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Effect of Adding Humic Acid and Phosphate Fertilizer Levels on Growth and Yield of Lettuce

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Abstract: *An experiment was carried out in the vegetables fields , College of Agricultural Engineering Sciences , University of Baghdad , Al-Jadriya in fall season 2017-2018 to study adding of humic acid and phosphate fertilizer levels on growth and yield of lettuce , sky cv. Experiment was included nine treatments of interaction between three levels of humic acid adding to soil preplanting 0 , 5 , 10 kg.ha^{-1} (H0 , H1 , H2 respectively) and three levels of phosphate fertilizer 0 , 120 , 180 kg.ha^{-1} (P0 , p1 , p2 respectively) . Factorial experiment was adopted according to RCBD with three replicates. Results showed interaction treatment H_2P_2 was Superior in plant height (39.80cm) and greatest of leaves number (78.70 leaf . plant $^{-1}$) and highest of dry weight of leaves (40.20 g.plant^{-1}) and greatest of head weight and total yield (1015.20 g and 67.0 ton.ha^{-1}) . The suggestion adding 10 kg,ha -1 humic acid preplanting and triple super phosphate at 180 kg.ha^{-1} resulted in highest vegetative growth and yield of lettuce .*
** GraduationResearch Project*

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I. Introduction

The lettuce is one of the leafy vegetables which is wildly grown in many parts of the world and its very important vegetable crop and it's not les important than tomato, cucumber or cabbage in many country specially USA where it's rank in third stage in the yield after tomato and sweet corn. in Europe lettuce grown in large area and it's one of the most important vegetable crop for exporting and that is due to it's high nutrient values and fast growing and tolerant the lower temperature and frost (Borass et al , 2011) . The lettuce is most important winter crop grown in Iraq and it's consumed an fresh leafy crop . Each 100 gram contain 95% water , one gram protein , 3 gram carbohydrates , 22 mg calcium , 25 mg phosphorus , 540 International unit vitamin A (Matlob et al , 1989) The plant need the mineral elements which can be gave by the adding chemical fertilizers which is one of important factor for growth of the plant in addition to the soil and water these factors is very important in the production of the foods for the world population and to produce more food most used more fertilizers (Swer et al , 2011) . The quantities of fertilizers must used in proper way to avoid the harmfull effect these fertilizers to the ecosystem (CSA , 2011) . The chemical fertilizers was a chemical compounds which contain one or more chemical element such as nitrogen , phosphorus and potassium (Ali , 2012) . The phosphorus element is very important for the plant growth and cell division and the formation of seeds . The phosphour is one of most important compounds such as the nucleic acid , oils , adenosine triphosphate (ATP) which is used as energy transfer inside the plant tissue and also to transfer the genetic characters with protein to form the nucleic acid DNA and RNA and also the phosphorus used by the plants to form the coenzymes and also used a phospholipid with help of protein to form the cell membranes (Mengel and kirkby , 1982) . The phosphorus is one of very important mineral elements which is needed by the plant in large quantities for it role in many processes in plant to increased the yield and plant need phosphorus in all stages of plant growth . The phosphorus can be prespetate or adhesive to the soil particals so we must add the phosphourto the plant during the growth of plants for longer time (Tisdale et al , 1985) . The humic acid is an organic fertilizers which can be used in wide range . It can be produced by the chemical or biological degradation of plant or animals tissues through the activities of the microorganism . The humic acid play an important role in changing the soil structure and improved it's physical and chemical and biological characters and it's also used as a good sources of macro or microelements specially the nitrogen and the high acidity of humic acid increased the ability of soil to hold the positive cation and decrease the losses of nitrogen as ammonium gas (Tan , 2003) . Humic acid also play a good roles in the photosynthesis and increased the permability of cell membrane and increasing the absorption of phosphorus (CaccoabdAqnolla , 1984) , Kassim (2005) found an elongation of broadbean plants with increasing the fertilizing with 40 , 80 , 120 kg P2O5 . ha -1 while the dose of 80 , 120 kg P2O5 . ha -1 gave the highest seed yields . Sebty (2017) found that an increases in number of leaves per plant and the yield and

seed yield per plant when plants was fertilized with 160 kg $P_2O_5.h^{-1}$ in compared with 0 , 80 kg P_2O_5 ha $^{-1}$. Khalil and Habity (2013) found that fertilizing lettuce plants (CV Paris Island Cos) with foliar spray with 0 , 1 , 2 $ml.L^{-1}$ and with three concentration of alge 300 extract (0 , 1.5 , 2.5) $ml.L^{-1}$ significantly increased the number of leaves and length and weight of head specially when plant sprayed with (2 $ml.L^{-1}$ humic acid + 2.5 $ml.L^{-1}$Alge 300) . Zahwan (2015) found the fertilizing onion plants onion plants with 8 kg .ha $^{-1}$ humic acid significantly increased the total yield when the plant fertilized with (0 , 4 , 6 , 8 $kg.ha^{-1}$) humic acid . This study was conducted to investigate the influences of phosphatic fertilizer and humic acid on growth and yield of lettuce.

II. Materials and Method

This experiment was conducted in the experiment station , Department of Horticulture and Gardening Landscape College of Agricultural Engineering Sciences , University of Baghdad , Al-Jadriya , the field was prepared arrange torows , the lettuce seedling CV SKY was planted 24.10.2017 the source of seedling was local nursery and the distance between the seedling was 25 cm and between the rows was 75 cm . Al the plants in this experiment was fertilized with 100 kg nitrogen $.ha^{-1}$ by using urea and 60 kg K2O . ha^{-1} by using potassium sulphate (Al-Bahash and abdolGhefor , 1984) . The experiment was consisted 9 treatments which found by the interaction between the two factors :

1. First factor: humic acid at 3 levels 0,5 , 10 kg .ha $^{-1}$ which represented H0 , H1 , H2 respectively .
2. Second factor phosphorus fertilizer at 3 levels 0 , 120 , 180 $kg.ha^{-1}$which represented which P0 , P1 , P2 respectively by using triple super phosphate as source of phosphorus which used preplanting .

The experimental design was RCBD with three replicates (Al-Khaffaji and Al-khemissi , 2012) . Each replicated consisted 9 treatments resulted from the interaction between the humic acid and the phosphate fertilizer. The agricultural practices was carried out which included irrigation , wedding during plant growth and when lettuce heads was reached the marketable size , the head was picked up at 28.1.2018 and following parameters was taken :height of heads , number of leaves per plant , the dry weight of the leaves (g) , weight of the head (g) , total yield (ton.ha -1) . Theresults wereanalyzed using Genstat and means was compared using L.S.D at 5%.

III. Results And Discussion

The results in table (1) shows a significant effect of adding humic acid to the soil in the height of heads and H2 gave the highest height of head (36.93cm) while the control treatment H0 gave (30.40cm) . The treatment with P2 gave the height of (36.03cm) while the control treatment P. gave lowest plant height (31.20cm). The interaction treatment H_2P_2 gave a height of (39.80 cm) while the treatment H0P0 gave a height of (27.40 cm) from the table (1) there is a significant differences due to the fertilizing the lettuce plants with humic acid and phosphate fertilizers and there interaction between them in number of leaves. Treatment H2 gave the highest number of leaves (72.26 leaf . $plant^{-1}$) while treatment H0 gave the lowest number of leaves (53.63 $leaf.plant^{-1}$) . Fertilizing lettuce plant with phosphate fertilizer significantly influenced the number of leaves per plant . Treatment P_2 gave the highest number of leaves (68.77 leaf . $plant^{-1}$) while treatment P0 gave 56.93leaf . $plant^{-1}$ .The interaction treatment H2P2 gave the significantly the highest number of leaf per plant (78.70 leaf .plant $^{-1}$) while treatment H0P0 gave (47.60 leaf . plant $^{-1}$) . The dry weight of leaves was significantly increased when lettuce plants was treated with humic acid (table 1) . treatment H2 gave highest dry weight (37.37 g) while treatment H0 lowest weight (24.96 g) . lettuce plant fertilized with phosphour significantly increased the dry weight of leaves . Treatment P2 significantly gave the highest dry weight (35.50 g) while treatment P0 gave (28.23 g) . The interaction treatment H2P2 significantly gave the highest dry weight (40.20 g) while treatment H0P0 gave Lowest dry weight of (21.70 g)

Table 1.Effect of adding humic acid and phosphorous on vegetative characters of lettuce plants

Treatment	Plant height (cm)	Number of leaves.plant-1	Dry weight of leaves (g)
Adding humic Acid			
H0	**30.40**	**53.63**	**24.96**
H1	**34.27**	**64.74**	**33.43**
H2	**36.93**	**72.26**	**37.37**
L.S.D 5%	**0.34**	**0.55**	**0.36**
Phosphorus fertilizer			
P0	**31.20**	**56.93**	**28.23**
P1	**34.37**	**64.94**	**32.02**
P2	**36.03**	**68.77**	**35.50**
L.S.D 5%	**0.34**	**0.55**	**0.36**
Interaction between humic acid and phosphorus fertilizer			
H0P0	**27.40**	**47.60**	**21.70**
H0P1	**31.70**	**55.20**	**23.96**

H0P2	**32.10**	**58.10**	**29.20**
H1P0	**32.50**	**59.30**	**29.80**
H1P1	**34.10**	**65.43**	**33.40**
H1P2	**36.20**	**69.50**	**37.10**
H2P0	**33.70**	**63.90**	**33.20**
H2P1	**37.30**	**74.20**	**38.70**
H2P2	**39.80**	**78.70**	**40.20**
L.S.D 5%	**0.59**	**0.95**	**0.62**

The result in table (2) show a significantly differences in the weight of lettuce head due to the treatment with humic acid. The treatment H2 gave the highest weight (913.16g) while treatment H0 gave the lowest weight (615.37g). Lettuce plants treated with phosphorus fertilizer significantly increased weight of the head. Treatment P2 significantly gave the highest weight (861.46g) while treatment P0 gave (673.97g). the interaction treatment between humic acid and phosphorus H2P2 gave significantly difference reached to (1015.20 g) while treatment H0P0 gave (522.20 g) from the same table (2) there is a significant differences between the treatments with humic acid in total yield of lettuce . Treatment H2 gave the highest yield (60.27 ton.ha^{-1}) while treatment H0 gave (40.64 ton.ha^{-1}) . Fertilizing lettuce plants with phosphorus significantly increased the total yield. Treatment P2 gave the highest yield (56.85 ton.ha-1) while treatment P0 gave (44.51 ton.ha^{-1}) . Interaction between the treatment with humic acid and phosphorus significantly increased the total yield. Treatment H2P2 gave the highest total yield (67.0 ton .ha^{-1}) while treatment H0P0 gave (34.57 ton.ha^{-1}) .

Table 2. Effect of adding humic acid and phosphorus on the yield characters of lettuce.

Treatment	Head weight (g)	Total yield (ton.ha-1)
Adding humic Acid		
H0	615.37	40.64
H1	791.40	52.23
H2	913.16	60.27
L.S.D 5%	4.08	0.29
Phosphorus fertilizer		
P0	673.97	44.51
P1	784.50	51.78
P2	861.46	56.85
L.S.D 5%	4.08	0.29
Interaction between humic acid and phosphorus fertilizer		
H0P0	522.50	34.57
H0P1	618.40	40.81
H0P2	705.20	46.54
H1P0	726.90	47.98
H1P1	783.30	51.70
H1P2	864.0	57.02
H2P0	772.50	50.98
H2P1	951.80	62.82
H2P2	1015.20	67.0
L.S.D 5%	7.06	0.52

From table (1) and (2) we can see that adding humic soil to the soil and fertilizing lettuce plant with phosphorus fertilizer significantly improve the growth of plants , and increased the yield specially the height of plants , number of leaves , dry weight of leaves , weight of heads and total yield , this can be attributed to the positive influences of humic acid on the vegetative growth through increasing the supplying the plants with elements specially organic nitrogen which increased the growth of vegetative parts of plants by increasing the formation of protein which increased the cell division and elongation (Arnot , 2001 and shaheen , 2007) . The humic acid also increased the plant nutrition by increasing the availability of nutrient elements in the soil and improve the growth of root system to increased the absorption of the nutrients from the soil and increased the enzyme activities and cell division (Matariov , 2002) . Humic acid increased the activities of ATpase enzyme in root cells and increased the root area and its speared in the soil to increased the absorption of water and nutrients and then increased vegetative growth (canellas et al , 2009) . Humic acid also contains proteins, carbohydrates and legnines and these are plant content so adding humic acid promote the growth of the plant (Kellcher and Simpson , 2006) . The phosphorus is one of microelements which is necessary for plant growth and improved yield for its direct role in most physiological activities in plant cells . The phosphors share in the transportation of the energy by the formation of ATP which rich energy (AboDahi and Al-younis , 1988 and Havlin et al 1999) . The phosphorus also inter in the formation and cell division and the transporting of genetic characters by formation of DNA and RNA and also in the formation of co-enzymes and also its shared on phospholipid with protein to form cell membranes (Mengel and Kirkby , 1982) . The content of phosphorus in

plant tissues at proper concentration was very important for growth and yield of plants (Erman , 2009 and Sebty , 2017) .

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