

RESPONSE OF POMEGRANATE " CV. WONDERFUL" TRANSPLANTS TO MINERAL NUTRITION AND GIBBERRELIC ACID

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ABSTRACT

This study was aimed to investigate response of pomegranate " Cv. Wonderful" transplants to mineral nutrition and gibberellic acid, it was conducted at the Coll. of Agriculture Engineering Sciences-University of Baghdad, a factorial experiment was according to R.C.B.D. with three replicates for two consecutive growth seasons 2018-2019 to addition six treatments of nue tharyan fertilizer (N.P.K. 20:20:20 and some micronutrients) with three concentrations (0, 2.5, 5 gm.L⁻¹) for each of the soil fertilization and foliar application, and spraying of gibberellic acid (GA₃) with three concentrations (0, 50, 100 mg.L⁻¹), and their interaction. Addition of chemical fertilizer to the soil with highest concentration (5 gm.L⁻¹) was the most effective, where led to a significant increases in average of plant height (66.56, 47.05 cm), leaf chlorophyll content (318.3, 323.9 mg.100 g⁻¹ fresh weight) and leaf dry weight (43.51, 50.20 %) for both seasons, respectively. The average of plant height, leaf chlorophyll content and leaf dry weight were increased when sprayed of GA₃ at 100 mg.L⁻¹ which reached (71.18, 52.99 cm), (317.5, 322.8 mg.100g⁻¹ fresh weight) and (43.13, 48.15 %) to this traits for both seasons, respectively. the interaction between two factors showed a different effects between highest and lowest on all the traits for both seasons.

Keywords: Deciduous fruit trees, plant growth regulators, chemical fertilizer, growth, leaves mineral.

*Part of M.SC. thesis of the 1st author

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استجابة شتلات الرمان صنف وندرفل للتغذية المعدنية والرش بحامض الجبريليك

فاروق فرج جمعة
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باحث

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المستخلص

هدف الدراسة هو معرفة مدى استجابة شتلات رمان صنف وندرفل للتغذية المعدنية وحامض الجبريليك، أُجريت هذه الدراسة في كلية علوم الهندسة الزراعية/ جامعة بغداد بتجربة عاملية ضمن تصميم R.C.B.D. للموسمين 2018 و 2019 من خلال إضافة ستة معاملات من السماد المعدني nue Tharyan (المكون من العناصر N.P.K. 20:20:20 وبعض العناصر الصغرى) بثلاثة تراكيز (0، 2.5، 5 غم.لتر⁻¹) لكل من طريقتي التسميد الأرضي والرش الورقي. ورش حامض الجبريليك بثلاثة تراكيز (0، 50، 100 ملغم.لتر⁻¹) وتداخلاتها. إذ أدى التسميد الأرضي بتركيز 5 غم.لتر⁻¹ إلى زيادة معنوية في متوسط ارتفاع النبات (66.56، 47.05 سم) ومحتوى الأوراق من الكلوروفيل (318.3، 323.9 ملغم.100 غم⁻¹ وزن طري) ونسبة المادة الجافة في الأوراق (43.51، 50.20 %) لكلا الموسمين بالترتيب. فيما بلغ متوسط ارتفاع النبات ومحتوى الكلوروفيل ونسبة المادة الجافة في الأوراق عند رش حامض الجبريليك بتركيز 100 ملغم.لتر⁻¹ القيم التالية (71.18، 52.99 سم) و (317.5، 322.8 ملغم.100 غم⁻¹ وزن طري) و (43.13، 48.15 %) للصفات أعلاه بالترتيب.

الكلمات المفتاحية: فاكهة نفضية، منظمات النمو النباتية، السماد كيميائي، النمو، العناصر في الأوراق.

*البحث مستل من رسالة ماجستير للباحث الأول

INTRODUCTION

Pomegranate (*Punica granatum* L.) is one of the important fruits in the world, which belonging to deciduous fruit trees and specifically to Punicaceae family, Pomegranate mainly grown in tropical and subtropical regions, the origin of this fruit trees is Iran and it is extensively cultivated in the mediterranean region (10). Pomegranate can be grown within different soils, but that being expense of vegetative growth, quantity and quality of fruit yield (25). Plant nutrition is very important for increasing the agriculture production and improving fruits quality (12). Some Mineral fertilizers prepared industrially and contained one or more important elements and had a several nomenclatures. Nitrogen (N), Phosphorus (P) and Potassium (K) are essential elements to plant growth and it's development, it has a direct effect on vegetative growth, yield and fruit quality. (24). Several studies were conducted to determine the role of mineral nutrition in growth and leaf minerals, Abd-Ella *et al*, (1) Mentioned that fertilizing by N.P.K. on pomegranate had a significant effect on shoots length, leaves number, leaf area index, leaf chlorophyll content and leaf content of N.P.K., Abdel-Sattar and Mohammed (2) found that Nitrogen application on pomegranate significantly increased leaf dry weight and leaf content of N.P.K., Al-Douri (4) recommended in his thesis fertilizing of soil by N.P.K. because was most effective to increasing traits was studied on "CV. Salimi" Pomegranate. Gibberellic acid (GA_3) is tetracyclic diterpenoid compound, it is one of necessary plant growth promotors which can be used for increasing and stimulating of plant growing. Biologically, the effect of gibberellins is stimulating of juvenility, cell division and enlargement by increasing of auxin production and effectiveness (5). Several studies were conducted to investigate affections of GA_3 on fruit trees, Al-Rashdi *et al*, (7) recorded the spraying of GA_3 on Grape increased of N.P.K Leaf content. Al-Rawi *et al*, (9) founded that spraying of GA_3 on "cv. peento" peach trees to increasing leaf dry weight and N.P.K leaf content, spraying of GA_3 by 50 mg.L^{-1} caused a significantly increasing leaves Phosphorus, leaves number, Leaf area and stem diameter.

Meanwhile, the foliar spraying of GA_3 at 100 mg.L^{-1} caused a significantly increasing of leaf Nitrogen content and increases of trees height compared with control treatment in study of apricot trees by Al-Abassy (3). This study was aimed to improving of pomegranate transplants by chemical fertilizing and spraying of gibberellic acid (GA_3) at the beginning of their growth will be supporting of good vegetative growth and thus accelerate to arrival production stage.

MATERIALS AND METHODS

This study was applied at the research station, Department of Horticulture and Landscape design, College of Agriculture Engineering Sciences, University of Baghdad during the growing seasons, 2018 and 2019. Factorial experiment within Randomized Complete Block Design (R.C.B.D.) with three replicates. each experimental unit included two one-year-old transplant, all of which were almost uniform growth, it was cultivated in pots whereby distributed within three Replicates, to study the effect of chemical fertilizers and gibberellic acid (GA_3) on Pomegranate "Cv. Wonderful". This study included two factors: first factor, six treatment of nue tharyan fertilizer which consist of balanced N.P.K. (20:20:20) and some micronutrients (F) as follows F0 (0 g.L^{-1}), F1 (2.5 g.L^{-1} soil fertilization), F2 (5 g.L^{-1} soil fertilization), F3 (2.5 g.L^{-1} foliar application), F4 (5 g.L^{-1} foliar Application) and F5 (1.25 g.L^{-1} soil fertilization + 1.25 g.L^{-1} foliar application), and the second factor is gibberellic acid (G) with three levels as follows G0 (0 mg.L^{-1}), G1 (50 mg.L^{-1}) and G2 (100 mg.L^{-1}), and their interaction, The studied factors were sprayed 3 times and 15 days interval for both seasons, Genstat was used to analysis of data and compared their mean's by least significant difference (L.S.D.) under the 0.05 level, (0.05), (8).

Studied traits

Plant height (cm) : Plant height were taken before treatments application in both seasons (in March) and at the end of season (June).

Leaf chlorophyll content (mg.100 g^{-1} fresh weight): Leaf chlorophyll content was estimated in mid-June according to (15). The fourth leaf was taken from the shoot tip for each experimental unit whereby was read by

Spectrophotometer on the wave lengths (663-645nm).

Leaf dry weight

Various random samples leaves were taken from transplants after dried them until stability of its weight, and calculated by (dividing of fresh weight on dry weight) x100.

Leaf Nitrogen content (%)

The leaves were taken at the beginning of June and dried using electric oven at 65 °C for 72 hrs. until the weight was stabled. then grinded and 0.2 gm were taken to digested, the sample was digested via mixture of concentrated sulfuric acid and perchloruric acid with ratio of 1:3, the Nitrogen was estimated by using micro Kjeldahl apparatus (17).

Leaf Phosphorus content (%)

It was estimated in June. using ammonium molybdates and ascorbic acid after taking the sample from digested extract and using spectrophotometer in wave length (882 nm) according to the method of Olsen and Sommers (22).

Leaf Potassium content (%)

Potassium was estimated in June by using the Flame photometer apparatus, based on the method proposed by Haynes (17).

RESULTS AND DISCUSSION

Plant height (cm): The results in Table 1 shows a significant differences among plants height between both factors and their interaction. all treatments of chemical fertilizer (N.P.K.) was significantly superior to non-fertilizing treatments for plant height. the soil fertilizing treatment (F2) with concentration of (5 gm.L⁻¹) had a highest plant tallest for both seasons respectively (66.56, 47.05 cm), respectively. While the (F0) plants recorded the shortest (52.03, 38.17 cm), for both seasons respectively. Spraying of GA₃ gave a significantly increases plant in height, on the concentration G2 (100 mg.L⁻¹) which had almost height in both seasons (71.18, 52.99 cm), But, the control (G0) had recording the lowest value (47.11, 28.63 cm), for the both seasons, respectively. The interaction between chemical fertilizer and GA₃ showed a significant difference for both seasons. The treatment (F2G2) produced the highest of plants height (77.50, 56.03 cm) for both seasons, respectively. While, F0G0 treatment caused the lowest increases of plant height for

both seasons (30.88, 21.47 cm), this revealed that the response of pomegranate seedlings to chemical fertilizers and spraying GA₃ were differed accordingly.

Leaf chlorophyll content (mg.100g⁻¹ fresh weight)

Results in Table 1 shows a significant differences among chemical fertilizer, GA₃ and their interaction in leaves chlorophyll content for both seasons. The F2 plants had a highest values of chlorophyll content (313.3, 323.9 mg.100g⁻¹ fresh weight) while the control treatment (F0) recorded the lowest values (288.0, 304.3 mg.100g⁻¹ fresh weight) for both season, respectively. The spraying of GA₃ had a significant differences for both seasons, but the G2 treatment with concentration at (100 mg.L⁻¹) recorded the highest values of this trait which reached (317.5, 322.8 mg.100g⁻¹ fresh weight), while the control treatment (G0) gave the lowest value of (286.1, 306.2 mg.100g⁻¹ fresh weight) for both seasons, respectively. Interaction between two factors showed significant differences where the F2G2 treatment gave the highest value of (340.0, 331.3 mg.100g⁻¹ fresh weight), while the control treatment (F0G0) gave the lowest value (277.9, 293.4 mg.100g⁻¹ fresh weight) for both seasons, The results showed that the pomegranate seedlings leaf chlorophyll response to chemical fertilizer was differed with compared to Gibberellic acid.

Leaf dry weight (%)

Results in Table 1 shows a significant differences between both factor treatments in leaf dry weight for both seasons. The soil addition of chemical fertilizer to the soil (N.P.K.) with concentration (5 gm.L⁻¹) gave a highest value for both seasons (43.51, 50.20%) respectively, but didn't significantly different with others in first season except control treatment which gave a lowest value (40.18, %), The significant differences in the second season was more clearly than previous with all fertilizer treatments compared with control (F0) which gave a lowest value (45.37 %), while spraying of GA₃ didn't appearing significantly effect on this parameter during the first season. but, in the second year of experiment G1 treatment gave a highest value of leaf dry weight which reached (49.40 %) compared with the lowest value (47.05 %) at

G0. meanwhile, didn't registered any significant differences with interaction treatments during both seasons. The nue tharyan fertilizer contain of macronutrient elements, which represented by Nitrogen, Phosphorus and Potassium, in their availability form, are essential for conducting vital processes within the plant and which necessary for vegetative growth. The results revealed that significant increases in plant height, leaf chlorophyll content and leaf dry weight was recorded in all fertilizer treatment. Nitrogen is very important element to cell division for increasing numbers of the cells and their size in the leaves, which increases the leaf area as a result of its entry into the structure of the amino acids, nucleic acids, that are important in the cell division and expansion of cells and its entry into the formation of amino acid, including Tryptophan which enters in to the biosynthesis pathway for Auxin, (13) Nitrogen had a positive role to formation of group porphyrin that enters to chlorophyll pigment structure (16). The indicates to increase of total chlorophyll in leaves. Phosphorus enters in the energy-rich compounds and photosynthesis process, thus increasing the production of nutrient elements within the plant, thus improving vegetative growth (19, 26). The vegetative growth activity is increased as result to the effect of Potassium as a catalyst in the formation of chlorophyll and proteins, which will do a lot of biological

processes such as photosynthesis, carbohydrate metabolism and organization mechanism of opening and closing of stomata, which leads to the improvement of vegetative traits, leads to the increase of manufactured materials, the transition to parts of the plant, increasing the length and number of its branches, and the availability of nutrient elements will help to increasing of growth and this is reflected on the manufacture of carbohydrates in the leaves as shows in Table 1, (18, 21). The data cleared that spraying of gibberellic acid (GA_3) treatments gave a significantly increases in studied traits (Table 1), for both seasons respectively, compared with control treatment. this is probably due to ability of GA_3 to increases and activations of some biological function and processes such as photosynthesis and stimulate production of auxin which have effects to growth and development of plants (5). Gibberellins are involved in the cell division and cell elongation, they also reported it is promoting growth by increasing plasticity of the cell wall followed by hydrolysis of starch that turns to sugar which reduce the cell water potential that resulting in the entry of water into the cell and causing more elongation and expansion of plant cells which reflected to improving of vegetative growth (20). Generally, these results are agreement with results of other researchers (6, 11, 14, 23).

Table 1. Effect of mineral nutrition and gibberellic acid on plant height, leaf chlorophyll content, leaf dry weight

Treatments	Plant height (cm)		Leaf chlorophyll content (mg.100 g ⁻¹ fresh weight)		Leaf dry weight (%)	
	2018	2019	2018	2019	2018	2019
F0	52.03	38.17	288.0	304.3	40.81	45.37
F1	62.93	39.88	303.8	314.1	42.92	48.50
F2	66.56	47.05	318.3	323.9	43.51	50.20
F3	59.53	38.34	294.5	312.8	42.35	47.32
F4	61.96	41.96	300.3	316.6	42.91	48.73
F5	62.55	38.48	305.6	317.9	43.12	49.08
L.S.D.	1.36	3.40	4.3	2.8	1.65	1.46
G0	47.11	28.63	286.1	306.2	42.23	47.05
G1	64.49	40.31	301.5	315.7	42.45	49.40
G2	71.18	52.99	317.5	322.8	43.13	48.15
L.S.D.	0.96	2.40	3.0	2.0	N.S.	1.03
F0G0	30.88	21.47	277.9	293.4	40.41	43.29
F0G1	58.71	35.30	282.9	303.4	40.56	47.30
F0G2	66.49	57.74	303.2	316.1	41.46	45.52
F1G0	48.52	25.50	285.0	305.9	42.79	48.21
F1G1	66.92	39.98	301.4	315.4	42.82	48.88
F1G2	73.35	54.16	325.1	320.9	43.13	48.40
F2G0	52.12	38.38	298.6	318.7	42.90	49.33
F2G1	70.04	46.73	316.3	321.7	43.10	50.58
F2G2	77.50	56.03	340.0	331.3	44.53	50.70
F3G0	49.50	27.92	280.0	302.8	41.65	45.25
F3G1	61.43	38.85	294.6	315.5	42.18	49.39
F3G2	67.67	48.26	308.8	320.0	43.22	47.33
F4G0	50.86	31.60	284.8	306.3	42.52	47.80
F4G1	64.17	41.23	305.9	317.9	42.98	50.07
F4G2	70.83	53.06	310.2	325.7	43.23	48.32
F5G0	50.77	26.89	290.7	310.3	43.10	48.39
F5G1	65.64	39.80	308.1	320.2	43.06	50.21
F5G2	71.25	48.74	318.1	323.1	43.19	48.65
L.S.D.	2.31	5.88	7.4	4.8	N.S.	N.S.

Leaf Nitrogen content (%)

The results in Table 2 shows a significant differences among two variables during both seasons in this trait, Where the soil fertilization of (N.P.K.) gave a significantly increased to highest value with F2 treatment which recorded (2.031, 1.961 %). While the control treatment (F0) recorded the lowest value (1.708, 1.670 %), respectively. Gibberellic acid gave a significant difference between all treatments for both seasons where the treatment G2 recorded the highest value which reached (2.111, 1.980 %), while the control treatment gave a lowest value was (1.733, 1.700 %). the Interaction treatments didn't

show a significant effect of leaves Nitrogen content during first season, but in season 2019 the interaction F2G2 gave a highest value which reached (2.233 %) compared with control treatment (F0G0) which recorded the lowest value (1.630 %), of leaves Nitrogen content.

Leaf Phosphorus content (%)

The results in Table 2 shows a significant differences of chemical fertilizer which caused a significantly increases to leaf phosphorus content for both seasons, F2 treatment had a highest value (0.153, 0.135 %) for both seasons, respectively, while the non-fertilizing treatment (F0) recorded the lowest value of

(0.117, 0.110 %). increasing of phosphorus content in leaves due to spraying of GA₃ especially at concentration 100 mg.L⁻¹ (G2) which gave a highest values of (0.149, 0.137 %) for both seasons respectively, while the control treatment (G0) gave the lowest value which amounted to (0.138, 0.120 %) for both seasons, respectively. Interaction between two factors shows a significant differences, where the F2G2 treatment gave a highest value (0.160, 0.148 %) for both seasons, respectively, while the control treatment (F0G0) recorded the lowest value (0.114, 0.105 %) for both seasons, respectively.

Leaf Potassium content

Table 2. Effect of Mineral Nutrition and Gibberellic acid on percentage of elements (N.P.K.) in leaves (%)

Treatments	Leaf Nitrogen content (%)		Leaf Phosphorus content (%)		Leaf Potassium content (%)	
	2018	2019	2018	2019	2018	2019
F0	1.708	1.670	0.117	0.110	1.255	1.672
F1	2.030	1.886	0.151	0.129	1.571	1.822
F2	2.031	1.961	0.153	0.135	1.668	1.886
F3	1.831	1.735	0.147	0.130	1.577	1.761
F4	1.920	1.841	0.150	0.131	1.637	1.828
F5	1.977	1.810	0.149	0.130	1.609	1.856
L.S.D.	0.101	0.061	0.003	0.003	0.080	0.025
G0	1.733	1.700	0.138	0.120	1.298	1.750
G1	1.904	1.771	0.146	0.125	1.537	1.780
G2	2.111	1.980	0.149	0.137	1.823	1.883
L.S.D.	0.071	0.043	0.002	0.002	0.056	0.017
F0G0	1.496	1.630	0.114	0.105	0.962	1.626
F0G1	1.681	1.683	0.117	0.110	1.238	1.683
F0G2	1.946	1.696	0.120	0.115	1.567	1.706
F1G0	1.845	1.723	0.151	0.113	1.359	1.760
F1G1	1.953	1.803	0.152	0.133	1.605	1.783
F1G2	2.291	2.133	0.150	0.143	1.749	1.923
F2G0	1.901	1.760	0.145	0.131	1.377	1.833
F2G1	2.005	1.890	0.155	0.127	1.680	1.853
F2G2	2.187	2.233	0.160	0.148	1.948	1.973
F3G0	1.650	1.686	0.137	0.125	1.338	1.703
F3G1	1.844	1.723	0.147	0.128	1.559	1.753
F3G2	1.999	1.796	0.156	0.136	1.834	1.826
F4G0	1.707	1.703	0.142	0.128	1.380	1.773
F4G1	1.953	1.763	0.154	0.123	1.576	1.786
F4G2	2.100	2.056	0.156	0.142	1.954	1.926
F5G0	1.801	1.696	0.140	0.121	1.375	1.803
F5G1	1.988	1.766	0.154	0.128	1.565	1.823
F5G2	2.142	1.966	0.153	0.141	1.888	1.943
L.S.D.	N.S.	0.105	0.005	0.006	N.S.	0.043

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