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Reinforcement of clean farming by using poultry manure and dry yeast and its effects on the growth and productivity of lettuce (*Lactuca sativa* L.)

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Abstract

A field study was carried out during the growing season 2020 in one of the private field in Sufia area / Ramadi district in order to determine the best combination of adding poultry manure and spraying with dry yeast on the growth and yield of lettuce plant (Lactuca sativa L.) Polaris cultivar. The study included the addition of poultry manure and dry yeast spraying, where a combination of treatments was made as follows: 1- the control treatment 2- 10% poultry Manure3- 15% poultry Manure4- Three grams dry yeast per liter for the experimental unit 5- Six grams dry yeast per liter for the experimental unit 6- 10 % poultry manure + 3 gm per liter dry yeast 7- 10% poultry manure + 6 gm dry yeast per liter 8 - 15% poultry manure + 3 gm dry yeast per liter 9- 15% poultry manure + 6 gm dry yeast per liter. The experiment was carried out according to a randomized complete block design with three replications, and treatments means were compared according to the L.S.D test at a significant level of 5%. The results showed that the combination (15% poultry Manure+ 6 g L-1 of dry yeast) was significantly outperformed of the following characteristics: head height, number of leaves, average head weight, leaf area, percentage of nitrogen in the leaves, with 42.69 cm, 70.493 leaves plant-1, 1.860 kg, 1451.33 cm2, and 3.15%, respectively. The combination (10% poultry Manure+ 6 g L-1of dry yeast) outperformed in percentage of carbohydrates (40.80%). It is concluded from this study that these fertilizers were characterized by giving positive results in vegetative growth characters, leaf content of nutrients and productivity.

Keywords: Clean agriculture, poultry waste, dry yeast, lettuce, Plant height.

Introduction

Lettuce (*Lactuca sativa* L.), is one of the winter vegetables crops that belongs to the Asteraceae family, which is grown in Iraq and different parts of the world. The part of the plant that is eaten fresh is the vegetative parts [1]. Most of the lettuce vari-

eties grown in Iraq belong to the lettuce group with elongated heads, as it is considered the richest in its nutritional value. This plant is located in sequence 26 in the list of nutritional value of vegetable crops [2]. Organic fertilizers are among the important sources that provide necessary nutrients for plant growth, as well as the significant role they play in increasing the activity of microorganisms in the soil, increased plant growth and production [3]. Found that the effect of poultry manure on the, vegetative growth and yield characters of the lettuce crop by adding 5 levels of poultry manure (0, 10, 20, 30 and 40 tons ha^{-1}), where level 40 gave the highest yield from the rest of the treatments [4]. The beneficial effects of organic fertilizers are not largely due to the value of nutrient fertilizers only, Incorrect the combined effects of the role of organic fertilizers in improving the composition of soil properties, as it is an important source of many nutrients, including N, P, and K [5]. Foliar nutrition is of importance and is considered efficient and inexpensive at the present time due to the frequent use of sprinkler irrigation, so this type of application is easy and efficient [6]. It is useful and feasible in conditions that are not suitable for uptake by the root system, especially in alkaline soils with a high content of lime and clay and lack of availability, and areas characterized by hot, dry climate in summer, as it negatively affects the yield in quantity and quality [7]. Foliar nutrition is one of the agricultural methods that complement the process of ground fertilization and is an alternative to it to provide the plant with important elements in the event that they are not available in the soil due to leaching or fixation, which is reflected in increasing the growth of the vegetative system and the yield [8]. The leaf is an important source of many metabolic activities, and it has the ability to absorb nutrients, like the roots. Foliar nutrition fills 85% of the plant's need for nutrients.

Biofertilizers are defined as all additives with a biological source, which are called microbial vaccines, which provide plants with their nutritional needs, by converting them from elements in their vital activity from their unavailable forms to forms, as well as supplying them with materials that encourage and stimulate growth, such as hormones and growth regulators, which contributes to reducing the use of chemical fertilizers by about 25% [9]. Yeast is one of the microscopic, single-celled fungi that reproduce vegetatively by budding and sometimes by simple division or both. Yeast contains reducing substances such as glycogen, fats, vitamins such as B1, B2 and B3, salts and proteins [10]. It is a biofertilizer that is healthy for humans and animals and reduces environmental pollution compared to chemical fertilizers, in addition to its high content of proteins, vitamins and natural hormones [11,12] mentioned that the addition of vital inoculants with the organic matter added to vegetable plants contributes to reduce the amount of chemical fertilizer to more than 45%, which reduces the cost of production and rationalizes the consumption of chemical fertilizers, in addition to the fact that microbial inoculants are environmentally friendly and non-polluting when used in modern agriculture [13] . stated that when spraying dry yeast at levels 0, 5 and 10 gm L^{-1} on eggplant plants, the concentration of 10 gm L^{-1} increased plant height, number of leaves and fresh weight of shoots, as well as

the content of N P k elements to the highest level, as well as increased the leaves content of hormones such as cytokinin, gibberellin, and indole acetic acid. Based on the foregoing, this study aims to determine the best combination of adding poultry manure and spraying with dry yeast on the growth and yield of lettuce plant (*Lactuca sativa* L.) Polaris's cultivar.

This study was carried out on the lettuce plant in one of the agricultural fields of Al-Sufia / Al-Ramadi area in Al-Anbar province, with coordinates of longitude 43.36 and latitude 33.44 for the period from 15/10/2020 to the end of February 27/2/2021, with the aim to determine the best combination of adding poultry manure and spraying with dry yeast on the growth and yield of lettuce plant (*Lactuca sativa* L.) Polaris's cultivar. The land was prepared by perpendicular plowing and then smoothed, then the land was divided into three blocks, each of which represents a replicate, and the land of the block was divided into 9 experimental units, and the distance between one plant and another was 25 cm. Planting was carried out on terraces, the width of the terrace is 70 cm, with two lines for each terrace, and the length of the terrace is 3 meters, as the area of the experimental unit is 2.1 square meters. Seedlings were planted alternately on the terrace and a drip irrigation system was used to irrigate the plants. The experiment was carried out with a randomized complete block design (RCBD) with three replications.

Preparing poultry waste

Poultry waste) was obtained from poultry houses for production of table eggs of private sector in the city of Ramadi, these residues were fermented on 15/5/2020 for a period of four months after being immersed in water for 18 hours to increase the moisture content, and then get rid of the excess water, as it was spread in layers, and for the purpose of accelerating decomposition, revitalizing microorganisms, and improving the content of the organic medium of some elements, urea fertilizer was added at a rate of 2% [14], Phosphate rock 1% and *Tirchodrma.harzinu* L. inoculum 1% [15,16] , then it was placed in a pile with a height of 0.5 m and a length of 1.5 m, and it was sprayed with water, with stirring, on a floor covered with polyethylene. The process of spraying with water continued for 4 days, for two hours in the morning and evening, until it became wet, then covered with a layer of polyethylene and monitored the rise in temperature inside the pile. It is stirred once every 10 days, with water sprinkled when needed, until the fermentation process is complete [17]. Then it was transferred to the experimental site and distributed according to treatments on 11/10/2020.

Preparation of dry yeast suspension

The preparation process was of yeast suspension carried out by adding of dry yeast with 1440 gm of sucrose and dissolving them in 240 liters of water (placed in three barrels, the capacity of each barrel is 100 liters). After 24 hours, the leaves were

sprayed one month after planting for the first spray, and two months later for the second spray [18].

The study included the addition of poultry Manureat the levels 10% and 15% at a depth of 20 cm by weight on a plant, and spraying with dry yeast at two concentrations of 3 and 6 gm L^{-1} after one month of seedling and after two months, and the following treatments combination was made:

T1 control treatment without addition
T2 10% poultry waste
T3 15% poultry waste
T4 3 gm dry yeast per liter^{-1} for the experimental unit
T5 6 gm dry yeast per liter^{-1} for the experimental unit
T6 10% poultry Manure+ 3 g L^{-1} dry yeast
T7 10% poultry Manure+ 6 g L^{-1} dry yeast
T8 15% poultry Manure+ 3 g L^{-1} dry yeast
T9 15% poultry Manure+ 6 g L^{-1} dry yeast

Studied traits:

Characteristics of vegetative growth:

The vegetative growth characteristics were measured at the end of the experiment when the heads were harvested in the field on 27/2/2021 when they became suitable for harvesting after 115 days from the date of planting the crop. Vegetative growth and some chemical characteristics were measured.

1- Average of head height (cm)
2- Average number of total leaves (leaf plant^{-1})
3- Average of head weight (kg)
4- Average of leaf area (cm^2), calculated according to [19] method.

Chemical properties:

1- The percentage of nitrogen in the leaves was calculated according to the method of [20].
2- The percentage of phosphorous in the leaves was calculated according to the method of [20].
3- The percentage of potassium in the leaves was calculated according to the method of [20].
4- The percentage of carbohydrates in the leaves, estimated according to the method of [21].

Table (1a): Components of dry yeast *Sacchromyce cervisiae* (Amino acids (mg.gm^{-1})) [22]

No.	Amino acids (mg.gm^{-1})	
1	Glycine	0.103
2	Alanine	0.132
3	Valine	0.312

4	**Leucine**	**0.067**
5	**Isoleucine**	**0.421**
6	**Aspartic acid**	**0.274**
7	**Glutamic acid**	**0.367**
8	**Serine**	**0.523**
9	**Threonine**	**0.206**
10	**Tyrosine**	**0.031**
11	**Phenyl alanine**	**0.116**
12	**Proline**	**0.041**
13	**Arginine**	**0.073**
14	**Lysine**	**0.089**
15	**Cysteine**	**0.025**
16	**Methionine**	**0.012**
17	**Histidine**	**0.078**
18	**Tryptophan**	**0.020**

Table (1b): Components of dry yeast *Sacchromyce cervisiae* (Mineral composition) [22]

No.	**Mineral composition**	
1	**P %**	**0.94**
2	**K %**	**0.18**
3	**Na %**	**0.12**
4	**Mg %**	**0.10**
5	**Ca %**	**0.04**
6	**µg. g^{-1} Mn**	**5.69**
7	**µg. g^{-1} Zn**	**69.5**
8	**µg. g^{-1} Cu**	**12.78**
9	**µg. g^{-1} Fe**	**30.5**

Table (1c): Components of dry yeast *Sacchromyce cervisiae* (Vitamins (mg gm^{-1})) [22]

No.	**Vitamins (mg gm^{-1})**	
1	**Vit.B1**	**0.163**
2	**Vit.B2**	**0.054**
3	**Vit.B6**	**0.019**
4	**Pantothenic acid**	**0.058**
5	**Biotin**	**0.091**
6	**Niacin**	**0.112**
7	**Inositol**	**0.372**

Table (1d): Components of dry yeast *Sacchromyce cervisiae* (other ingredients (%)) [22]

No.	other ingredients (%)	
1	**Total nitrogen**	**7.69**
2	**Carbohydrate**	**5.47**
3	**Ash**	**13.51**
4	**Water**	**4.70**

Results and Discussion

Plant height (cm)

The results indicate that there are significant differences between the treatments (Figure 1), where treatment T9 (15% poultry Manure+ 6 gm L^{-1} dry yeast) outperformed the rest of the treatments and recorded the highest head height of 42.690 cm, compared with the control treatment T1, which recorded the lowest head height of 35.463 cm.

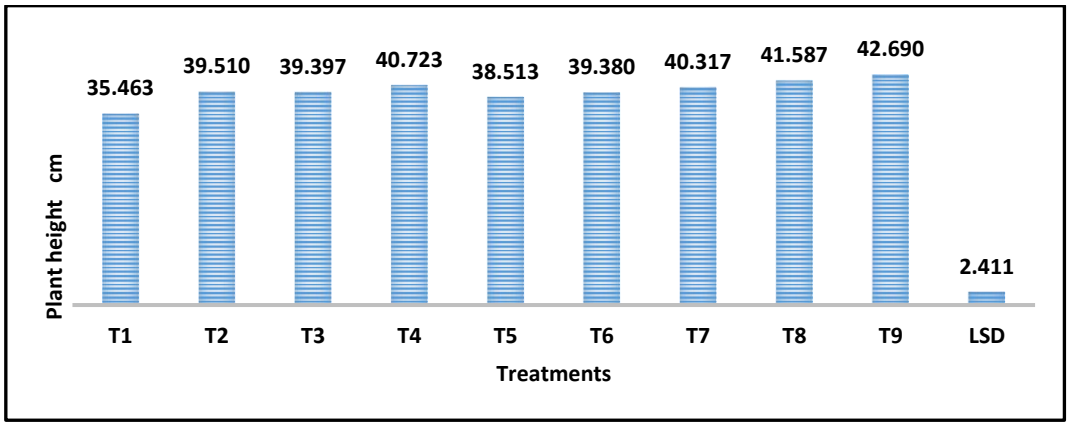

Figure (1): Head height of lettuce (cm)

Total number of leaves (leaf $plant^{-1}$)

The results indicate that there are significant differences between the treatments (Figure 2), where treatment T9 (15% poultry Manure+ 6 gm L^{-1} dry yeast) outperformed the rest of the treatments and recorded the highest number of leaves of 70.493 leaf $plant^{-1}$, compared with the control treatment T1, which recorded the lowest head height of 53.427 leaf $plant^{-1}$.

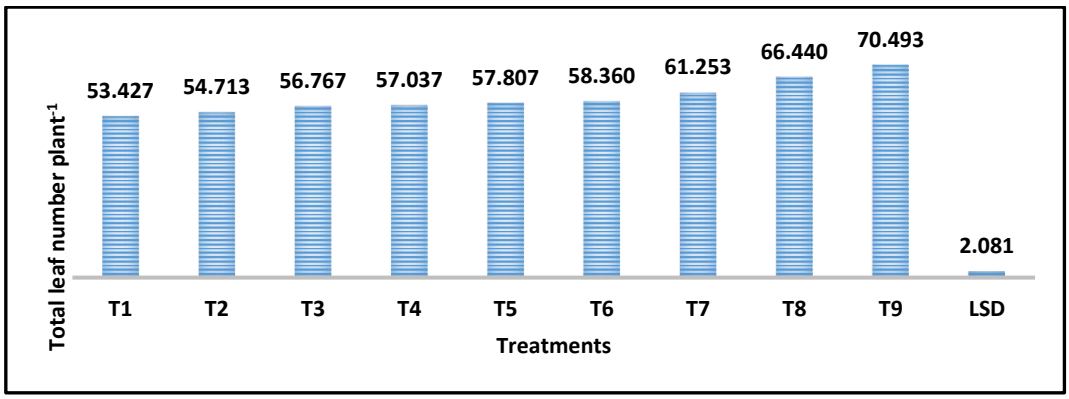

Figure (2): The total number of leaves (leaf plant^{-1})

average head weight (kg)

The results indicate that there are significant differences between the treatments (Figure 3), where treatment T9 (15% poultry Manure+ 6 gm L^{-1} dry yeast) outperformed the rest of the treatments and recorded the highest average head weight of 1.860 kg, while treatment T1 gave the lowest rate of 0.907 kg.

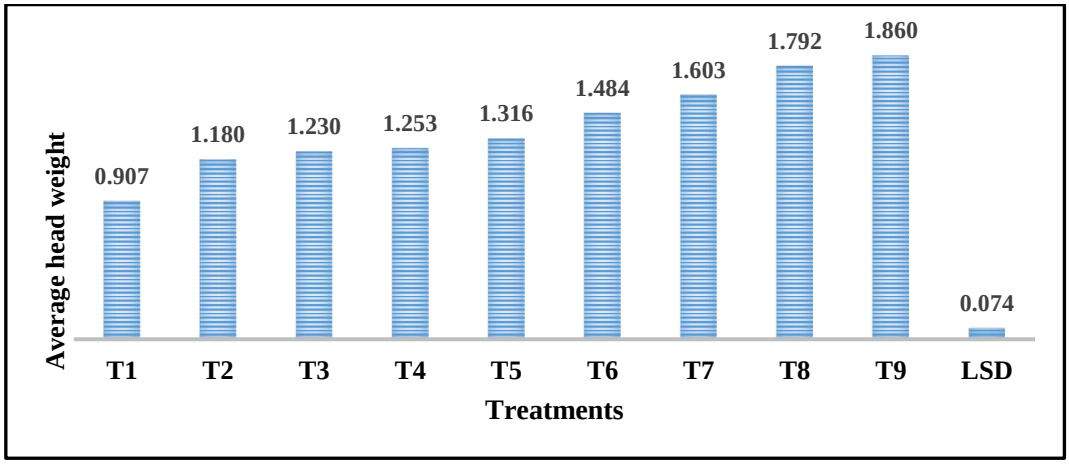

Figure (3): Average head weight (kg) of lettuce plants

Average leaf area (cm^2)

The results of (Figure 4) show that there are significant differences between the treatments, as the T9 treatment outperformed the rest of the treatments and recorded the highest rate of leaf area (1451.333 cm^2), while the control treatment recorded the lowest rate of 675.667 cm^2.

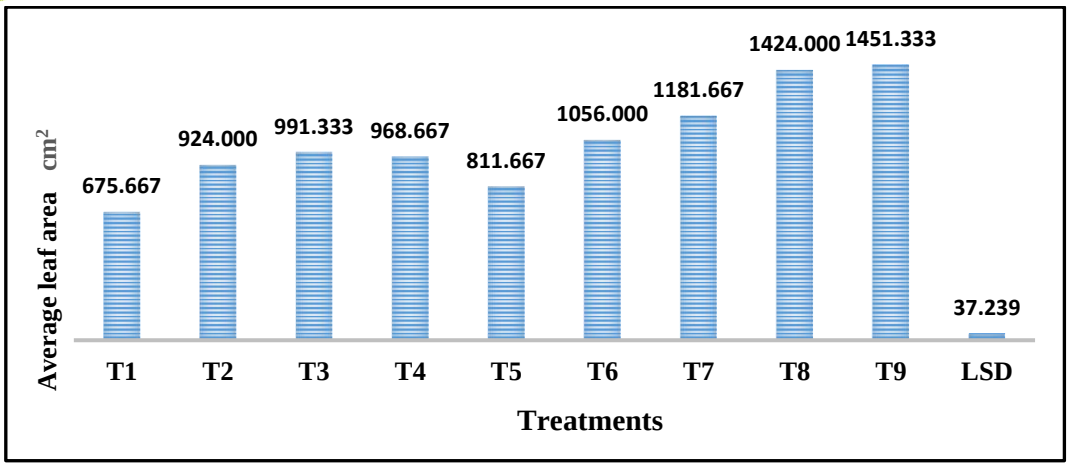

Figure (4): Average leaf area (cm^2) of lettuce plants

Percentage of nitrogen in the leaves (%)

The results of (Figure 5) show that there are significant differences between the treatments, as the T9 treatment outperformed the rest of the treatments and recorded the highest rate of nitrogen percent (3.159 %), while the control treatment recorded the lowest rate of 1.376 %.

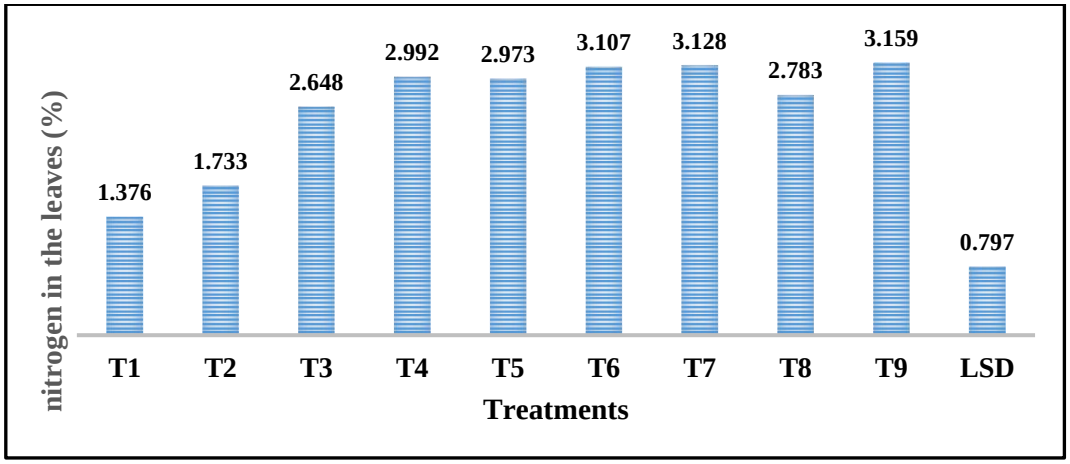

Figure (5): Percentage of nitrogen in the leaves (%) of lettuce plants

Percentage of phosphorus in leaves (%)

The results of (Figure 6) indicate that there are no significant differences between the study treatments in the percentage of phosphorus content in lettuce leaves.

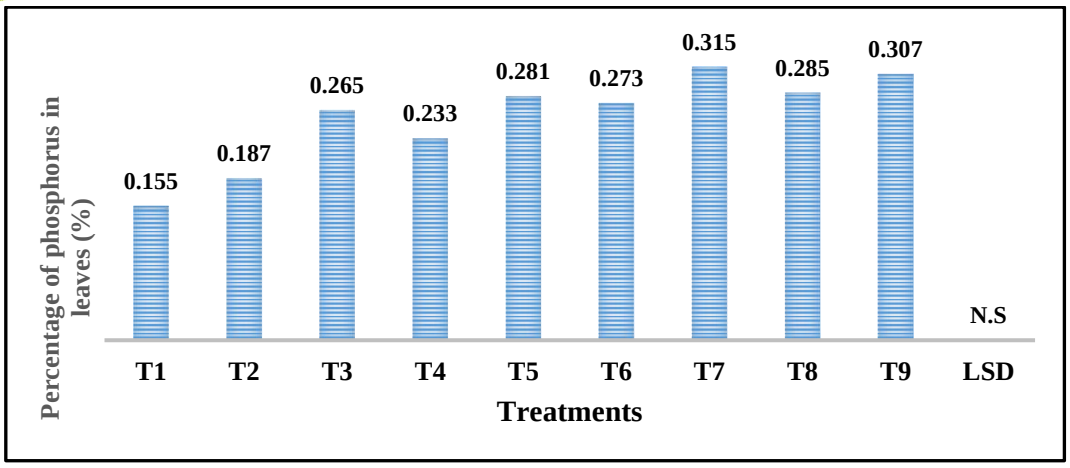

Figure (6): Percentage of phosphorus in the leaves (%) of lettuce plants

Percentage of potassium in the leaves (%)

The results of Figure (7) indicate that there are no significant differences between the study treatments in the percentage of potassium content in lettuce leaves.

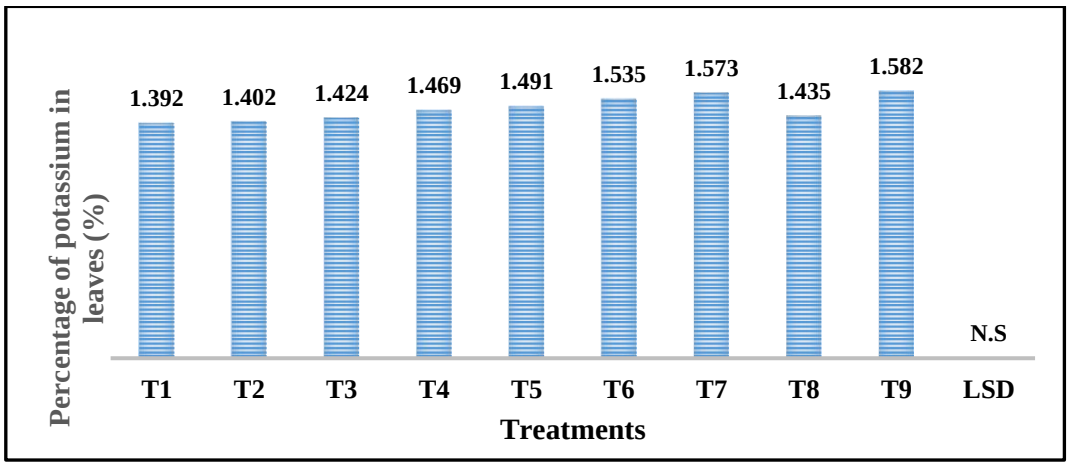

Figure (7): Percentage of potassium in the leaves (%) of lettuce plants

Percentage of carbohydrates in leaves (%)

The results indicates that there are significant differences between the study treatments (Figure 8), where the T7 treatment (10% poultry Manure+ 6gm liter -1 dry yeast) was superior to the rest of the treatments and recorded the highest percentage of carbohydrates (40.802%), compared to the control treatment, which recorded the lowest percentage of carbohydrates (39.082%).

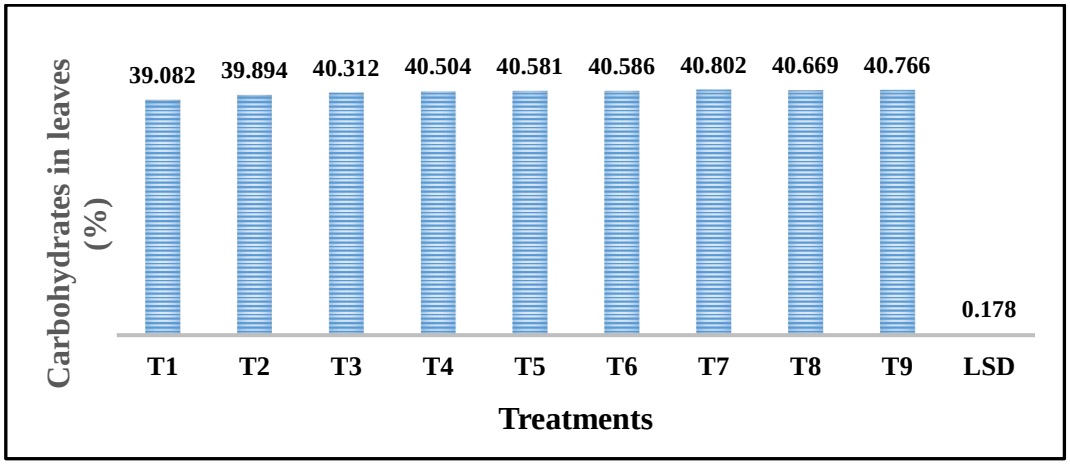

Figure (8): Percentage of carbohydrates in the leaves (%) of lettuce plants

Poultry Manure was added and sprayed with dry yeast to the lettuce plant, because the lettuce plant is a leafy plant that responds to nutrition due to the nature of its vegetative growth and the consumed part, as the addition of the two study factors aimed to provide the main nutrients at the beginning of growth (spraying with dry yeast), as well as providing these elements throughout the growing season due to the continuity of decomposition of poultry manure. The effect of organic fertilizers is not only because of the nutrients they contain, but also affects the soil properties, as it works to increase porosity, aeration, and regulate the movement of water in the soil [23]. Therefore, the reason for increasing the vegetative growth characteristics of lettuce (Figures 1, 2, and 4) is due to the role of organic fertilizers and dry yeast in providing the soil and plant with plant nutrients, whether macro or microelements, which play an important role in plant growth through their participation in the vital activities of the plant [24]. Where the organic fertilization treatments and dry yeast had a significant effect on the height of the head, the number of leaves, and the leaf area (Figure 2). The organic matter also works to increase growth and plant height due to its availability of nutrients and thus increases the number and activity of microorganisms, which work to increase the activity of enzymes, which in turn carry out the process of decomposition of organic compounds and then the elements are released, thus plant growth rates increased [25]. As well as improving the physical and chemical properties of the soil by increasing its porosity and preserving its moisture, as it works to raise the temperature of the growth medium, increasing the absorption of water and nutrients, and thus positively affecting vegetative growth [26].

The increase in the head weight of the plants treated with poultry manure and spraying with dry yeast is due to the improvement of vegetative growth, especially the increase in the number of leaves and the increase in the average leaf area (Figures 2 and 4), which increased the carbon metabolism products and the accumulation of the products of this process (carbohydrates and proteins) in the storage parts of plants, this is reflected in the increase in head weight [27].

The increase in the percentage of nitrogen in the leaves (Figure 5), is also attributed to the fact that the addition of poultry Manureled to a decrease in the pH of the soil and an improvement in its composition by increasing its water retention and increasing its aeration, which increased the growth of the roots and then the absorption of available elements. These results are consistent with what was found by [28] who observed an increase in leaf nitrogen content after composting with poultry manure and spraying with dry yeast in lettuce.

The results also indicate that there are significant differences in estimating the content of carbohydrates in leaves (Figure 8), which is attributed to the role of carbon dioxide in activating the process of carbon metabolism and increasing the production of carbohydrates, which is reflected in the encouragement of dense root growth, which helps in increasing the absorption of nutrients, and the increase in the activity of the carbon metabolism process due to the increase in CO_2 in air, which affected the vegetative growth by increasing the accumulation of carbohydrates in the plant. This is due to the important role of the study factors in increasing the vital activities within the plant due to its availability of nutrients continuously and throughout the growth period [8].Whereas for the ratio of potassium and phosphorus in the leaves, no significant differences were observed between the study treatments.

Clean agriculture has an important role in the agricultural sector, through integrated plans to achieve sustainable agricultural development, which is in line with the social and economic requirements that have an impact on raising agricultural development rates and increasing crop productivity, and benefit from the waste, whether plant or animal, which leads to the protection of the environment from pollution and the achievement of healthy food security. Therefore, the addition of organic residues and dry yeast improved the growth of lettuce, its yield, and some chemical properties. These natural materials are a suitable alternative technology in clean agriculture and the preservation of the agricultural environment from the use of manufactured fertilizers.

The fortification of poultry manure with different concentrations of dry yeast is one of the important and necessary processes for leafy crops which is responsive nutrients to provide nutrients throughout the growing season.

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