

EFFECT OF PHOSPHOR FERTILIZER, MAGNETIC WATER AND HUMIC ACID ON THE GROWTH, PHOTOSYNTHESIS PIGMENTS AND OIL YIELD COMPONENTS OF *Nigella sativa* PLANT

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ABSTRACT

Pots experiment was carried out in the greenhouse of Horticulture Department College of Agriculture Engineering Sciences/ University of Duhok to investigate the influence of three levels of P₂O₅ fertilizer (0, 260 and 520 mg) per pot , humic acid at (0, 0.6 and 0.8 mg.L⁻¹) and magnetic water with three group, group (1) irrigated with tap water, group (2) irrigated with magnetized water remain in the container for 12 hours and group (3) irrigated with magnetized water remain in the container for 24 hours on the growth and oil yield of Black cumin *Nigella sativa* L. The experimental treatments consisted of five replications in Random Complete Block Design (RCBD). The results revealed that P₂O₅ fertilizer at 520 mg.pot⁻¹ significantly increased all the studied characteristics. Humic acid at 0.6 and 0.8 mg.L⁻¹ had no significant effect on most of the studied characteristics except total chlorophyll and volatile oil. The group of plants that irrigated with magnetic water for 24 h caused significant increasing in all studied characteristics. Double and triple interactions among studies factors showed significant influence on all the studied characteristics as compared to untreated plants including (plant height, number of branches per plant, stem diameter, number of capsule/plant, dry weight, total chlorophyll, fixed oil percentage, volatile oil percentage and total carbohydrates percentage).

Key words: Black cumin, Humic acid, Magnetic water.

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INTRODUCTION

One of the most important medicinal plants is Black cumin (*Nigella sativa* L). It is an annual herbaceous plant belonging to the family Ranunculacea which grows in west Asia and Mediterranean region, it is one of the most studied plants extensively due to its importance in phytochemical and pharmaceutical aspects (Riaz *et al.*, 1996).The plant acquired its Pharmacological activity and its medical value in great splendor and occupied a special place for medicinal plants in the Islamic civilization through the ideological belief in its treatment of multiple diseases the holy prophet, Mohammed (peace be upon him) that the plant is Heals all sickness except death. (Ul-Hassan Gilani.,*et al* 2004). It has been used as a herbal medicine for more than 2000 years. It is also used as a food additive and flavor in many countries; it was used as natural remedies traditionally from ancient time may be from Assyrian civilization (Kamil, 2003). Traditionally the black seed and its oil show effectively range of antibacterial, antitumor, anorexia, anti-inflammatory, fever, hypoglycemic, skin disease, muscle relaxant, cough and immune stimulant activities (Hosseinzadeh *et al.*, 2007; and Buriro and Tayyab, 2007 and Shabnam *et al.*, 2012). Researcher mentioned that most of these effects attributed to the essential and volatile oils of *N.sativa* plant seeds (Nickavar *et al.*, 2003 and Gharby *et al.*, 2014). It was also reported that high levels of nitrogen and

phosphorus fertilizers (280 N and 260 P₂O₅ kg ha⁻¹) caused significant increase in fixed oil, volatile oil, protein and phosphorus content in the seeds of *Nigella sativa* plant (Hammo, 2008). Al- Rubaye, (2009) concluded that providing nigella plants with foliar fertilizers during active vegetative growth increases yield significantly when compared with soil applied fertilizers.

Recently the use of physical methods for plant growth stimulation is getting more popular due to the less harmful influence on the environment. Moreover, magnetized water for irrigation is recommended to save irrigation water (Al-adjadjiyan, 2007).

Magnetic water is considered one of several physical factors effects on plant growth and development. Magnetic water fields are known to induce biochemical changes and could be used as a stimulator for growth related reactions (Hameda and El-Sayed, 2014).

Magnetic Water plays important role in the growth of any plant. on the quality of water used is such as enhances the growth, good quality and quantity and good yield of plants (Mousavi 2011; Fard *et al.*, 2011).The effects of magnetic treatment of irrigation water and snow pea (*Pisum sativum* L var. macrocarpon) and Kabuli chickpea *Cicer arietinum* L on the seeds emergence, early growth and nutrient contents of seedlings were investigated under glasshouse conditions the results showed that magnetic water led to a significant increase in emergence rate index 42% for snow pea and 51% for chickpea), shoot dry weight (25% for snow pea and 20% for chickpea) and contents of N, K, Ca, Mg, S, Na, Zn, Fe and Mn in both seedling varieties compared to control seedlings Maheshwari and Grewal (2010). Also studied the changes in plants with seeds subjected to electric, magnetic or electromagnetic field. Effect of high voltage field on fruits like pineapple has also been studied Dastgheib *et al.*,(2013).

Effect of Magnetic water on chemical composition and nutrients on the *Vicia faba*, L. cv. Giza 3 plant the seeds of broad bean were irrigated with water passed through magnetic device is carried out by (Hameda and El Sayed, 2014), the results showed that magnetic water treatment enhanced the growth, chemical constituents such as chlorophyll a and b, carotenoids, total available carbohydrates, protein, total amino acids, total phenol, RNA,DNA,) and inorganic minerals (K⁺, Na⁺, Ca⁺²and P⁺³) contents in all parts of broad bean plant

Humic acid is one of the novel materials when it applied to nutrient solution enhanced the growth of transplants also increased the minerals structure (David *et al.*, 1994). It has efficiency in the growth of plants and the availability of the elements, the using of humic acid even though with little concentration lead to increase permeability of the cellular membrane (Solange and Rezende 2008). Humic acid promoted plant growth and induced soil microorganisms like bacteria and fungi and provide carbon as a source for the organism's humic acid as well acting as chelating good martial, (Leonard, 2008). Humic compounds are the most abundant of the complex ligands, which are found in nature. In this regard, it is well known that the humic compounds improve soil structure, increase soil microbial population, increase soil cation exchange capacity and providing some specific materials for plant root indirectly by providing macro and micro minerals, leading

to the increase of soil fertility (Rizal *et al.*,2010). Similar to these results Gad El-Hak *et al.*, (2012) obtained that foliar application of pea plants with humic acid is very beneficial to the crop growth and yield.

This study was done to clarify the influence of phosphor fertilizers, magnetic water and humic acid on vegetative, reproductive growth, photosynthesis pigments and seeds oil yield of *Nigella sativa* plant.

MATERIALS AND METHODS

Pots experiment was conducted at 2013 in greenhouse of Horticulture department /college of Agriculture Engineering Sciences /University of Duhok to investigate the effect of some agricultural factors on vegetative growth and oil seed yield of *Nigella sativa* L. The seeds which were bought from the herbal market of Duhok city were cultivated in 15th Oct 2013 sowed handily in with (15 cm) diameter were filled with soil that analyzed physically and chemically in the laboratory of soil department, as showed in (Table 1). The plants were fertilized with three level of phosphor (0, 260 and 260 mg) P₂O₅ per pot added to the plants after 3 to 4 pairs of leaves were appeared. Humic acid at three concentrations (0 and 0.6 and 0.8 mg.L⁻¹) were sprayed after one month of planting by three times within ten days intervals. The plants were watered with magnetized water was prepared by passing through a pair of strong permanent magnets disk (0.32T) with opposite polarity created in the Physics department college of science in Duhok University without side effects. Which positioned outside polymer container in opposite pole configuration. Three groups were used, group (1) irrigated with tap water, group (2) irrigated with magnetized water remain in the container for 12 hours and group (3) irrigated with magnetized water remain in the container for 24 hours, to check if the water is magnetized or not a simple test was done cardboard was placed over a pair of strong permanent magnets then few drops of magnetized water were poured on cardboard exactly above the magnets. The water if properly magnetized stayed in a circular form whereas normal water failed to stay. Weeds were removed by hand and all agriculture practices were done as needed. Harvesting was done on 15th June 2013 manually by pulling the dry plants out of the soil.

Experimental measurements concluded some vegetative growth (high of plant, stem diameter, number of branch per plant, number of capsule per plant, and dry weight vegetative growth and some photosynthesis pigments, oil yield of seeds and total carbohydrate.

Fixed oil percentage measurement according to (A,O,A,C,2000), volatile oil percentage measurement according to British pharmacopeia, (Ggrainger, 1968) which was mentioned by (Ranganna,1986), total carbohydrate measurement according to Herbert *et al.* (1971) using the Spectra photometer .

Table (1): Physical and chemical properties of soil.

N%	P%	K%	EC mmhos/cm	pH	Organic matter %	CaCO ₃ %
0.023	0.008	0.084	1.8	7.64	1.08	24.04
Clay %	Sand %	Silt		Texture		
16.93	58.62	23.0		Sandy Silt		

All measured Characters were subjected to variance analysis. And all data obtained were analyzed and compared statistically at a significance level of 5%, using SAS program (SAS, 2007).

RESULTS AND DISCUSSION

Vegetative Growth Trails.

Height of plant. (cm).

The results in Table (2) indicated that P_2O_5 fertilizer at 520 mg.pot^{-1} significantly increased the height of plant (58.82 cm) compared to (45.18 cm) at $0 \text{ mg.pot}^{-1} P_2O_5$, also mentioned that the effect of magnetic water represented was significantly increased the height of plants to (59.03 cm) in comparison with untreated plant was (53.98 cm) .while the height of plant had no significant effect when treated with humic acid the values were (56.86, 56.61 and 56.82 cm) respectively for 0,0.6,0.8 mg.L^{-1} concentration . The interaction between P_2O_5 at 520 mg.pot^{-1} and magnetic water with 24 h gave the highest plants (61.08 cm) as compared to untreated (51.40 cm). On the other hand there was no significant effect on the high of plants when p_2o_5 with H.A used. The interaction between P_2O_5 fertilizer and humic acid showed significant differs when P_2O_5 fertilizer at 520 mg.pot^{-1} with all concentrations of humic acid (58.89, 58.70 and 56.87 cm) respectively as compared to (53.88 cm) when treated with $P_2O_5 0 \text{ mg.pot}^{-1}$ fertilizer combined with 0.6 mg.L^{-1} .The same table showed that applying humic acid at all concentration interacted with magnetic water treatments effected on the height of plant significantly (59.07,59.03 and 58.98 cm) respectively comparing to the untreated plants (54.06,53.77 and 54.11 cm) . The triple interaction among p_2o_5 at 520 mg.pot^{-1} . magnetic water with 24 h and humic acid at 0,0.6 and 0.8 mg.L^{-1} obtained the best values included (61.10,61.12 and 61.03 cm) respectively when compared with 0 mg.pot^{-1} of P_2O_5 , magnetic water with humic acid ¹(51.56, 51.04, and 51.60 cm) respectively.

Number of Branches (branch.Plant⁻¹).

Table (3) showed that P_2O_5 at 520 mg. pot^{-1} concentration gave the highest number of branches (7.88 branch. Plant⁻¹) as compared to (7.18 branch. Plant⁻¹) with treated plants. The highest number of branches was noticed when the plants irrigated with magnetic water for 24 h it was (7.89 branch. Plant⁻¹) as compared to the plants that irrigated by tap water (7.08 branch.Plant⁻¹). While there are no significant effect appeared when the treated with humic acid at all concentrations. The interaction between P_2O_5 at mg. pot^{-1} and magnetic water with 24 h gave the highest value of branches number (8.24 branche. Plant⁻¹) as compared to (6.72 branch.Plant⁻¹) with untreated plants. While there was significant effect on the number of branches when P_2O_5 at 520 mg. pot^{-1} with humic acid at all concentrations (7.85,7.89 and 7.90 branch.Plant⁻¹) respectively as compared to (7.19, 7.14 and 7.20 branch. Plant⁻¹) respectively for P_2O_5 at 0 mg. pot^{-1} interacted with all humic acid concentrations. The same table showed that adding humic acid at all concentrations interacted with magnetic water 24 h significantly differs (7.85, 7.86 and 7.98 branch. Plant⁻¹) as compared to (7.06, 7.12 and 7.20 branch. Plant) at magnetic water 0 h interacted with humic acid at all concentrations. Regarding to the triple

interaction among P₂O₅ at 520 mg. pot⁻¹, magnetic water 24 h and humic acid at all concentrations gave the significant value (8.17,8.22and 8.32 branch. plant¹) in comparison with lowest value obtained from the interaction of 0 mg. pot⁻¹ of p₂o₅ ,magnetic water 0 h and humic acid at all concentrations (6.73.6.73 and 6.70 branch.plant¹) respectively.

Table (2): Effect of phosphor fertilizer, magnetic water and humic acid on the hight of *Nigella sativus* plant (cm).

P ₂ O ₅ (mg.pot ⁻¹)	Magnetic water (hours)	Humic acid(mg.L ⁻¹)			P ₂ O ₅ × Magnetic water	P ₂ O ₅ effect
		0	0.6	0.8		
0	0	51.56f	51.04f	51.60f	51.40 f	54.18 c
	12 h	54.95e	54.29e	54.86e	54.70 e	
	24 h	56.57d	56.30d	56.47d	56.45d	
260	0	54.53e	54.42e	54.57e	54.50 e	57.29 b
	12 h	57.92c	57.67c	57.83c	57.88 c	
	24 h	59.54b	59.68b	59.44b	59.55 b	
520	0	56.09 d	55.86d	56.16d	56.03 d	58.82 a
	12 h	59.48b	59.11b	59.42b	59.34 b	
	24 h	61.10 a	61.12a	61.03a	61.08 a	
P ₂ O ₅ × Humic acid	0	54.36 c	53.88d	54.31c	Magnetic water effect	
	260	57.33b	57.26b	57.28b		
	520	58.89 a	58.70a	58.87a		
Magnetic water × Humic acid	0	54.06 c	53.77c	54.11c	53.98 c	
	12 h	57.45b	57.03b	57.37 b	57.28 b	
	24 h	59.07 a	59.03a	58.98 a	59.03 a	
Humic acid effect		56.86 a	56.61 a	56.82 a		

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

Table (3): Effect of phosphor fertilizer, magnetic water and humic acid on the branches number of *Nigella sativus* plant (branch.plant⁻¹).

P ₂ O ₅ (mg.pot ⁻¹)	Magnetic water (hours)	Humic acid(mg.L ⁻¹)			P ₂ O ₅ × Magnetic water	P ₂ O ₅ effect
		0	0.6	0.8		
0	0	6.73 k	6.73 k	6.70 k	6.72g	7.18 c
	12 h	7.34 g-j	7.21 h-j	7.28 h-j	7.28 e	
	24 h	7.51 f-h	7.47f-i	7.62 e-g	7.53 cd	
260	0	7.08 j	7.14 ij	7.08 j	7.10f	7.56 b
	12 h	7.70 d-f	7.62 e-g	7.65 e-g	7.66 c	
	24 h	7.87 c-e	7.88 c-e	7.99 b-d	7.92 b	
520	0	7.38 f-j	7.48 f-h	7.40 f-j	7.42 cd	7.88 a
	12 h	8.00 b-d	7.96 b-d	7.98 b-d	7.98 b	
	24 h	8.17 bc	8.22 ab	8.32 a	8.24 a	
P ₂ O ₅ × Humic acid	0	7.19 c	7.14 c	7.20 c	Magnetic water effect	
	260	7.55 b	7.55 b	7.58 b		
	520	7.85 a	7.89 a	7.90 a		
Magnetic water × Humic acid	0	7.06 c	7.12 c	7.06 c	7.08 c	
	12 h	7.68 b	7.60 b	7.64 b	7.64 b	
	24 h	7.85 a	7.86 a	7.98 a	7.89 a	
Humic acid effect		7.53 a	7.52 a	7.56 a		

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

Stem diameter (mm).

The data in Table (4) recorded that significant effect appeared in stem diameter of the plants when P₂O₅ 520 mg. pot⁻¹ concentration compared to untreated plants and the values respectively were (5.24 and 4.52mm). Irrigating the plants with magnetic water 24h was significantly differed with the plans irrigated with 0 and 12h tap water and they were respectively (5.33, 4.48 mm and 4.93). The results also showed that all concentrations of humic acid do not have significant effect on stem diameter. Significant effect was observed with interaction between P₂O₅ 520 mg. pot⁻¹ and magnetic water 24 h gave (5.65mm) as compared to 0 mg. pot⁻¹ (4.08 mm). The interaction between P₂O₅ 520 mg. pot⁻¹ fertilizer with all concentrations of humic acid were significantly effected (5.20, 5.28 and 5.23 mm) respectively as compared to other treatments especially at P₂O₅ 0 mg. pot⁻¹ for all the concentrations of humic acid the values were (4.58, 4.45 and 4.52 mm) respectively. The same direction was observed with interaction between humic acid at all concentration with magnetic water 24 h obtained significant effect on the stem diameter (5.32, 5.33 and 5.34mm) compared to the untreated plants by magnetic water with all concentrations of humic acid (4.49, 4.50 and 4.45 mm) respectively. The triple interaction among the triple interaction among P₂O₅ at 520 mg. pot⁻¹,

magnetic water 24 h and humic acid at all concentrations obtained the highest values of stem diameter (5.59,5.69 and 5.66 mm) compared to lowest values (4.15,4.03 and 4.06 mm) respectively for P₂O₅ at 0 mg. pot⁻¹ , magnetic water 24 h and humic acid at all concentrations.

Table (4): Effect of phosphor fertilizer, magnetic water and humic acid on the stem diameter of *Nigella sativus* plant (mm).

P ₂ O ₅ (mg.pot ⁻¹)	Magneti c water (hours)	Humic acid(mg.L ⁻¹)			P ₂ O ₅ × Magnetic water	P ₂ O ₅ Effect
		0	0.6	0.8		
0	0	4.15 l	4.03 l	4.06 l	4.08 g	4.52 c
	12	4.61 i-k	4.46 k	4.53 jk	4.54 f	
	24	4.98e-h	4.87 i-h	4.95f-h	4.93 de	
260	0	4.57 jk	4.60 i-k	4.51	4.56 f	4.99 b
	12	5.03d-h	5.03d-h	4.98 e-h	5.01 d	
	24	5.39 c	5.44 a-c	5.40 bc	5.41 b	
520	0	4.77 h-j	4.86 g-i	4.78 h-j	4.80 e	5.24 a
	12	5.23c-f	5.29 cd	5.24 c-e	5.25 c	
	24	5.59 ab	5.69 a	5.66 a b	5.65 a	
P ₂ O ₅ × Humic acid	0	4.58 c	4.45 c	4.52 c	M .W effect	
	260	5.00 b	5.02 b	4.97 b		
	520	5.20a	5.28 a	5.23 a		
Magnetic water × Humic acid	0	4.49 c	4.50 c	4.45 c	4.48 b	
	12	4.95 b	4.93 b	4.92 b	4.93 b	
	24	5.32 a	5.33 a	5.34 a	5.33 a	
Humic acid effect		4.92 a	4.92 a	4.90 a		

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

Numberof capsules.pant⁻¹

The data represented in Table (5) showed that P₂O₅ fertilizer at 520 mg.pot⁻¹ had significant effect on the number of capsules (38.46 capsules. plant⁻¹) compared to 0 and 260 mg.pot⁻¹ (34.40 and 36.46 capsules. plant⁻¹). The plants that irrigated with magnetic water 24h was significantly differed (38.70 capsules. plant⁻¹) with the plans that irrigated with 0 and 12 h magnetic water (33.70 and 37.42 capsules. plant⁻¹) respectively The results also showed that there is no significant effect for all concentrations of humic acid on number of capsules. Significant effect was obtained from the interaction between P₂O₅ at 520 mg.pot⁻¹ and magnetic water with 24 h on number of capsules (40.63 capsules.plant⁻¹) compared to untreated plants (34.40 capsules.plant⁻¹).When P₂O₅ fertilizer at 520 mg.pot⁻¹ applied with all the concentrations of humic acid had significant effect (38.37,38.51 and 38.59 capsules.plant⁻¹) respectively when compared to lowest values (34.23,34.37 and

34.60 capsules.plant⁻¹) respectively that obtained from 0 mg.pot⁻¹ all concentrations of humic acid. The interaction between humic acid at all concentration with magnetic water with 24 h treatments have significant effect on the number of capsules (38.49,38.68 and 38.94 capsule. plant⁻¹) as compared to the plants treated with 0 h magnetic water interacted with all concentrations of humic acid (33.50,33.51 and 33.43 capsule.plant⁻¹) respectively. On the other hand the triple interaction among P₂O₅ at 520 mg. pot⁻¹, magnetic water 24 h and humic acid at 0.6 and 0.8 mg.L⁻¹ obtained the highest values of number of capsules (40.57 and 40.86 capsule.plant⁻¹) compared to (31.31,31.35 and 31.37capsule.plant⁻¹) respectively 0 of P₂O₅ at 520 mg.pot⁻¹, all concentration of humic acid and 0 h magnetic water.

Table (5): Effect of magnetic water, humic acid and phosphor fertilizer on the number of capsules of *Nigella sativus* plant (capsules.pant⁻¹).

P ₂ O ₅ (mg.pot ⁻¹)	Magnetic water (hours)	Humic acid(mg.L ⁻¹)			P ₂ O ₅ × Magnetic water	P ₂ O ₅ effect
		0	0.6	0.8		
0	0	31.31 i	31.35 i	31.37 i	31.34 g	34.40 c
	12	35.07 g	35.24g	35.55fg	35.29 e	
	24	36.31 ef	36.52e	36.88de	36.57 d	
260	0	33.73 h	33.78 h	33.56 h	33.69 f	36.74 b
	12	37.48cd	37.67cd	37.74 b	37.63 c	
	24	38.72 b	38.95 b	39.07 b	38.91 b	
520	0	35.46 fg	35.40fg	35.36 g	35.40 e	38.46 a
	12	39.21 b	39.29 b	39.54b	39.35 b	
	24	40.45 b	40.57 a	40.87 a	40.63 a	
P ₂ O ₅ × Humic acid	0	34.23 c	34.37 c	34.60 c	Magnetic water effect	
	260	36.65 b	36.80 b	36.79 b		
	520	38.37 a	38.42 a	38.59 a		
Magnetic water × Humic acid	0	33.50 c	33.51 c	33.43 c	33.48 c	
	12	37.25 b	37.40 b	37.61 b	37.42 b	
	24	38.49 a	38.68 a	38.94 a	38.70 a	
Humic acid effect		36.42 a	36.53 a	36.66 a		

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

Dry weight of plant (g).

Table (6) showed that P₂O₅ fertilizer at 520 mg.pot⁻¹ significantly increased the dry weight of plants (7.205 g) compared to 0 and 260 mg.pot⁻¹ (5.760 g and 6.309g). The plants which treated with magnetic water 24h was significantly differed than that treated with 0 and 12 h magnetic water the values were (7.117, 5.746 and 6.411g) respectively. No significant differences appeared between all the concentrations of humic acid that used. The interaction between P₂O₅ fertilizer at 520 mg.pot⁻¹ and magnetic water for 24 h gave a significant effect on dry weight

(7.939 g) as compared to other treatments especially untreated plants (5.103g). Although all the humic acid concentrations of do not show significant effect compared to each other when it applied with P₂O₅ fertilizer at 520 mg.pot⁻¹ on the dry weight of plant (7.132, 7.293 and 7.190 g) respectively, but they significantly differed with other treatments especially of 0 mg.pot⁻¹ P₂O₅ and the values were respectively for all concentration of humic acid (5.797, 5.850 and 5.634 g). The data obtained that interaction between at humic acid 0 and 0.6 mg.L⁻¹ concentrations with magnetic water with 24 h treatment have significant effect on dry weight (7.190 and 7.214g) when compared to the lowest values obtained from 0 h magnetic water with all concentrations of humic acid (5.712, 5.791 and 5.740 g) respectively. Significant values of dry weight were obtained when (7.857, 8.004 and 7.957g) when 520 P₂O₅ mg.pot⁻¹, 24 h magnetic water with all concentrations of humic acid as compared to other treatments especially when 0 P₂O₅ mg.pot⁻¹, 0 h magnetic water with all concentrations of humic acid (5.009, 5.138 and 5.073 g) respectively.

Table (6): Effect of magnetic water, humic acid and phosphor fertilizer on the dry weight of *Nigella sativus* plant (g).

P ₂ O ₅ (mg.pot ⁻¹)	Magnetic water (hours)	Humic acid(mg.L ⁻¹)			P ₂ O ₅ × Magnetic water	P ₂ O ₅ effect
		0	0.6	0.8		
0	0	5.009 g	5.138 g	5.073 g	5.103 e	5.760 c
	12	5.770 f	5.852 f	5.606 f	5.742d	
	24	6.522 de	6.561 de	6.225e	6.436 c	
260	0	5.605 f	5.654 f	5.593 f	5.617 d	6.309 b
	12	6.276 e	6.368 e	6.126e	6.360 cd	
	24	7.028 bc	7.077 bc	6.823cd	6.97 b	
520	0	6.434 de	6.581 de	6.541 de	6.518c	7.205 a
	12	7.105bc	7.295 b	7.074bc	7.168 b	
	24	7.857a	8.004 a	7.957 a	7.939 a	
P ₂ O ₅ × Humic acid	0	5.797cd	5.850 c	5.635 d	Magnetic water effect	
	260	6.303 b	6.366 b	6.257 b		
	520	7.132 a	7.293 a	7.190 a		
Magnetic water × Humic acid	0	5.712 d	5.791 d	5.740 d	5.746 c	
	12	6.383 c	6.505 c	6.345 c	6.411 b	
	24	7.190 ab	7.214 a	7.00 b	7.117 a	
Humic acid effect		6.410 ab	6.503 a	6.340 b		

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

Photosynthesis Pigments, Oil Yield Contain and Chemical Compounds.
Chlorophyll a content (µg.mg⁻¹)

Table (7) indicated that significant value of chlorophyll a content in the plants was obtained when P₂O₅ fertilizer at 520 mg.pot⁻¹ was used (20.21 µg.mg⁻¹),

while untreated plants showed the lowest value ($16.14 \mu\text{g}\cdot\text{mg}^{-1}$). Irrigated the plants with magnetic water 24h had significant effect on the chlorophyll a content ($20.24 \mu\text{g}\cdot\text{mg}^{-1}$) as compared to other treatments (16.14 and $17.81 \mu\text{g}\cdot\text{mg}^{-1}$) respectively for 0 and 12 h magnetic water. Despite there was no significant difference between the both concentration of humic acid (0.6 and $0.8 \text{ mg}\cdot\text{L}^{-1}$), but were differs with $0 \text{ mg}\cdot\text{L}^{-1}$ and the values were (17.84 , 18.11 and $18.24 \mu\text{g}\cdot\text{mg}^{-1}$) respectively. The interaction between P_2O_5 at $520 \text{ mg}\cdot\text{pot}^{-1}$ and magnetic water with 24 h obtained significant effect on content of chlorophyll a ($22.39 \mu\text{g}\cdot\text{mg}^{-1}$) as compared to untreated plants ($14.21 \mu\text{g}\cdot\text{mg}^{-1}$), while the interaction between P_2O_5 fertilizer at $520 \text{ mg}\cdot\text{pot}^{-1}$ and humic acid at both 0.6 and $0.8 \text{ mg}\cdot\text{L}^{-1}$ the values were (20.24 and $20.45 \mu\text{g}\cdot\text{mg}^{-1}$) they were significantly differs with other treatments especially P_2O_5 fertilizer at $0 \text{ mg}\cdot\text{pot}^{-1}$ with all concentrations of humic acid (15.98 , 16.15 and $16.27 \mu\text{g}\cdot\text{mg}^{-1}$). Applying humic acid at $0.8 \text{ mg}\cdot\text{L}^{-1}$ interacted with magnetic water for 24h showed significant effect ($20.72 \mu\text{g}\cdot\text{mg}^{-1}$) compared to 0 h magnetic water with all concentrations of humic acid (16.08 , 16.18 and $16.15 \mu\text{g}\cdot\text{mg}^{-1}$). The triple interaction among P_2O_5 at $520 \text{ mg}\cdot\text{pot}^{-1}$, magnetic water for 24 h and humic acid at (0.6 and $0.8 \text{ mg}\cdot\text{L}^{-1}$) obtained significant values of chlorophyll a content (22.34 and $22.94 \mu\text{g}\cdot\text{mg}^{-1}$) respectively compared to all treatments especially $0 \text{ P}_2\text{O}_5 \text{ mg}\cdot\text{pot}^{-1}$, 0h magnetic water and all concentrations of humic acid (14.22 , 14.23 and $14.19 \mu\text{g}\cdot\text{mg}^{-1}$) respectively. Chlorophyll b content ($\mu\text{g}\cdot\text{mg}^{-1}$).

The results in Table (8) showed that the highest value of chlorophyll b contents in the plants was conducted when p_2o_5 fertilizer at $520 \text{ mg}\cdot\text{pot}^{-1}$ was used ($6.99 \mu\text{g}\cdot\text{mg}^{-1}$) while untreated plants gave the lowest value ($5.25 \mu\text{g}\cdot\text{mg}^{-1}$). Treating the plants with magnetic water for 24h had significant effect on the chlorophyll b contents compared to the plants irrigated with tap water (6.91 and $5.18 \mu\text{g}\cdot\text{mg}^{-1}$) respectively. All the concentrations of humic acid had no significant effect on chlorophyll b contents. The interaction treatment between P_2O_5 at $520 \text{ mg}\cdot\text{pot}^{-1}$ and with magnetic water for 24h gave significant effect on the content of chlorophyll b content ($7.58 \mu\text{g}\cdot\text{mg}^{-1}$) as compared to untreated plants ($5.25 \mu\text{g}\cdot\text{mg}^{-1}$). Applying P_2O_5 at $520 \text{ mg}\cdot\text{pot}^{-1}$ with and humic acid at all concentrations had significant effect on chlorophyll b content the values were (6.98 , 6.95 and $7.06 \mu\text{g}\cdot\text{mg}^{-1}$) respectively as compared with all the treatments especially the lowest value obtained from. P_2O_5 at $520 \text{ mg}\cdot\text{pot}^{-1}$ interacted with all concentrations of humic acid the values were respectively (5.11 , 5.25 and $5.40 \mu\text{g}\cdot\text{mg}^{-1}$). The same direction was observed when the plants were treated with humic acid at (0.0 , 0.6 and $0.8 \text{ mg}\cdot\text{L}^{-1}$) interacted with magnetic water for 24h had significant effects (6.80 , 6.99 and $6.95 \mu\text{g}\cdot\text{mg}^{-1}$) respectively as compared to untreated plants (5.12 , 5.20 and $5.22 \mu\text{g}\cdot\text{mg}^{-1}$) in chlorophyll b contents. The triple interaction of P_2O_5 at $520 \text{ mg}\cdot\text{pot}^{-1}$, magnetic water for 24h and humic acid at all concentrations showed significant effect

of chlorophyll b content obtained (7.77,7.87 and 7.92 $\mu\text{g.mg}^{-1}$) as compared to P_2O_5 at 0 mg.pot^{-1} , magnetic water for 0h with all concentrations of humic acid (4.22,4.39 and 4.53 $\mu\text{g.mg}^{-1}$) respectively.

Table (7): Effect of magnetic water, humic acid and phosphor fertilizer on the chlorophyll a of *Nigella sativus* plant ($\mu\text{g.mg}^{-1}$).

P ₂ O ₅ (mg.pot ⁻¹)	Magnetic water (hours)	Humic acid(mg.L ⁻¹)			P ₂ O ₅ × Magnetic water	P ₂ O ₅ effect
		0	0.6	0.8		
0	0	14.22 i	14.23 i	14.19 i	14.21 f	16.14 c
	12	15.79 h	15.98 h	15.87 h	15.88 e	
	24	17.94 fg	18.25 ef	18.76 e	18.32 c	
260	0	15.85 h	16.01 h	15.90 h	15.92 e	17.84 b
	12	17.42 g	17.76 fg	17.58 fg	17.59 d	
	24	19.57 d	20.03 cd	20.47 c	20.02 b	
520	0	18.17 e-g	18.32 ef	18.37 ef	18.29 c	20.21 a
	12	19.74 cd	20.07 cd	20.05 cd	19.95 b	
	24	21.89 b	22.34 ab	22.94 a	22.39 a	
P ₂ O ₅ × Humic acid	0	15.98 e	16.15 e	16.27 e	Magnetic water Effect	
	260	17.61 d	17.93 cd	17.99 c		
	520	19.93 b	20.24 ab	20.45 a		
Magnetic water × Humic acid	0	16.08 e	16.18 e	16.15 e	16.14 c	
	12	17.65 d	17.94 c	17.83 cd	17.81 b	
	24	19.80 b	20.20 b	20.72 a	20.24 a	
Humic acid effect		17.84 b	18.11 a	18.24 a		

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

Table (8): Effect of magnetic water, humic acid and phosphor fertilizer on the chlorophyll b of *Nigella sativus* plant ($\mu\text{g}.\text{mg}^{-1}$).

P ₂ O ₅ (mg.pot ⁻¹)	Magnetic water (hours)	Humic acid(mg.L ⁻¹)			P ₂ O ₅ × Magnetic water	P ₂ O ₅ effect
		0	0.6	0.8		
0	0	4.22 g	4.39 g	4.53 g	4.38 g	5.25 c
	12	5.21 ef	5.19 ef	5.39 e	5.27 e	
	24	5.89 d	6.18 d	6.26 d	6.11 d	
260	0	5.0 ef6	5.12 ef	4.92 f	5.03 f	5.91 b
	12	6.05 d	5.92 d	5.79 d	5.92 d	
	24	6.73 bc	6.91 bc	6.65 c	6.76 c	
520	0	6.09 d	6.08 d	6.19 d	6.12 d	6.99 a
	260	7.09 b	6.89 bc	7.05 b	7.01 b	
	520	7.77 a	7.87 a	7.92 a	7.85 a	
P ₂ O ₅ × Humic acid	0	5.11 c	5.25 c	5.40 c	Magnetic water effect	
	260	5.95 b	5.98 b	5.79 b		
	520	6.98 a	6.95a	7.06 a		
Magnetic water × Humic acid	0	5.12 c	5.20 c	5.22 c	5.18 c	
	12	6.12 b	6.00 b	6.08 b	6.07 b	
	24	6.80 a	6.99 a	6.95 a	6.91 a	
Humic acid effect		6.01 a	6.06 a	6.08 a		

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

Total chlorophyll content ($\mu\text{g}.\text{mg}^{-1}$)

The results in Table (9) pointed out that P₂O₅ fertilizer at 520 mg.pot⁻¹ gave the significant value of total chlorophyll (28.04 $\mu\text{g}.\text{mg}^{-1}$) as compared to (21.79 and 24.61 $\mu\text{g}.\text{mg}^{-1}$) were obtained with 0 and 260 mg.pot⁻¹P₂O₅. Irrigating the plants with magnetic water for 24h was significantly differed with the plans that irrigated with tap water and magnetic water for 12h they were respectively (28.04, 21.70 and 24.38 $\mu\text{g}.\text{mg}^{-1}$). Applying humic acid at (0.8 mg.L⁻¹) had significant effect on the content of total chlorophyll in plant (24.98 $\mu\text{g}.\text{mg}^{-1}$) as compared to (24.74 and 24.73 $\mu\text{g}.\text{mg}^{-1}$) respectively for (0 and 0.6 mg.L⁻¹). The interaction between P₂O₅ fertilizer at 520 mg.pot⁻¹ and magnetic water with 24 h showed significant effect on content of total chlorophyll content (31. 59 $\mu\text{g}.\text{mg}^{-1}$) as compared to other treatments especially untreated plants (18.68 $\mu\text{g}.\text{mg}^{-1}$). Significant difference obtained when used with humic acid at all concentrations the values were (27.88 ,28.10 and 28.15 $\mu\text{g}.\text{mg}^{-1}$) when compared to other treatments especially when P₂O₅ fertilizer at 0 mg.pot⁻¹ used with humic acid at all concentrations (21.94,21.55 and 21.88 $\mu\text{g}.\text{mg}^{-1}$) respectively. When the plants were treated with humic acid at all concentrations interacted with magnetic water for 24h showed significant effect on total chlorophyll contents. (28.24, 28.32 and 28. 54 $\mu\text{g}.\text{mg}^{-1}$) respectively and the lowest values were obtained from untreated plants (21.87, 21.44 and 21.78 $\mu\text{g}.\text{mg}^{-1}$). The triple interaction P₂O₅ fertilizer at 520 mg.pot⁻¹, magnetic water with

24 h and humic acid at all concentrations showed significant values of total chlorophyll content (31.38,31.69 and 31.71 $\mu\text{g.mg}^{-1}$) as compared to other treatments but the lowest values were. (19.07,18.27 and 18.69 $\mu\text{g.mg}^{-1}$) respectively for P_2O_5 fertilizer at 0 mg.pot^{-1} , tap water and humic acid with all concentrationa.

Table (9): Effect of magnetic water, humic acid and phosphor fertilizer on the total chlorophyll of *Nigella sativus* plant.

P_2O_5 (mg.pot^{-1})	Magnetic water (hours)	Humic acid(mg.L^{-1})			P_2O_5 × Magnetic water	P_2O_5 effect
		0	0.6	0.8		
0	0	19.07 h	18.27 i	18.69 hi	18.68 g	21.79 c
	12	21.31 g	21.25 g	21.52 g	21.36 g	
	24	25.44 d	25.15 d	25.44 d	25.34 d	
260	0	21.54 g	21.24 g	21.70 g	21.49 g	24.61 b
	12	23.78 f	24.22 ef	24.53 ef	24.17 f	
	24	27.91bc	28.12 b	28.45 b	28.16 b	
520	0	25.01 d	24.82 de	24.96 d	24.93 e	28.04 a
	12	27.25 c	27.79 bc	27.79 bc	27.61 c	
	24	31.38 a	31.69 a	31.71 a	31.59 a	
P_2O_5 × Humic acid	0	21.94 d	21.55 d	21.88 d	Magnetic water effect	
	260	24.41 c	24.53 c	24.89 b		
	520	27.88 a	28.10 a	28.15 a		
Magnetic water × Humic acid	0	21.87 d	21.44 e	21.78 de	21.70 c	
	12	24.11 c	24.42 c	24.61 b	24.38 b	
	24	28.24 a	28.32 a	28.54 a	28.36 a	
Humic acid effect		24.74 b	24.73 b	24.98 a		

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

volatile oil percentage (%).

The results in Table (10) indicated that p_2o_5 fertilizer at P_2O_5 fertilizer at 520 mg.pot^{-1} significantly increased the volatile oil content (0.823%) as compared to 0 and 260 mg.pot^{-1} (0.795 and 0.819 %), also the same Table mentioned that the effect of magnetic water for 24 h was significantly increased the content of volatile oil to (0.833%) in comparison with the plants irrigated with tap water and magnetic water (0.785 and 0.818 %). Applying the humic acid had significant effect on the volatile oil content especially at 0.8 mg.L^{-1} it was (0.815%) while 0 and 0.6 gave lowest values (0.811 and 0.811) respectively. The interaction between P_2O_5 fertilizer at 520 mg.pot^{-1} and magnetic water for 24 h showed a significant effect on content of volatile oil (0. 844%) while the lowest value obtained from 1 untreated plants (0. 767%). Significant difference noticed when P_2O_5 fertilizer at 520 mg.pot^{-1} used with and humic acid at 0.8 mg.L^{-1} on the content of volatile oil (0.828%) as compared to lowest value of volatile oil content (0.792, 0.794 and 0.795 %). Respectively from 0

mg.pot⁻¹ P₂O₅ fertilizer with all the concentrations of humic acid. Despite when the plants were treated with humic acid at all concentrations interacted with magnetic water for 24 h did not show significant difference (0.833, 0.832 and 0.835%) respectively but they were significantly different with other treatments especially the plants irrigated with tap water interacted with all concentrations of humic acid (0.783, 0.782 and 0.789%) respectively. Treating the plants with P₂O₅ fertilizer at 520 mg.pot⁻¹, magnetic water with 24 h and humic acid at all concentrations gave significant values of volatile oil content especially at 0.8 mg.L⁻¹, the values were (0.842, 0.842 and 0.848%) when compared to all treatments. (0.767, 0.766 and 0.769%) respectively for P₂O₅ fertilizer at 0 mg.pot⁻¹, magnetic water with 0 h and humic acid at all concentrations.

Table (11) conducted that treating the plants Table (12) showed that fertilizer at P₂O₅ fertilizer at 520 mg.pot⁻¹ significantly increased the fixed oil content (38.45%) as compared to 0 and 260 mg.pot⁻¹ (35.74 and 36.15 %), Irrigating the plants with magnetic water for 24h to was significantly different with the plants that irrigated with tap water and magnetic water for 12 h the values were respectively (37.06 %, 35.04 and 37.42 %). Humic acid had no significant effect on the content of fixed oil in plant at all concentrations. The interaction between P₂O₅ fertilizer at 520 mg.pot⁻¹ and magnetic water for 24 h showed significant effect on content of fixed oil (39.58%) as compared to other treatments especially untreated plants (33.99%). There was significant difference noticed when P₂O₅ fertilizer at 520 mg.pot⁻¹ used with humic acid at all concentrations and the values were (37.87, 38.01 and 37.85%) respectively when compared with other treatments especially when P₂O₅ fertilizer at 0 mg.pot⁻¹ interacted with humic acid at all concentrations (35.12, 35.58 and 35.52%). respectively. When the plants were treated with humic acid at all concentrations interacted with magnetic water for 24 h showed significant difference with other treatments (37.29, 36.85 and 37.05%) respectively but the lowest values were untreated plants (35.31, 34.95 and 34.84%) in fixed oil contents. The triple interaction of P₂O₅ fertilizer at 520 mg.pot⁻¹, magnetic water for 24 h and humic acid at all concentrations and P₂O₅ fertilizer at 520 mg.pot⁻¹, magnetic water for 12 h and humic acid at all concentrations showed the significant effect on fixed oil content the values were (39.56, 39.57 and 39.6 %) and (38.90, 39.26 and 39.15%) as compared to other treatments especially lowest values obtained from interacted P₂O₅ fertilizer at 0 mg.pot⁻¹, magnetic water for 0 h with all concentrations of humic acid. (34.52, 33.81 and 33.64%) respectively.

Table (10): Effect of magnetic water, humic acid and phosphor fertilizer on the volatile oil (%) of *Nigella sativus* plant.

P ₂ O ₅ (mg.pot ⁻¹)	Magnetic water (hours)	Humic acid(mg.L ⁻¹)			P ₂ O ₅ × Magnetic water	P ₂ O ₅ effect
		0	0.6	0.8		
0	0	0.767 k	0.766 k	0.769k	0.767 f	0.795 c
	12	0.800 hi	0.801 h	0.802h	0.801 d	
	24	0.817 gf	0.816 gf	0.815 g	0.816 c	
260	0	0.791 j	0.789 j	0.795 hj	0.792 e	0.819 b
	12	0.824 ef	0.824 ef	0.828 cd	0.825 b	
	24	0.841 ab	0.839 b	0.841ab	0.840 a	
520	0	0.792 j	0.792 j	0.802h	0.795 e	0.823 a
	12	0.825 de	0.827 cd	0.835 bc	0.829 b	
	24	0.842 ab	0.842 ab	0.848 a	0.844 a	
P ₂ O ₅ × Humic acid	0	0.795c	0.794c	0.795c	Magnetic water effect	
	260	0.819 b	0.817 b	0.821 b		
	520	0.820 b	0.820b	0.828 a		
Magnetic water × Humic acid	0	0.783c	0.782 c	0.789 c	0.785 c	
	12	0.816 b	0.817 b	0.822 b	0.818 b	
	24	0.833 a	0.832 a	0.835 a	0.833 a	
Humic acid effect		0.811 b	0.811 b	0.815 a		

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

Fixed oil percentage (%)

Table (11): Effect of magnetic water, humic acid and phosphor fertilizer on the fixed oil (%) of *Nigella sativus* plant .

P ₂ O ₅ (mg.pot ⁻¹)	Magnetic water (hours)	Humic acid(mg.L ⁻¹)			P ₂ O ₅ × Magnetic water	P ₂ O ₅ effect
		0	0.6	0.8		
0	0	34.52 e	33.81 e	33.64 e	33.99 d	35.74 c
	12	36.58 c-d	36.31 d	36.24d	36.37 c	
	24	37.25 c-d	36.62 c-d	36.70 c-d	36.86 bc	
260	0	34.59 e	34.28 e	34.33 e	34.40 d	36.15 b
	12	36.65 c-d	36.78 c-d	36.93 c-d	36.78 bc	
	24	37.33 bc	37.09 c-d	37.39 b	37.27 b	
520	0	36.84 c-d	36.76 c-d	36.55 c-d	36.72 c	38.46 a
	12	38.90 a	39.26 a	39.15 a	39.10 ab	
	24	39.56 a	39.57 a	39.61 a	39.58 a	
P ₂ O ₅ × Humic acid	0	36.12 d	35.58 dc	35.52 d	Magnetic water Effect	
	260	36.19 b	36.05 bc	36.21 b		
	520	37.87 ab	38.01 a	37.85 ab		
Magnetic	0	35.31 c	34.95 c	34.84 c	35.04 c	

water	12	37.38 b	37.45 b	37.44 b	37.42 b
× Humic acid	24	37.29 a	36.85 ab	37.05 a	37.06 a
Humic acid effect		36.58 a	36.36 a	36.37 a	

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

Total carbohydrates percentage

Table (12) showed that fertilizer at P_2O_5 fertilizer at 520 mg.pot^{-1} significantly increased the total carbohydrates content (29.73%) as compared to 0 and 260 mg.pot^{-1} (28.82 and 29.53 %), The data in the same Table showed that the effect of magnetic water for 24 h was significantly increased the content of total carbohydrates to (30.71) in comparison with the plants irrigated with tap water and magnetic water for 14 h it was (27.85 and 29.52%). Applying humic acid had no significant effect on the total carbohydrates content at all concentrations. The interaction between P_2O_5 fertilizer at 520 mg.pot^{-1} and magnetic water with 24 h showed significant effect on content of total carbohydrates (31.08%) as compared to other treatments, the lowest value obtained from untreated plants (27.31%). P_2O_5 fertilizer at 260 and 520 mg.pot^{-1} interacted with humic acid at all concentrations of humic acid the values were (29.48, 29.55 and 29.56%); (29.71, 29.73 and 29.75%) respectively for both treatments as comparison with lowest values obtained from using P_2O_5 fertilizer at 0 interacted with all humic acid concentrations (28.98, 29.04 and 28.43%) respectively. Applying humic acid at (0.0, 0.6 and 0.8 mg.L^{-1}) interacted with magnetic water for 24h showed significant different (30.44, 30.85 and 30.84%) respectively with other treatments especially the plants irrigated with tap water interacted with 0 mg.L^{-1} (27.95, 28.01 and 27.57%) respectively in total carbohydrates contents. The triple interaction using P_2O_5 fertilizer at 520 mg.pot^{-1} , magnetic water for 24 h and humic acid at (0.0, 0.6 and 0.8 mg.L^{-1}) gave significant values of total carbohydrates content when compared to other treatments (30.76, 31.14 and 31.34%) respectively while lowest values founded when plants treated with 0 mg.pot^{-1} P_2O_5 fertilizer with tap water and all concentrations of humic acid (27.54, 27.62 and 26.76 %) respectively.

This significant increase in the characteristics of research is consistent with several researchers. (Singh *et al.*, 1999) confirmed this finding. Garg and Malhotra (2008) mentioned that he results that height of plant, number of branches, number of leaves per plant stem diameter and seed yields increased with increasing of P_2O_5 fertilization of *Nigella sativa* plants. Rana (2012) also ensured these findings. This increasing may be explained due to that phosphorus known to help developing broader root system and thus helping the plants to extract water and nutrients from more depth. This, in turn, could enhance the plants to produce more assimilates which was reflected in high biomass (Gobarah *et al.*, 2006). Researchers have been increasingly interested in using magnetic technology in agricultural fields after the positive effects of this technique on the growth and flowering of plants. This can be clear up that

magnetized water has a positive effect on the characteristics of flowers, bulbs and seeds. This may be due to the physical and chemical changes of magnetically treated water, which resulted in the easy absorption of water and soluble elements by the root mass as well as improved vegetative growth characteristics resulting in an increase in the amount of photosynthesis (Al-Mu'adidi, 2006; Nasher, 2008.; Kuntiyastuti and Suryantini, 2014.).

Table (12): Effect of magnetic water, humic acid and phosphor fertilizer on the total carbohydrates (%) of *Nigella sativus* plant

P ₂ O ₅ (mg.pot ⁻¹)	Magnetic water (hours)	Humic acid(mg.L ⁻¹)			P ₂ O ₅ × Magnetic water	P ₂ O ₅ effect
		0	0.6	0.8		
0	0	27.54 j	27.62j	26.76j	27.31f	28.82 b
	12	29.37fg	29.06g	28.52h	28.98 d	
	24	30.03 ce	30.46b-d	30.03c-e	30.17 a	
260	0	28.05 h-j	28.12 h-j	27.88hi	28.02 e	29.53 a
	12	29.87d-f	29.56 e-g	29.64 e-g	29.69 b	
	24	30.53bc	30.96ab	31.16 a	30.88 a	
520	0	28.27hi	28.30 hi	28.07h-j	28.22 e	29.73 a
	12	30.10c-e	29.74d-f	29.83ef	29.89 b	
	24	30.76ab	31.14 a	31.34 a	31.08 a	
P ₂ O ₅ × Humic acid	0	28.98b	29.04 b	28.43c	Magnetic water effect	
	260	29.48 a	29.55 a	29.56 a		
	520	29.71 a	29.73 a	29.75 a		
Magnetic water × Humic acid	0	27.95 e	28.01 d	27.57e	27.85 c	
	12	29.78 bc	29.45 bc	29.33c	29.52 b	
	24	30.44 a	30.85 a	30.84 a	30.71 a	
Humic acid effect		29.39 a	29.44 a	29.25 a		

*Means followed by the same letter for each factor and interaction do not differ significantly from each other's according to Duncan's Multiple range Test at 5% level.

The same results also obtained by Amin (2009) found that irrigating Iris bulbs with magnetically treated water resulted in an increase in stem diameter, chlorophyll and dry weight Al-Jubouri (2006) approved that by improving the flowering characters of *Tagets erecta* L when irrigated by magnetized water. Deshpande (2014) conferred that using the magnetic water in place of normal tap water can be seen as a promising technique for rapid and healthy growth of plants. Regarding to the humic acid it works indirectly on the speed of absorption and transfer of the rest of the elements by entering the formation of chlorophyll pigments, thus increasing the carbonation process and building the proteins of great importance in stimulating plant growth and reaching a good nutritional state, which increased the efficiency of the plant to absorb

and accumulate the elements, (Taiz and Zeiger, 2006; David *et al.*, 1994) have reported that humic substances promoted growth and more mineral nutrient uptake of plant due to the better-developed root systems. Although there were no significant increment in the studied objective may be due to the shortage of concentrations that used in this trial, except the volatile oil percentage these results agreed with Noroozi sharaf and Kaviani (2018) when they studied the effect of humic acid concentrations on *Thymus vulgaris* they concluded that humic acid increased the essential oil quality and quantity by increasing the humic acid concentrations. Humic acid is natural biological organic, which has a high effect on plant growth and quality. However, the mechanisms of the promoting effect of humic acid on the volatile composition were rarely reported. In this study, the effects of soil application of humic acid on the chemical composition and nutrients uptake of *Thymus vulgaris* were Nardi *et al.* (2002) proposed that humic acid could directly influence plant growth components such as cell permeability, respiration, photosynthesis, and cell elongation. Previous researches have shown other effects of humic substances on fruits (Arancon *et al.* 2006) vegetables (Yildirim 2007), cereals (Jones *et al.* 2007) and *Lolium perenne* (Verlinden *et al.* 2010). This was followed by reducing in the incidence of plant disease (Naidu *et al.* 2013; Olivares *et al.* 2015). In addition to the notable changes on nutrient uptake and plant primary metabolism, secondary metabolism may also be strongly affected by humic substances (Canellas *et al.* 2015).

تأثير السماد الفوسفاتي، الماء الممغنط وحامض الهيوميك على نمو، صبغات البناء الضوئي وإنتاج الزيت وبعض المركبات لنبتات حبة البركة *Nigella sativa*

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الخلاصة

أجريت التجربة في البيت الزجاجي التاب لقسم البستنة/ كلية علوم الهندسة الزراعية / جامعة دهوك لدراسة تأثير تراكيز السماد الفوسفاتي P_2O_5 (0, 0.6 و 0.8 ملغم/لتر) و الماء الممغنط بثلاث مجاميع ، مجموعة (1) تم ريها بماء الحنفية و المجموعة (2) تم ريها بالماء الممغنط بعد ان تم مغنتتها و خزنت لمدة 12 ساعة والمجموعة (3) المروية بالماء الممغنط المخزونة لمدة 24 ساعة على محصول الحبة السوداء أو حبة البركة السوداء أو حبيبة النجيلة تألفت المعاملات التجريبية من خمسة مكررات باستخدام تصميم القطاعات العشوائية الكاملة (RCBD) وأظهرت النتائج أن سماد P_2O_5 في (520 ملغم/سندانة) زاد بشكل كبير كل الصفات المدروسة. لم يكن لحامض الهيوميك عند 0.6 و 0.8 ملغم/لتر تأثير كبير على معظم الصفات المدروسة باستثناء الكلوروفيل الكلي و الزيت الطيار. مجموعة النباتات التي تم سقيها بالماء الممغنط المخزون لمدة 24 ساعة أدى الى زيادة كبيرة في جميع الخصائص المدروسة. أظهرت التداخلات الثنائية والثلاثية بين العوامل المدروسة تأثيراً كبيراً على جميع الصفات التي تم دراستها مقارنةً بالنباتات غير المعاملة (ارتفاع النباتات، عدد الفروع / النباتات، قطر الساق، عدد الثمار / النباتات، الوزن الجاف، الكلوروفيل الكلي، نسبة الزيت الثابت، نسبة الزيت الطيار ونسبة الكربوهيدرات الكلية).

الكلمات المفتاحية: حبة البركة، حامض الهيوميك، الماء الممغنط.

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