2000ppm+pH7	2.27de	2.51bc	2.41cd	2.11ef	1.89gh	2.24AB
2000ppm+500NAA+pH5	1.64ij	1.59jk	2.03fg	1.31lm	1.33kl	1.58D
2000ppm+500NAA+pH7	2.61b	2.55bc	2.31de	2.09f	2.11ef	2.34A
Mean	2.08A	2.15A	2.15A	1.67B	1.70B	

Values followed by the same letter (s) of each column are not significantly different at 5% level
IBA Indole Butyric Acid, NAA Naphthalene Acetic Acid, ppm part per million.

It has been long known that different plant species, including important crops, have different soil pH optima for growth (Small, 1946). pH is a major, variable growth factor in natural and agricultural soils. Rhizosphere pH is connected to many physiological and environmental parameters, like growth, respiration, biotic interactions, the solubility of nutrients and toxic ions, and the leaching of soil anions (Hinsinger et al., 2003). Plant roots encounter spatial and temporal variations of pH in the soil, and changes in soil water. A strong correlation between the rapid pH response and the transcriptional response to short-term auxin treatment (30 and 60 min) is evident. pH is highly variable in soil due to variations in elemental, organic and ionic composition, as well as water status. As a consequence, roots will upon growth and over time experience different pH environments that will affect the root surface and apoplastic pH (Gao et al., 2004). In addition, active modulation of apoplastic pH is performed by plant roots for facilitating nutrient uptake but also more generally by plant cells for inducing growth and in response to external signals (Felle, 2001). Soil pH is an important factor for plant growth, as it affects nutrient availability, nutrient toxicity, and has a direct effect on the protoplasm of plant root cells. It also affects the abundance and activity of soil organisms (from microorganisms to arthropods) responsible for transformations of nutrients (Nicol et al. 2008). Changes of rhizosphere pH affects plant growth including morphology, photosynthesis, nutrient absorption (Daqiu et al., 2013). High pH reduced the weight of plant and uptake of nutrients (Hajiboland et al., 2003).

Conclusion

From the previous experiment we can conclude that hybrid No.5 was the best hybrid genotype of the used five hybrids and hybrid No.4 followed it. The best growth measurements were recorded when treated hybrid genotypes by 1000ppm IBA +500ppm NAA under pH5 of irrigation water followed by 2000ppmIBA under pH7 of irrigation water.

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Conflicts of interest

None

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دراسات على اكثار هجن جديدة من اللوز ×الخوخ بواسطة العقل الخشبية

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تمت هذه التجربة خلال عامى ٢٠١٩ و٢٠٢٠ وذلك بهدف دراسة تاثير هرمونات التجذير مع درجتين مختلفتين من الحموضة للماء على خمس هجن جديدة من اللوز ×الخوخ. الهجن الجديدة المقاومة للنيماتودا والمتحملة للملوحة. يبلغ عمر الأشجار تسع سنوات مزروعة في معهد بحوث البساتين - مركز البحوث الزراعية تحت نفس المعاملات البستانية الموصى بها. تألفت هذه التجربة من ثماني معاملات باستخدام اندول حمض البيوتيريك (IBA) بتركيزات ١٠٠٠ و ٢٠٠٠ جزء في المليون مع أو بدون ٥٠٠ جزء في المليون من نفثالين حمض الخليك (NAA) تحت درجة الحموضة ٥ و ٧.

أوضحت النتائج تفوق هجين رقم ٥فى تسجيل اعلى قيم لقياسات النمو والقياسات الكيميائية تبعه هجين رقم ٤ بينما سجل هجين رقم ٣ اقل القيم. اعلى نسبة تجذير (59.76&56.28) واطول جذور (سم (4.23&4.01 سجلتها المعاملة باستخدام ١٠٠٠ جزء فى المليون اندول حمض البيوتيريك مع ٥٠٠ جزء ف المليون نفثالين حمض الخليك لان الاكسينات تزيد من انقسام خلايا الكالس وتحث نشأت مبادئ الجذور

يؤخر ١٠٠٠جزء فى المليون اندول حمض البيوتيريك مع ٥٠٠ جزء ف المليون نفثالين حمض الخليك تساقط الاوراق فيزيد من تراكم نوتج البناء الضوئى تجاه الاوراق فتزيد مساحة الورقة (34.34&32.98 سم^{2} (و الوزن الطازج (2.11 &2.53)جم . والجاف) 0.89&0.97جم. (.كبر مساحة الورقة يزيد مننسبة الكربوهيدرات الى النيتروجين.

الرى باستخدام pH5يحسن تيسر العناصر الغذائية ف التربة ودوبانها عن ph7لماء الرى اضافة تركيبة من ١٠٠٠ جزء ف المليون من اندول حمض البيوتيريك مع ٥٠٠ جزء ف المليون من نفثالين حمض الخليك حسنت من تشاط التحليل الغذائى فزاد من الكربوهيدرات وامتصاص المغذيات ومنتجات التمثيل الضوئي التي توفر الطاقة للانقسام واستطالة خلايا الكامبيوم الوعائية ثم تؤدي إلى أقصى طول للافرع. يزيد الرى ب pH5 تيسر وذوبان المغذيات وترشح ايونات التربة عن ٧ pH.

حصل الهجين رقم ٥ المعامل ١٠٠٠ جزء في المليونIBA +500 جزء في المليون من NAA تحت pH5 أعلى قيم معنوية لجميع قياسات النمو (نسبة تجدير % 67.2&58.8عدد للجدور5.95&6.03 وطول للافرع 7.30&7.51سم ومساحة للاوراق 8.3&38.9سم^{2} مع افضل قياسات كيميائية وزن طازج 2.59&2.71جم ( ) وزن جاف 1.12&1.28جم( ) واندولات كلية(0.471&0.483). علاوة على ذلك ، كان استخدام درجة حموضة الماء العادية (٧) أفضل عند استخدام التركيز العالي ل IBA فقط (٢٠٠٠ جزء في المليون).

الكلمات المفتاحية: هجن اللوز× الخوخ العقل الخشبية اندول حمض البيوتيريك نفثالين حمض الخليك حموضة ماء الرى.