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Effect of Magnesium and Foliar Spray of Gibberellic and Salicylic Acids on Vegetative Growth Characteristics of Peach (*Prunus persica* L.) Saplings CV. Miski

ABSTRACT

This study was conducted in the lath house of the Department of Horticulture and Landscape Design/ College of Agriculture/ Tikrit University during the growing season of 2017 to investigate the effect of magnesium application and the foliar spraying of both gibberellic and salicylic acids on the vegetative growth characteristics of peach saplings CV. Miski, aged one year which were grafted on Apricot seedlings. Magnesium was added in three concentrations (0, 50 and 100 mg.litre^{-1}) and was labelled as Mg_0, Mg_1 and Mg_2 consecutively. The gibberellic acid was sprayed in three concentrations (0, 50 and 100 mg.liter^{-1}) and labelled as GA_0,GA_1 and GA_2 consecutively. Besides the salicylic acid was sprayed with the following concentrations (0, 100 and 200 mg.L^{-1}) and labelled as SA_0, SA_1 and SA_2 consecutively. All these processes were performed starting from April 10 three times, with a time interval of three weeks. The experiment was performed based on the split-plot system in Randomized Complete Block Design (RCBD) in which the various magnesium concentrations were added to the main plots and both the gibberellic and salicylic acids were applied to the subplots. The results showed that the addition of magnesium has positively increased the main stem diameter, single leaf area, total leaves area per plant and the relative chlorophyll concentrations in leaves. The height and the diameter of a sapling, length of the branches, leaf area and total leaves area of sapling were increased as a result of foliar spraying with gibberellic acid. The spraying of salicylic acid has a positive effect on the saplings' characteristics (leaf area, total leaves area and relative chlorophyll concentration in leaves). The dual or triple interaction treatments between the three studied factors had the positive results in most characteristics were investigated.

INTRODUCTION

Peach is one of a deciduous fruit trees; its scientific name is (*Prunus persica* L.), belonging to Rosaceae family, its characterized of rapid growth and short lifespan and also the early entry into the fruiting or production stage and the tendency to basal branching, all these factors can lead to the final shape of training in one or two years (Hasan, 2002).

It's necessary to have seedlings with strong growth of important and good cultivars which requires adequate care in terms of fertilization and using plant growth regulators because the seedlings consume large amounts of soil nutrients including Magnesium which is the main ingredient of the

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chlorophyll structure and also as carrier or transport for phosphorus and the enzymes that form and hydrolyze the carbohydrates and the vegetable fats (Yassin, 1992).

It's possible to improve the vegetative growth of the seedlings by spraying with specific growth regulators such as gibberellic acid which helps to elongate the tree branches by elongating individual cells and their expansion (Hartmann et al, 2002). Not only that the gibberellic acid contributes to delay of ageing of the leaves by slowing chlorophyll and RNA and protein degradation but also it helps to increase their production (Wasfi, 1995).

Salicylic acid is a plant hormone with phenolic properties and it regulates numerous physiologic processes in plants including regulating ion absorption, the hormonal balance, stomata movement and the flowery stimulation (Popova et al, 1997). Besides its role in regulating the plant's response to the environmental conditions stress such as heat, drought and heavy metals. Also, it acts as an accelerator in the formation of chlorophyll and the carotenes pigments and a facilitating agent in the photosynthesis (Hayat and Ahmad, 2007).

This study aimed to investigate the role of magnesium fertilization and the foliar spraying of gibberellic and salicylic acids in improving the vegetative growth of the peach saplings cv. Miski.

MATERIALS AND METHODS:

This study was conducted in the lath house of the department of horticulture and landscape design/college of agriculture/Tikrit university during the growing season of 2017 on the peach saplings cv. Miski of one-year age that were grafted on Apricot seedlings rootstock. The experiment aimed to study the effect of magnesium addition and the foliar application of both gibberellic and salicylic acids on the vegetative growth characteristics. The saplings were pruned right after planting in a 10 kg plastic bags which were filled with a soil, and the final pruning was performed in the last week of February in which the saplings were shortened to be 70 cm in height and removed every brunch at the main stem.

Three factors were studied, the first is Magnesium as a magnesium sulfate which was added in three concentrations (0, 50 and 100 mg.litre^{-1}) and were labelled as Mg_0, Mg_1 and Mg_2 consecutively. Every sapling was received 600 ml of magnesium solution. The second factor was a gibberellic acid which was sprayed in three concentrations (0, 50 and 100 mg.liter^{-1}) and labelled as GA_0,GA_1 and GA_2 consecutively. While the third factor was a salicylic acid which sprayed with the following concentrations (0, 100 and 200 mg.L^{-1}) and labelled as SA_0, SA_1 and SA_2 consecutively. All these processes were performed starting from April 10 three times, with a time interval of three weeks.

Both gibberellic and salicylic acid were sprayed three times in the whole season, all of which were done early in the morning using a portable sprayer of 5 Liters and using a surfactant agent in order to reduce the surface tension and facilitate the distribution of the solution on the leaves. The experiment was carried out using the split-plot system in the randomized complete block design (RCBD) with three replicates and two saplings per each experimental unit. The Magnesium solutions were added to the Main Plots and bot the gibberellic acid and the salicylic acid were added to the Sub Plots.

The number of the saplings was 162 distributed as (2×3×3×3×3) and after collecting the data the results were analyzed statistically by SAS on a computer and the average values were compared using Duncan's new multiple range test with a probability of 5%.(1) (Al-Rawi and Khalaf-Allah, 2000).

Table (1) Physical and chemical properties of the experiment soil*

Characteristics	Values	Unit

Sand	37	%
Silt	32	%
Clay	31	%
Soil texture	Sandy-loamy-clay	
Soil pH	7.55	
Electrical conductivity	70	MS
Organic matter	1.12	$gm.Kg^{-1}$
N	0.14	%
P	0.9	%
K	1.3	%
Mg	4.8	$mq.L^{-1}$

*The soil sample was analyzed in the laboratory of The Soil Science and Water Resources Dept.- College of Agric.- Tikrit University

The studied characteristics:

Sapling's Height (cm):

The heights of the saplings were measured using a metric tape from the grafting spot to the end of the longest branch in the first week of November 2017.

Increase in the diameter of the main stem of the sapling (mm):

The diameter was measured above the grafting spot by 10 cm using Vernier method twice, first at the beginning of the growth season (2017/3/1), and the second in 2017/11/1 and the difference between the two readings represents the average increase in the diameter of the stem.

Average branch length:

A metric measuring tape was used to measure the lengths of the newly formed branches at the end of October.

The area of a single leaf (cm^2):

The area of a single leaf was measured in the first week of October by collecting ten fully expansion leaves from each trial unit and from different locations and each leaf was glued on A4 sized papers that have a fixed area and weight, and after being scanned, the areas that form the leaf shapes were sliced and were weighted by a sensitive electronic balance, by using the following equation it was possible to calculate the area of ten leaves (Patton, 1984):

$$area\ of\ ten\ leaves\ (\text{cm\^2}) = \frac{area\ of\ A4\ paper\ (cm\text{\^2})\ x\ weight\ of\ the\ sliced\ area\ (gm)}{weight\ of\ A4\ paper\ (gm)}$$

The result was divided by ten in order to obtain the single leaf area.

Total leaves area per sapling (cm^2):

The total leaves area was measured by multiplying the total number of leaves of each sapling by the area of a single leaf.

The leaves relative chlorophyll content (SPAD):

The content was measured using a Japan made Chlorophyll Meter SPAD-502 by having ten readings for each plant thus twenty readings per unit in two dates 2017/4/2 and 2017/6/4.

RESULTS AND DISCUSSION:

Sapling's Height (cm):

In table (2) the results reveal that the addition of magnesium to the soil and the spraying of salicylic acid separately did not positively effect on the height of sapling, on the other hand the spraying with gibberellic acid has led to a positive increase in sapling's height by 5.63% and 7.56% for the two concentrations of gibberellic acid as compared to the control treatment that had the least height 136.63 cm, this could be attributed to the fact that the gibberellic acid was a contributing factor

in increasing the foliar area (table 6) which in turn has increased the photosynthesis and further to the seedlings' development and better growth. (Cheng and Fuchigami, 2001; Chen and Chen, 2004)
The dual treatment of magnesium and spraying of gibberellic acid it was found out that Mg_2GA_2 gave the highest sapling 156.67 cm and positively surpassed the control of 131.33 cm with an increased rate of 17.77%.

The interaction treatments between magnesium and salicylic acid also gave an increase in saplings' height compared to the control in which Mg_2SA_2 has the highest value (154.44 cm) and positively surpassed the control with an increased rate of 11.82%.
The table also shows that the high concentration dual treatment of both gibberellic and salicylic acids GA_2SA_2 has surpassed all the other treatments except GA_1SA_1 with an increased rate of 17% as compared to the control which gave the least heights 134.67 cm.
The triple interaction treatment $Mg_2GA_2SA_2$ gave the highest value 166.0 cm and positively surpassed the other treatments with an increase rate 26.4% as compared to the control.

Table (2) Effect of magnesium, gibberellic and salicylic acids on the height (cm) of peach sapling cv. Miski.

Magnesium concentrations ($mg.L^{-1}$)	Gibberellic acid concentrations ($mg.L^{-1}$)	Salicylic acid concentrations ($mg.L^{-1}$)			interaction treatments of Mg and GA_3	Effect of magnesium (Mg)
		0.0 (SA_0)	100 (SA_1)	200 (SA_2)		
0.0 (Mg_0)	0.0 (GA_0)	131.33cde	128de	134.67b-e	131.33c	138.52 a
	25 (GA_1)	138.67b-e	152a-e	128.67de	139.78bc	
	50 (GA_2)	144.33a-e	136.33b-e	152.67a-e	144.44abc	
50 (Mg_1)	0.0 (GA_0)	135b-e	136.33b-e	145a-e	138.78bc	142.22 a
	25 (GA_1)	143.67a-e	153a-d	141.67a-e	146.11ab	
	50 (GA_2)	143.67a-e	127.67e	154abc	141.78abc	
100 (Mg_2)	0.0 (GA_0)	137.67b-e	142a-e	139.67b-e	139.78bc	147.19 a
	25 (GA_1)	141b-e	142.67a-e	157.67ab	147.11ab	
	50 (GA_2)	145.67a-e	152.33a-e	166.00a	154.67a	
Interaction treatments of Mg & SA	0.0 (Mg_0)	138.11b	138.78b	138.67b	**Effect of gibberellic acid (GA_3)**	
	50 (Mg_1)	140.78b	139b	146.89ab		
	100 (Mg_2)	141.44b	145.67ab	154.44a		
Interaction treatments of GA_3 & SA	0.0 (GA_0)	134.67c	135.44c	139.78bc	136.63b	
	25 (GA_1)	141.11bc	149.22ab	142.67bc	144.33a	
	50 (GA_2)	144.56bc	138.78bc	157.56a	146.96a	
Effect of Salicylic acid		140.11a	141.15a	146.67a		

*Mean values followed by different letters indicate significant differences at the probability of 0.05 according to Duncan's multiple range test (MRT)

The increase of sapling's stem diameter (mm):

Table (3) indicates that the addition of magnesium in the concentrations 50 and 100 $mg.L^{-1}$ led to a positive increase in the diameter in a rate of 19.52% and 37.87% consecutively as compared to the control, this can be explained by the fact that magnesium has a significant role in the increase in the total foliar area (table 6) and also the total foliar chlorophyll content (tables 7 and 8), also the magnesium is an important component of the chlorophyll molecule (Mengel & Kirkby, 2001) and the latter has the primary role in photosynthesis which in turn leads to various growth processes.
Also, the foliar spraying of gibberellic acid in the concentrations 25 and 50 $mg.L^{-1}$ led to a positive effect on the diameters of the saplings with an increased rate of 17.13% and 22.47% consecutively as compared to the control which gave the least values 3.56 mm.
This results can be attributed to the role of gibberellic acid that the increase of auxin production by reducing the enzymes IAA oxidase and Peroxidase (Hopkins and Huner, 2004), also the foliar

spraying has increased the total foliar area (table 6) and the total foliar chlorophyll content (tables 7 and 8) this in turn may lead to the increase of the photosynthesis and its utilization in several growth processes thus the increase in the saplings' diameters.
Spraying of salicylic acid in the concentrations 100 and 200 mg.L^{-1} didn't have any significant role in the increase of diameter values.

Table (3) Effect of magnesium, gibberellic and salicylic acids on increase of stem diameters (cm) of peach saplings cv. Miski.

Magnesium concentrations (mg.L^{-1})	**Gibberellic acid concentrations (mg.L^{-1})**	**Salicylic acid concentrations (mg.L^{-1})**			**interaction treatments of Mg and GA_3**	**Effect of magnesium (Mg)**
		0.0 (SA_0)	**100 (SA_1)**	**200 (SA_2)**		
0.0 (Mg_0)	0.0 (GA_0)	3.06cde	2.98de	2.92e	2.99d	**3.38 b**
	25 (GA_1)	3.63a-e	3.37b-e	3.29b-e	3.43cd	
	50 (GA_2)	3.39b-e	3.02cde	4.72a-e	3.71cd	
50 (Mg_1)	0.0 (GA_0)	3.72a-e	3.22b-e	3.28b-e	3.41cd	**4.04 a**
	25 (GA_1)	4.93abc	5.32a	3.97a-e	4.74ab	
	50 (GA_2)	3.17b-e	3.84a-e	4.90a-d	3.97bcd	
100 (Mg_2)	0.0 (GA_0)	4.82a-e	3.35b-e	4.67a-e	4.28bc	**4.66 a**
	25 (GA_1)	4.61a-e	3.28b-e	5.10ab	4.33bc	
	50 (GA_2)	5.28a	5.51a	5.37a	5.39a	
Interaction treatments of Mg & SA	0.0 (Mg_0)	3.36c	3.12c	3.64c	**Effect of gibberellic acid (GA_3)**	
	50 (Mg_1)	3.94bc	4.13abc	4.05abc		
	100 (Mg_2)	4.90ab	4.05abc	5.04a		
Interaction treatments of GA_3 & SA	0.0 (GA_0)	3.87bc	3.18c	3.62bc	3.56b	
	25 (GA_1)	4.39ab	3.99abc	4.12abc	4.17a	
	50 (GA_2)	3.95bc	4.12abc	5.00a	4.36a	
Effect of Salicylic acid		4.07a	3.77a	4.25a		

*Mean values followed by different letters indicate significant differences at the probability of 0.05 according to Duncan's multiple range test (MRT)

The interaction treatment by the highest concentration of magnesium and gibberellic acid (Mg_2GA_2) led to the greatest increase and positively exceeded the other treatment except for Mg_1GA_1, that increasing rate 80.27% as compared to the control which made the least growth 2.99 mm only.
Table (3) also shows that the high concentration of dual treatment of magnesium and salicylic acid gave the highest value of saplings' stem diameters and positively surpassed the control in an increased rate of 50%, besides the dual treatment Mg_0SA_1 gave the least growth and was 3.12mm.
The interaction treatment of gibberellic acid and salicylic acid has positively increased the diameter values in which GA_2SA_2 led to the widest diameter 5mm and positively exceeded the other formulas with increase rate recorded at 29.2% as compared to the control and 57.23% as compared to GA_0SA_1 which was the least effective treatment.

Concerning the triple treatment of magnesium and gibberellic and salicylic acids, the highest values were reported with the high concentration of magnesium and gibberellic acid and with three levels of salicylic acid, especially $Mg_2GA_2SA_1$ which positively surpassed many other treatments including the control with 80.06% increase and the formula $Mg_0GA_0SA_2$ had the least diameter values with an increase rate of 88.7%.

Length of the branch (cm):

The results in table (4) shows that the addition of magnesium to the soil and the foliar spraying of salicylic acid were performed separately did not positively effect on the branch lengths, but the foliar spraying of gibberellic acid alone has a positive effect on the length values in the two concentrations 25 and 50 mg.L^{-1} that gave 12.65% and 16.17% increasing rate consecutively as compared to the control which the latter gave the least growth in lengths measured at 61.64 cm. this

could be attributed to the role of gibberellic acid in the processes of cell division and elongation (Hartmann et al, 2002).

In the dual treatment of magnesium and gibberellic acid it was noted that there was no significant difference among the many formulas that were applied on the length values but they were all higher as compared to the control, and the highest value was recorded with Mg_2GA_2 with increase rate of 50.32% as compared to the control which had the shortest length of a branch 50.56 cm.

The dual treatment of magnesium and salicylic acid had a significant effect on the length of brunch, in which all the formulas except Mg_1SA_1 have positively exceeded the control treatment, but the longest branch was recorded in the formula Mg_2SA_2 with 76.72cm with increase rate 39.64% as compared to the control.

GA_1SA_1 and GA_2SA_2 treatments only that surpassed the control were with an increased rate of 19.79% and 24.21% respectively, the shortest lengths were in the treatment of GA_0SA_2 where branch length was 60.47cm.

Most of the triple treatment formula gave a positive increase in branch lengths as compared to the control, and particularly $Mg_2GA_1SA_2$ resulted in the highest values of 83.00 cm which is 86.52% higher than the control which gave the shortest length 44.5cm.

Table (4) Effect of magnesium, gibberellic and salicylic acids on brunch length (cm) of peach saplings cv. Miski.

Magnesium concentrations ($mg.L^{-1}$)	**Gibberellic acid concentrations ($mg.L^{-1}$)**	**Salicylic acid concentrations ($mg.L^{-1}$)**			**interaction treatments of Mg and GA_3**	**Effect of magnesium (Mg)**
		0.0 (SA_0)	**100 (SA_1)**	**200 (SA_2)**		
0.0 (Mg_0)	0.0 (GA_0)	44.50g	56.17d-g	51.00fg	50.56b	63.72a
	25 (GA_1)	57.33c-g	78.33abc	69.83a-f	68.50a	
	50 (GA_2)	63.00a-g	74.00a-e	79.33ab	72.11a	
50 (Mg_1)	0.0 (GA_0)	65.33a-g	65.83a-f	68.50a-f	66.56a	66.91a
	25 (GA_1)	66.50a-f	67.67a-f	68.17a-f	67.44a	
	50 (GA_2)	72.83a-f	55.33efg	72.00a-f	66.72a	
100 (Mg_2)	0.0 (GA_0)	74.67a-e	59.40b-g	74.67a-e	67.80a	72.06a
	25 (GA_1)	83.00a	71.00a-f	63.17a-g	72.39a	
	50 (GA_2)	77.83a-d	70.17a-f	80.00ab	76.00a	
Interaction treatments of Mg & SA	0.0 (Mg_0)	54.94c	69.50ab	66.72ab	**Effect of gibberellic acid (GA_3)**	
	50 (Mg_1)	68.22ab	62.94bc	69.56ab		
	100 (Mg_2)	72.61ab	66.86ab	76.72a		
Interaction treatments of GA_3 & SA	0.0 (GA_0)	61.50c	60.47c	62.94bc	61.64b	
	25 (GA_1)	62.33bc	72.33abc	73.67ab	69.44a	
	50 (GA_2)	71.94abc	66.50abc	76.39a	71.61a	
Effect of Salicylic acid		65.26a	66.43a	71.00a		

*Mean values followed by different letters indicate significant differences at the probability of 0.05 according to Duncan's multiple range test (MRT)

The leaf area (cm^2):

The results in a table (5) reveal that the addition of magnesium in 100 $mg.L^{-1}$ concentration has positively surpassed both the magnesium in 50 $mg.L^{-1}$and the control treatments and the latter being the weakest. This can be explained by the fact that Magnesium stimulates the Ribulose bisphosphate carboxylase enzyme which reacts with carbon dioxide CO_2 in the dark reactions of Calvin cycle, thus it leads to higher absorption of basic nutrients which in turn leads to a faster vegetative growth and increase in the leaf area (Mengel and Kirkby, 2001).

Table (5) Effect of magnesium, gibberellic and salicylic acids on leaf area (cm^2) of peach saplings cv. Miski.

		Salicylic acid concentrations		

Magnesium concentrations ($mg.L^{-1}$)	Gibberellic acid concentrations ($mg.L^{-1}$)	($mg.L^{-1}$)			interaction treatments of Mg and GA_3	Effect of magnesium (Mg)
		0.0 (SA_0)	100 (SA_1)	200 (SA_2)		
0.0 (Mg_0)	0.0 (GA_0)	22.94fg	22.18g	25.89d-g	23.67d	26.72c
	25 (GA_1)	27.09d-g	26.84d-g	26.44d-g	26.79cd	
	50 (GA_2)	31.94b-e	26.78d-g	30.39c-f	29.70bc	
50 (Mg_1)	0.0 (GA_0)	28.30d-g	27.81d-g	31.15b-e	29.09bc	29.31b
	25 (GA_1)	25.03efg	27.16d-g	28.81c-g	27.00cd	
	50 (GA_2)	30.89b-e	31.63b-e	32.97bcd	31.83ab	
100 (Mg_2)	0.0 (GA_0)	29.66c-g	27.12d-g	37.97ab	31.58ab	32.57a
	25 (GA_1)	32.29b-e	32.88bcd	30.36c-f	31.84ab	
	50 (GA_2)	26.02d-g	36.02abc	40.80a	34.28a	
Interaction treatments of Mg & SA	0.0 (Mg_0)	27.32cd	25.27d	27.57cd	**Effect of gibberellic acid (GA_3)**	
	50 (Mg_1)	28.07bcd	28.87bcd	30.98bc		
	100 (Mg_2)	29.32bcd	32.00b	36.38a		
Interaction treatments of GA_3 & SA	0.0 (GA_0)	26.97c	25.70c	31.67ab	28.11b	
	25 (GA_1)	28.14bc	28.96bc	28.53bc	28.54b	
	50 (GA_2)	29.62bc	31.48ab	34.72a	31.94a	
Effect of Salicylic acid		28.24b	28.72b	31.64a		

*Mean values followed by different letters indicate significant differences at the probability of 0.05 according to Duncan's multiple range test (MRT)

Spraying of gibberellic acid has led to a positive increase in the single leaf area for the saplings, the concentration of 50 $mg.L^{-1}$gave the greatest leaf area and positively surpassed the control and also the low concentration of gibberellic acid 25 $mg.l^{-1}$, and their increase rate 13.62% and 11.91% consecutively. This can be explained by the fact that the gibberellic acid has a major role in the cell division and elongation and stimulate the alpha-amylase and protease enzymes and others (Hopkins and Huner, 2004).

Foliar spraying of The high concentration of salicylic acid gave a high value of leaf area (31.64 cm^2) and has a positively increased this characteristic and exceeded the control which gave the least area 28.24 cm^2 and also exceeds the low concentration treatment which did not have any significant difference as compared to the control.

The dual treatment of both magnesium and salicylic acid Mg_2SA_2 gave the highest leaf area values and positively exceeded the other dual treatment of the two mentioned factors, with increase rate 33.16% as compared to the control, also Mg_2SA_1, in turn, has outperformed many other treatments including the control, the least recorded area was 25.27 cm^2 with Mg_0SA_1 which didn't have a significant advantage over the control.

Some of the dual treatments of gibberellic acid and salicylic acid forms gave a positive increase as compared to the control, especial the high concentration form GA_2SA_2 which gave an increase of 28.74% as compared to the control. In the triple treatment, it was found out that some of the formulas gave a positive increase in the leaf area as compared to the control and was most significant in the treatment $Mg_2GA_2SA_2$ which resulted in an area of 40.8 cm^2 and positively exceeded the control and $Mg_0GA_0SA_1$ with increase rate 77.85% and 83.95% respectively.

Total leaves area of sapling (dm^2):

The addition of magnesium in two concentrations 50 and 100 $mg.L^{-1}$positively surpassed the control with an increase rate 11.9% and 23.29% respectively, thus the high concentration surpassed the low concentration by 10.27%.

Table (6) Effect of magnesium, gibberellic and salicylic acids on total leaves area (dm^2) of peach saplings cv. Miski.

		Salicylic acid concentrations		

Magnesium concentrations ($mg.L^{-1}$)	Gibberellic acid concentrations ($mg.L^{-1}$)	($mg.L^{-1}$)			interaction treatments of Mg and GA_3	Effect of magnesium (Mg)
		0.0 (SA_0)	100 (SA_1)	200 (SA_2)		
0.0 (Mg_0)	0.0 (GA_0)	82.91f	81.85g	95.43d-g	86.70d	101.04c
	25 (GA_1)	116.95b-f	107.42c-g	98.59d-g	107.65bc	
	50 (GA_2)	116.86b-f	95.66d-g	113.80b-g	108.77bc	
50 (Mg_1)	0.0 (GA_0)	111.40b-g	111.30b-g	117.02b-f	113.24bc	113.06b
	25 (GA_1)	93.53efg	107.82c-g	108.80c-g	103.39c	
	50 (GA_2)	114.48b-g	123.46b-e	129.71bcd	122.55ab	
100 (Mg_2)	0.0 (GA_0)	109.23c-g	103.76c-g	144.56ab	119.18abc	124.67a
	25 (GA_1)	121.36b-e	130.16bcd	109.20c-g	120.24abc	
	50 (GA_2)	99.91d-g	136.22bc	167.64a	134.59a	
Interaction treatments of Mg & SA	0.0 (Mg_0)	105.57bcd	94.97d	102.58cd	**Effect of gibberellic acid (GA_3)**	
	50 (Mg_1)	106.47bcd	114.19bc	118.51bc		
	100 (Mg_2)	110.17bcd	123.83b	140.47a		
Interaction treatments of GA_3 & SA	0.0 (GA_0)	101.18bc	98.97c	118.97b	106.37b	
	25 (GA_1)	110.61bc	115.13bc	105.53bc	110.43b	
	50 (GA_2)	11.42bc	118.54b	137.05a	121.97a	
Effect of Salicylic acid		107.40b	110.85b	120.52a		

*Mean values followed by different letters indicate significant differences at the probability of 0.05 according to Duncan's multiple range test (MRT)

The spraying of gibberellic acid in 50 $mg.L^{-1}$yielded the highest leaves area as compared to the control and the low concentration of gibberellic acid 25 $mg.L^{-1}$in a rate of 14.67% and 10.45% respectively. The spraying of salicylic acid had similar results to the gibberellic acid, in which a high concentration 200 $mg.L^{-1}$gave the highest values as compared to the control and the low concentration 100 $mg.L^{-1}$in a rate of 12.22% and 8.72% respectively.

The increase in the total leaves area by the addition of magnesium and the foliar spraying of gibberellic acid and salicylic acid was attributed to their role in the increase of single leaf area (Table 5), it could be that each one of these factors have their own role in the increase the number of leaves in each sapling, thus there's an increase by multiplying the number of leaves by the area of a single leaf.

All the dual treatment formulas of magnesium and gibberellic acid have positively exceeded the control which gave the least total leaves area 86.7 $dm^{2,}$ the highest values were recorded in Mg_2GA_2 with 134.59 dm^2, there was an increased rate of 55.24% compared to the control treatment. And from the table (6) we can see that the dual treatment Mg_2SA_2 gave the highest total leaves area 140.47cm^2 and exceeded the control in rate of 33.06%, while the least recorded area was 94.97 dm^2 with the treatment Mg_0SA_1, also the interaction treatment of GA_2SA_2 yielded the highest area 137.05 dm^2 and exceeded the control by 35.45%. In the triple treatment, the formula $Mg_2GA_2SA_2$ gave the highest total leaves area as compared to the control with an increased rate of 102.2%.

Leaves relative chlorophyll content (SPAD) in April:

According to table (7), the addition of 100$mg.L^{-1}$magnesium to the soil has led to a positive increase in the leaves relative chlorophyll content with an increase rate 6.97% as compared to the control, this could be explained by the readiness of the added magnesium in the soil and the fast absorption by the roots and since the magnesium is the main component of the chlorophyll's structure (Al-Sahi,2005).

The high concentration of foliar spraying of gibberellic acid 50 $mg.L^{-1}$has positively exceeded both the control and the low concentration 25 $mg.L^{-1}$with an increased rate of 7.04% as compared to the control which gave the least leaves relative chlorophyll content (40.92 SPADs). Gibberellic acid's role in the increase in chlorophyll content is by increasing the production of carbohydrates that

involve in the chlorophyll synthesis, also gibberellic acid helps in reduction of chlorophyll's degradation. (Wasfi, 1995; Al-Khafaji and Muslat, 1995).

Table (7) Effect of magnesium, gibberellic and salicylic acids on Leaves relative chlorophyll content (SPAD) of peach saplings cv. Miski in April.

Magnesium concentrations ($mg.L^{-1}$)	**Gibberellic acid concentrations ($mg.L^{-1}$)**	**Salicylic acid concentrations ($mg.L^{-1}$)**			**interaction treatments of Mg and GA_3**	**Effect of magnesium (Mg)**
		0.0 (SA_0)	**100 (SA_1)**	**200 (SA_2)**		
0.0 (Mg_0)	0.0 (GA_0)	37.40ef	39.60def	40.40b-f	39.13d	40.89b
	25 (GA_1)	39.97c-f	41.57a-f	42.60a-e	41.38bcd	
	50 (GA_2)	41.57a-f	41.70a-f	43.17a-d	42.14bc	
50 (Mg_1)	0.0 (GA_0)	42.53a-e	40.13c-f	42.30a-e	41.66bcd	41.99ab
	25 (GA_1)	41.03b-f	42.93a-d	36.67f	40.21cd	
	50 (GA_2)	43.83a-d	42.10a-e	46.37a	44.10ab	
100 (Mg_2)	0.0 (GA_0)	40.83b-f	43.33a-d	41.73a-f	41.97bc	43.74a
	25 (GA_1)	43.50a-d	44.60a-d	44.13a-d	44.08ab	
	50 (GA_2)	45.00abc	45.47a-b	45.03abc	45.17a	
Interaction treatments of Mg & SA	0.0 (Mg_0)	39.46c	40.96bc	42.06abc	**Effect of gibberellic acid (GA_3)**	
	50 (Mg_1)	42.47ab	41.72abc	41.78abc		
	100 (Mg_2)	43.11bc	44.47a	43.36ab		
Interaction treatments of GA_3 & SA	0.0 (GA_0)	40.26c	41.02bc	41.48bc	40.92b	
	25 (GA_1)	41.50bc	43.03abc	41.13bc	41.89b	
	50 (GA_2)	43.47ab	43.09abc	44.86a	43.80a	
Effect of Salicylic acid		41.47a	42.38a	42.49a		

*Mean values followed by different letters indicate significant differences at the probability of 0.05 according to Duncan's multiple range test (MRT)

The salicylic acid concentrations hadn't any positive effect on this characteristic, while the dual treatment Magnesium and Gibberellic acid has positively exceeded the control, especially Mg_2GA_2 which gave the highest value 45.17 SPAD with an increased rate 15.44%, the control gave the least leaves relative chlorophyll content. Mg_2SA_1 gave the highest chlorophyll content and positively exceeded the other treatments including the control with an increase rate 12.7% as compared to the control.

Also, in the table, we note that the interaction treatment of high concentration of gibberellic and salicylic acids (GA_2SA_2) has only surpassed the control in a rate of 11.43%.

For the triple interaction treatments, some formulas have positively exceeded the control, $Mg_1GA_2SA_2$ gave the highest leaves relative chlorophyll content (46.37 SPAD) and positively surpassed the other treatments including the control and $Mg_1GA_1SA_2$ which the latter gave the least value with an increased rate of 23.98% and 26.45% respectively.

Leaves relative chlorophyll content (SPAD) in June:

Table (8) indicates that the addition of magnesium in 50 $mg.L^{-1}$and 100 $mg.L^{-1}$ to the soil has led to a positive increase in the relative chlorophyll content by 3.24% and 4.77% respectively as compared to the control. Also, the high concentration of foliar spraying of gibberellic acid in 50 $mg.L^{-1}$ gave a positive increase as compared to the control and the low concentration with an increased rate of 5.56% as compared to the control.

Table (8) Effect of magnesium, gibberellic and salicylic acids on Leaves relative chlorophyll content (SPAD) of peach saplings cv. Miski in June.

Magnesium concentrations ($mg.L^{-1}$)	Gibberellic acid concentrations ($mg.L^{-1}$)	Salicylic acid concentrations ($mg.L^{-1}$)			interaction treatments of Mg and GA_3	Effect of magnesium (Mg)
		0.0 (SA_0)	100 (SA_1)	200 (SA_2)		
0.0 (Mg_0)	0.0 (GA_0)	39.33g	41.27d-g	41.00efg	40.53c	41.08b
	25 (GA_1)	42.07c-g	41.00efg	40.23fg	41.10c	
	50 (GA_2)	40.37fg	42.77a-g	41.67d-g	41.60bc	
50 (Mg_1)	0.0 (GA_0)	41.53d-g	40.90efg	42.80a-f	41.74bc	42.41a
	25 (GA_1)	40.73efg	42.20b-g	40.60efg	41.18c	
	50 (GA_2)	43.57a-f	43.93a-e	45.47ab	44.32a	
100 (Mg_2)	0.0 (GA_0)	40.77efg	40.17e-g	42.07c-g	41.33c	43.04a
	25 (GA_1)	41.63d-g	43.57a-f	44.53a-d	43.24ab	
	50 (GA_2)	42.90a-f	45.03abc	45.73a	44.56a	
Interaction treatments of Mg & SA	0.0 (Mg_0)	40.59c	41.68bc	40.97c	**Effect of gibberellic acid (GA_3)**	
	50 (Mg_1)	41.94bc	42.34abc	42.96ab		
	100 (Mg_2)	41.77bc	43.26ab	44.11a		
Interaction treatments of GA_3 & SA	0.0 (GA_0)	40.54c	41.11c	41.96c	41.20b	
	25 (GA_1)	41.48c	42.26bc	41.79c	41.84b	
	50 (GA_2)	42.28bc	43.91ab	44.29a	43.49a	
Effect of Salicylic acid		41.43b	42.43a	42.68a		

*Mean values followed by different letters indicate significant differences at the probability of 0.05 according to Duncan's multiple range test (MRT)

As for salicylic acid, the two concentrations 100 $mg.L^{-1}$ and 200 $mg.L^{-1}$ gave a positive increase of 2.41% and 3.02% respectively as compared to the control. It is thought that salicylic acid involves in the production of porphyrins which participates in the process of chlorophyll production and also increases the production of proteins and nucleic acids thus increase in the division of chloroplasts and increase chlorophyll (Mohammed and Younis, 1991).

The different combination treatments had positive effects on the leaves relative chlorophyll content, in the dual treatment of Magnesium and gibberellic acid the two formulas Mg_1GA_2 and Mg_2GA_2 gave the highest values of the leaves relative chlorophyll content and positively exceeded most of the other forms of treatment, with increased rates 9.35% and 9.94% consecutively as compared to the control which gave the least the leaves relative chlorophyll content (40.53 SPAD). In the dual treatment of magnesium and salicylic acid, most of the formulas did not positively differ from the control, but the formula GA_2SA_2 gave the highest value and exceeded most other treatments in rates of 8.67% as compared to the control. Also, it was noted that all the forms of the dual treatment of gibberellic and salicylic acids did not result in any positive increase from the control except GA_2SA_1 and GA_2SA_2 that exceeded the other treatments in rates of 8.31% and 9.25% as compared to the control which gave the least leaves relative chlorophyll content.

As for the triple interaction treatments in the table, the high concentrations treatment, $Mg_2GA_2SA_2$ gave the highest values and positively exceed the other treatments including the control treatment ($Mg_0GA_0SA_0$) in a rate 16.27%, the control had the least leaves relative chlorophyll content.

REFERENCES:

Al- Khafaji, M. A. and M. M. Muslat (1995). Effect of GA_3 on fruit set and yield of *Citrus limon*, Burmann. CVS. Mahalee. J. Taqany- Taqania Res., 29: 126-141.

Al-Rawi, K. M. and A. M. Khalaf-Allah (2000). Design and Analysis of Agricultural Experiments. Dar-Alkutub for Printing and Publishing, Mosul University, Iraq.

Al-Sahi, B. Gh. (2005). Physiological Study of Production and Growth of *Gerbera jamesonii*, A PhD Thesis, College of Agriculture, Baghdad University, Iraq.

Chen, L.S. and L. Chen (2004). Photosynthetic enzymes and carbohydrate metabolism of apple leaves in response to nitrogen limitation. J. Hort. Sci. And Biotechnology, 79 (6): 923-929.
Cheng, L. and L. H. Fuchigami (2001). CO2 Assimilation in relation to nitrogen in apple leaves. J. Hort. Sci. and Biotechnology, 75 (4):383-387.
Hartmann, H. T.; D. E. Kester; F. T. Davies and J. R. L. Geneve (2002). Plant Propagation: Principle and Practices. 7th Ed. Prentice Hall, Upper Saddle River, New Jersey07458, PP: 880.
Hasan, T. Al-Sheikh (2002). Encyclopedia of Almond Fruits, 1st Edition, Aladdin Press, Damascus, Syria.
Hayat, S. and A. Ahmad (2007). Salicylic Acid: A Plant Hormone. Springer (Ed) Dordrecht, The Netherlands.
Hopkins, W.G. and N.P.A. Hüner (2004). Introduction to Plant Physiology.3 Ed Edit. John Wiley and Sons, Inc. U.S.A.
Mengel K, and E.A. Kirkby (2001). Principles of Plant Nutrition. Kluwer Academic Publishers, Dordrecht.
Mohammed, A.-A. K. and M. A. Younis (1991). The Principles of Plant Physiology, Part Three. Al-Hikma Press, Page 1-876.
Patton, L. (1984). Photosynthesis and Growth of Wild Used for Short Rotation Forestry.ph. D. Thesis submitted to the Univ. of Dublin (Trinity College). (C.F. Saieed, N.T. (1990). Studies of variation in primary productivity, growth and morphology in relation to the selective improvement of board leaved tree species.ph. D. Thesis National Uni. Ireland.
Popova, L; T. Pancheva, and A. Uzunova, (1997). Salicylic acid: properties, biosynthesis and physiological role. Bulg. J. Plant Physiol. 23:85-93.
Wasfi, E. (1995). Regulators of Growth and Flowering and Their Use in Agriculture, Academic Library, Cairo, Egypt.
Yassin, B. T. (1992). Physiology of Water Stress in Plants, Dar-Alkutub for printing and Publishing, Mosul University, Iraq.

تأثير المغنيسيوم والرش الورقي بحامضي الجبرليك والسلساليك في صفات النمو الخضري لشتلات الخوخ صنف مسكي (*Prunus persica* L.)

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المستخلص

نفذت التجربة في الظلة الخشبية التابعة لقسم البستنة وهندسة الحدائق/ كلية الزراعة جامعة تكريت خلال موسم النمو 2017 لمعرفة تأثير اضافة المغنيسيوم والرش الورقي بحامضي الجبرليك والسلساليك في صفات النمو الخضري لشتلات الخوخ صنف مسكي بعمر سنة واحدة والمطعمة على اصل المشمش البذري ، حيث اضيف المغنيسيوم بثلاثة مستويات هي صفر و 50 و100 ملغم.لتر$^{-1}$ ورمز لها Mg_0 و Mg_1 وMg_2 على التوالي، ورش حامض الجبرليك بالمستويات الثلاثة صفر و 25 و 50 ملغم.لتر$^{-1}$ ورمز لها GA_0 و GA_1 وGA_2 على التوالي ،كما رش حامض السلساليك بثلاثة مستويات صفر و 100 و 200 ملغم.لتر$^{-1}$ ورمز لها SA_0 و SA_1 و SA_2 على التوالي وان جميع هذه المعاملات اجريت ثلاث مرات خلال الموسم ابتداءً من 10 نيسان وبفاصل زمني قدره ثلاثة اسابيع . نفذت التجربة وفق نظام القطع المنشقة في تصميم القطاعات العشوائية الكاملة RCBD حيث وضعت مستويات المغنيسيوم في القطع الرئيسية ومستويات الرش بحامضي الجبرليك والسلساليك في القطع الثانوية، واظهرت النتائج. ان اضافة المغنيسيوم زادت معنوياً من صفات الزيادة في قطر الساق ومساحة الورقة الواحدة والمساحة الورقية الكلية للشتلة ومحتوى الاوراق من الكلوروفيل النسبي، في حين لم يؤثر معنوياً في صفة ارتفاع النبات وطول الفرع. كما ان رش الجبرليك زاد معنوياً من صفات ارتفاع الشتلة والزيادة في قطر الساق وطول الفرع ومساحة الورقة الواحدة والمساحة الورقية الكلية للشتلة، اما رش حامض السلساليك فزاد معنوياً من مساحة الورقة الواحدة والمساحة الورقية الكلية ومحتوى الاوراق من الكلوروفيل الكلي لشهر حزيران، في حين لم يؤثر

معنوياً في صفة ارتفاع الشتلة والزيادة في قطر الشتلة وطول الفرع ومحتوى الاوراق من الكلوروفيل النسبي لشهر نيسان، وان معاملات التداخل الثنائي او الثلاثي لعوامل الدراسة لاسيما بالمستوى العالي لكل منها أدت الى نتائج إيجابية في أكثر الصفات المدروسة.

الكلمات المفتاحية: الخوخ ، مسكي، حامض الجبرليك، السلساليك، المغنيسيوم.