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Effect of Spraying Humic Acid and Potassium Fertilization on Growth and Yield of Lettuce Plant Lsuctuca Sativa L

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***Abstract*---**A field experiment was conducted in season 2019-2020 to study the effect of different levels fertilization using humic acid and potassium on the growth of lettuce plant. The experiment was conducted according to Complete Randomized Blocks Design(RCBD) and with two factors: the first is the ground fertilization factor using compound fertilization with levels of 200, 100 and 50 kg /ha and the second factor is foliar fertilization with humic acid with three concentrations (50, 25 and 12.5 ppm). The results showed increased in root length, wet, dry weight and chlorophyll content with higher values reached (16.1 and 16.7 / g), (97.7 and 101.1 / cm) ,(11.9 and 10.6 / g) and (76.52 and 70) using treatment 200 kg / ha potassium and 50 ppm humic acid respectively. While the lowest rates were recorded with control treatment for all treatment. Vegetative characteristics recorded same response for fertilization with level of 200 kg / ha and 50 ppm, the highest averages for stem length, leaf area, head diameter, head weight and head diameter with values (44.5

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and 47.7), (8114 and 7255), (72.4 and 67.5), (1123 and 3.781) and (4.72 and 5.67) / cm.

***Keywords*---**growth yield, lettuce plant, potassium fertilization, spraying humic acid.

Introduction

The demand for fresh green crops increased in recent times with the excessive increase in the world population, which required the provision of crops faster and more to meet the needs of the market and the consumer. One of the methods used among the agricultural methods to increase production is the use of chemical fertilizers, which have shown a high speed and efficiency in increasing crop growth. In recent times, the use of fertilizers has increased in an excessive, random and frequent manner, which has caused the emergence of great problems on the environment and humans alike, including soil and water pollution from the remnants of these fertilizers and the accumulation of some carcinogens in the consumers' bodies resulting from the accumulation of these fertilizers in crops and their transfer to the human body in addition to their impact negatively on the properties of the soil and its micro-organisms (Al-Allaf, 2014). On the other hand, the use of this type of chemical fertilizers can be positive if scientific and accurate methods are used in their use to lead to the desired method. The reports of the World Health Organization (WOH) and the World Food Organization (FAO) recommended limiting the use of chemical fertilizers excessively and indiscriminately, and resorting to adopting the method of the Integrated Management of Agricultural Fertilizers that relies on the use of more than one method and type to reach the best productivity with the least possible harm to the environment and people (AL-Yasari and Al-Hilli, 2018). One of the solutions proposed to reduce the use of chemical fertilizers is organic fertilizers in a joint, elaborate and efficient manner to ensure the continuity of the high production of crops because on the one hand they improve the properties of the soil and increase the growth and development of the roots and the vegetative part of the plant as well as increase the important microbiological activities in the soil (Vargas et al., 2017). On the other hand, it reduces the negative impact of manufactured fertilizers and reduces production costs significantly. The organic matter added to the soil improves the physical properties and builds of the soil and increases the stability of its aggregates and its ability to retain water. And it is considered one of the main sources of the necessary nutrients in plant nutrition and accelerates the activity of soil revival, which in general is in the interest of production as a whole (Faith and Kevin, 2021).

Foliar fertilization is one of the fast and highly efficient ways to meet the plant's need from the necessary nutritional requirements, and it is to spray a part or the vegetative group of the plant with a catalytic solution that contains the necessary nutrients for several times, And it is considered one of the important means of providing nutrients to the plant and it provides what the plant requires during sensitive and critical periods of growth that the roots cannot fulfill, As well as reducing the energy loss consumed for transporting some important ions inside the plant (Mohammed *et al.*, 2020). Humic acid is one of the nutrients that have a

clear effect on agricultural production in terms of quantity and quality of production, as it is one of the major nutrients that play a fundamental role in plant growth and development, and it has a number of functions within the plant body represented by regulating osmotic effort and increasing effectiveness and resistance Field crops for all difficult climatic conditions, it also works to speed up the absorption of nutrients, and it works to regulate the breathing process by controlling the opening and closing of the stomata, and it stimulates a number of enzymes necessary for plant growth and the process of forming and transporting carbohydrates (Zhou et al., 2022). Lettuce plant (*Lactuca sativa* L.) is one of the most important crops rich in vitamins and protein belonging to the family of Asterceaea. The lettuce plant is the only species in the genus of lettuce that is cultivated for commercial purposes, according to the United Nations Food and Agriculture Organization. Given the importance of this crop, must search or pay attention to the possible mechanisms, techniques and means in order to increase the productivity of this crop. Potassium, after adding it to the soil, speeds up the absorption of nutrients by the roots, and potassium acts as a medium for transporting nutrients from the soil to the plant. It affects an increase in the velocity of plant growth through its effect on the increase in growth of the root system. To evaluate the efficiency of using humic acid by spraying on leaves as an organic fertilizer as an alternative to industrial chemical fertilizers in improving the growth and yield of the lettuce plant.

Materials and Methods

Site study

Afield experiment study carried out in Al-Abasia village north city of Samarra.

Experimental design

The experiment applied by using CRBD Design with 2 factors : first factor using humic acid (spry) with three concentration (50, 25,12.5 and 0 ppm) and second factors using potassium with levels (200, 100 and 50 and 0 kg/ h) . Number of treatments interaction between the factors Nine (9) with three replicates. Control treatment depended without normal filterizer levels.

Table 1
Name of treatment

No	Name of treatment	No	Name of treatment
1	Untreated T1	6	T6
2	Humic acid 50ppm T2	7	T7
3	Humic acid 25ppm T3	8	T8
4	Humic acid 12.5ppm T4	9	T9
5	T5	10	T10

Field experimental

The land divided to unites (4x3m) with 17 equal lines for each . Small plant planted in lines with 20 cm between plants and regular irrigated with all agriculture process during plant growth and normal fertilizer level.

Filterizer treated

Powder of humic acid used to prepare solation (dissolved powder in water V/W) to prepare concentration 50,25 and

Table 2
The effect of fertilization method in addition to soil (kg/ha) and foliar spray (ppm) on the head length characteristic of lettuce plants

Treatments					
soil (kg / ha)	Control	Humic (ppm)			
		12.5ppm	25ppm	50 ppm	average
200 kg		41.6g	44.3c	47.6a	44.5a
100 kg	29.5i	43.6e	44d	44.3c	43.9b
50 kg		43f	39h	47.6b	43.2c
Average		42.7b	43.4b	47.5a	

12.5ppm. Humic solution spared at morning time directly on leaf plant before 1 day regular irrigation after 15 , 30 and 45 days from planting. Potassium K_2SO4 added and covered by soil after planted plant to lines bellow around 15cm under plants with three levels 200. 100 and 50 kg /h.

Growth characteristics

Ten 10 plants obtained randomly from the experimental unit and the average recorded of each depending on 10 plants.

Head length (cm)

The height of the plants is measured using a graduated tape to measure from the part of the stem above the soil surface to the upper end of the plant.

Head diameter (cm)

The diameter of the head is measured by means of a graduated tape by wrapping the tape around the head.

Head weight (gm)

The weight of the head is measured after the completion of the plant, as 30 plants were taken from each experimental unit and randomly from each line for each of the treatments and then placed on a sensitive scale to know the difference between the different weights between the treatments in the unit experimental (Vinay et al., 2022).

Result and Discussion

Head length (cm)

The results obtained from the analysis of variance table (2) showed significant differences in the characteristic of head length according to the different types and levels of fertilization treatments. Adding fertilizer to the soil had a significant effect on increasing the length of the head, and the highest average length was recorded with the level of 200 kg /ha with values of (44.5) and differed from the levels of 100 and 50 kg, which recorded averages of (43.9 and 43 cm) respectively, which differed from the control treatment. It gave the lowest average head length(29.5 cm).

May be potassium added to soil works by stimulating more than (60) enzymes, all of which contribute in all stages of plant growth to maintaining the largest number of leaves in a state of activity and vitality until the end of the planting season and this is reflected in the increase in the number of leaves and the length of the head, as well as potassium works to prolong periods Vegetative growth, which increases the length of the head, and this is consistent with. When adding potassium, it helps to elongate internodes, especially the increase in plant growth, carbohydrate synthesis, and cell division, and this is consistent with who confirmed that head length increased with increasing concentrations of potassium fertilization.

Table 2 also showed a significant superiority for the treatment of foliar spray with an average head length of 47.5 cm, which recorded a significant difference from the spray level of 25 and 12.5 ppm, which recorded mean values of head length (42.4 and 42.7 cm) respectively, which recorded a significant difference. On the treatment of consecutive control which had the lowest weights , The length of the roots has a significant effect recorded as a result of the interference between the treatments and their combinations in the head characteristics. The mixture of 200 and 50 kg fertilizers with humic acid spray at a concentration of 50 ppm recorded the highest averages with values of (46.7 cm) for each, which differed from the rest of the treatments that recorded a significant difference between them and from the control treatment, which recorded the lowest mean values for the root length characteristic with values of 29.5 cm. The organic matter has an important role in improving the (chemical and physical) properties of the soil and works to increase the activity of some micro-organisms present in the soil and this leads to an increase in the length of the head of the lettuce plant.

Head diameter (cm)

The head diameter characteristic showed a similar effect in response to the effect of different fertilization treatments by adding potassium fertilizer and spraying humic acid. The level of 200 kg / ha had the highest mean of stem diameter (61.2 / g), which was significantly different from the levels 50 and 100 kg, which recorded values of (61.2 and 59.7) g, which differed between them and which differed significantly from the control treatment, which gave less Average weight of 30g. Potassium has an important role in ATP by activating phosphorous uptake processes (Ferreira et al., 2021), Which is considered one of the necessary and

important elements to accelerate the transfer processes and fill the sieve tubes with products of photosynthesis processes with compounds that are high or large molecular weights such as proteins and carbohydrates and this increases the thickness of the diameter and works to maintain the osmotic pressure in the cell and its swelling and thus the process of opening and closing Stomata, This is in agreement with (Khamaj, 2015), who indicated an increase in the diameter of the head with an increase in the concentrations of potassium fertilization.

Table 3
The effect of fertilization method in addition to soil (kg / ha) and foliar spray (ppm) on the stem diameter characteristic of lettuce plants

Treatments					
Fertilization / soil (kg / ha) Compound fertilizer	Control	fertilization spray / leaves (ppm) Humic			
		12.5ppm	25ppm	50 ppm	average
200 kg		79.6a	66 d	71.6b	72.4 a
100 kg	30 d	56.6b	56c	66.6c	59.7 c
50 kg		55c	64.3e	64.3e	61.2 b
Average		63.7b	63.7b	67.5a	

Spraying with humic acid at different concentrations statistical differences in the mean stem diameter with reaching (67.5 cm) at the spray level of 50ppm, which recorded a significant difference from the two spray treatments (12.5 and 25 ppm) that did not differ between them (63.7 cm) for each and differed from the control treatment that was It gave the least average to the diameter of the stem, and the reason for this is that humic acid works to provide the important nutrients for plant growth. The addition of humic acid increases the absorption processes of monovalent ions such as (ammonium and potassium) by accelerating the active uptake of plant roots, which leads to an increase in head height and diameter. The stem diameter characteristic of plants recorded significant differences due to the overlap between fertilized treatments with different fertilization species and their concentration. The largest diameter of the lettuce plant was recorded with the fertilizer treatment 200 kg and the concentration of 50ppm of humic acid at averages amounting to (76.6 / g), which differed significantly from the rest of the treatments, which in turn recorded a significant difference between them, and for the control treatment, which recorded the lowest averages for the average head diameter,It reached 30 cm.

Head weight (kg)

The results of Table (4) indicate the existence of statistically significant differences for the fertilization treatments and with the control treatment. The highest weights for the experimental treatments were recorded with the fertilization level of 200 kg / ha, with averages of (1123 g), which differed significantly from the level of 100 and 50 kg, which recorded values of (1059 and 868.5) g, which differed significantly from the control treatment, which had the lowest rates of head weight characteristic (530) g. The treatment by spraying with organic fertilizer showed significant differences in the weight of the head. Table 4-5 head weight recorded the highest leaf spray weight with a concentration of 50 ppm with

weights reaching (1123), which differed from the treatments 12.5 and 50 ppm with values reaching 1059 and 868 / gm and differed from the control treatment, which recorded the lowest values. This is due to the fact that the addition of humic acid has a significant effect on the emergence and growth of roots, as well as the increase in their length, which helps to speed up the absorption of micro and macro nutrients. As humic acid increases absorption and nutrient aggregation processes, especially nitrogen, by increasing the permeability of cell membranes and stimulates the absorption of major and minor nutrients such as (phosphorous, potassium, magnesium, calcium, iron and zinc) that increase the weight of the head that humic acid helps increase photosynthesis processes and thus increases the necessary nutrients stored in the head, then enlarges the head size and increases weight.

Table 4
The effect of fertilization method in addition to soil (kg/ha) and foliar spray (ppm) on the head weight characteristic of lettuce plants

Treatments					
Fertilization / soil (kg / ha) Compound fertilizer	Control	fertilization spray / leaves (ppm) Humic			
	530h	12.5ppm	25ppm	50 ppm	average
200 kg		810f	1179b	1380a	1123 a
100 kg		933.3e	1103d	1141c	1059b
50 kg		600.6g	633.9f	1371a	868.5 c
Average		781.3c	971.9b	1297a	

The averaged head weights recorded different responses to the interaction between the fertilization treatments. The overlap between levels of 200 and 50 kg / ha and fertilization by spraying at a concentration of 50 ppm recorded the highest averages with weights of 1380 and 1371 g, respectively. Whereas, the lowest values of head weight were recorded with the level of 50 kg / ha and 12.5 ppm with a weight of 600 g, which differed significantly with means reaching (44.6 cm) for stem length, which differed significantly from the control treatment, which had the lowest mean weights of 530 g. One of the causes of increased head weight refers to the length of the physiological maturity period, which helped in the sufficient time to increase the weight of the head, when adding potassium increases the increase in head weight, especially during the winter cycle as well as the increase in The surface area of the leaf and the efficiency of the conversion processes of carbohydrates and proteins from the source to the downstream and this helps in increasing the weight of the head, When potassium fertilizer is added to fertilization, it increases the plant's efficiency in the biological and physiological processes of plant by forming ATP and also helps to increase the absorption of both nitrogen and proteins.

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