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THE EFFECT OF POULTRY WASTES, UREA AND INOCULATION WITH *PSEUDOMONAS FLUORESCENS* ON ORGANIC CARBON, TOTAL NITROGEN, AND GROWTH TRAITS OF *VIGNA RADIATA* L.

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Abstract

Investigating the effect of the application of different sources of fertilizers on organic carbon, total nitrogen, and some characteristics of the growth of *mung bean (Vigna radiata.* L) in both of the rhizosphere and bulk soils, a pots experiment was conducted in the greenhouse canopy in one of the fields affiliated to the Faculty of Agriculture - the University of Qadisiyah during the summer season of 2018. The cultivation soil was a silty loam. Local variety mung bean seeds (Khedrawi) were planted. The treatments of the study were as the fellow: two levels of nitrogenous mineral fertilizer (urea) M1 and M2 (20 and 40) kg.N.h^{-1}, respectively, one level of organic fertilizer (poultry waste) (10 tons.h^{-1}), a single level biofertilizer with *Pseudomonas fluorescens* bacteria, control treatment, and their interaction treatments. The experiment was designed following the Completely Randomized Design (CRD) with six replicates and the means were compared according to the Least Significant Difference (L.S.D) test at a probability level (α=0.05). The assay of organic carbon, total nitrogen, and some growth characteristics of the mung bean plant in the soil of the root surrounding (rhizosphere) and the distant soil (bulk soil) was estimated for all study treatments after 30 days of planting. The same measurements were repeated with some measurements of the vegetative and root growth characteristics after 60 days of the planting date.

The results are summarized the following: The treatment of poultry residues (O) significantly increased in the amount of organic carbon in comparison with the other individual treatments for the period of 30 days from planting compared to control treatment, which had the lowest value of organic carbon into the rhizosphere and bulk soils (14.67 and 13.35) g.kg^{-1}.soil, respectively. According to the period of 60-days after planting date, the value of organic carbon for the two regions increased to (15.36 and 14.90) g.kg^{-1}.soil, respectively. The treatment of bilateral overlap between poultry residue and biofertilizer with *Pseudomonas fluorescens* (OB) gave the highest significant increase in the amount of organic carbon for a period of (30) days of the planting date in both the rhizosphere and bulk soils compared with the individual treatments as they valued at (15.22 and 13.92) g.kg^{-1}.soil. After the 60 days of cultivation, the amount of organic carbon in both soil regions of the rhizosphere and bulk soils increased to (16.00 and 15.16) g.kg^{-1}.soil, respectively.

The treatment of the overlap between poultry waste, inoculation with *Pseudomonas fluorescens* and urea at level II (OBM_2) resulted in the highest significant increase in organic carbon for a period of (30) days after the planting date in both of the rhizosphere and bulk soils (16.30 and 15.26) g.kg^{-1}.soil, respectively. According to the period of 60 days, the amount of organic carbon in the two regions increased (16.61 and 15.40) g.kg^{-1}.soil, respectively, in comparison with the mono and bilateral treatments. The treatment of poultry residues (O) significantly increased the total nitrogen amount over the rest of the mono treatment for the period of (30) days of cultivation compared to the control that had the lowest total nitrogen value for the region of the rhizosphere and bulk soils (1.89 and 1.48) g.kg^{-1}.soil, respectively.

After the 60 days, the total nitrogen value for the two regions increased, as it reached (2.61 and 1.62) g.kg^{-1}.soil for the rhizosphere and bulk soils, respectively. The treatment of bilateral interference between poultry and urea residues at the second level (OM_2) resulted in the highest significant increase in the total nitrogen amount for the 30 days after planting for the region of the rhizosphere and bulk soils compared to the mono factors (1.55 and 1.49) g.kg^{-1}.soil. According to the 60 days of the planting date, the total nitrogen amount for the two regions increased to (2.29 and 1.59) g.kg^{-1}.soil, respectively.

The treatment of the interaction between poultry residues and the biological vaccination with *Pseudomonas fluorescens* and urea at level II (OBM_2) resulted in the highest significant total nitrogen increase for the period of (30) days from the planting date in the rhizosphere and bulk soils (2.03 and 1.81) g.kg^{-1}.soil, respectively. In a period of 60 days, the total nitrogen amount increased for both regions, as it reached (2.53 and 2.50) g.kg^{-1}.soil, respectively, in comparison with the mono and bilateral

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treatments.

The treatment of poultry waste (O) achieved the highest average of plant height for the mung bean plant (29.20) $cm.plant^{-1}$ compared to the control. The treatment of overlap between poultry waste and urea at the second level (OM_2) resulted in the highest average plant height of the mung bean plant, (34.50) $cm.plant^{-1}$ compared to the mono treatments. The treatment of triple overlap between poultry waste and bacterial vaccination and urea at the second level (OBM_2) resulted in the highest significant increase in the plant height of the mung bean plant (36.23) vaccination, respectively, in comparison with the mono and bilateral treatments.

The treatment of poultry wastes (O) gave the highest mean average weight of vegetative and root weight of mung bean (10.84 and 0.45) $g.plant^{-1}$, respectively, compared to the control. The treatment of overlap between poultry waste and urea at the second level (OM_2) achieved the highest mean average of the dry weight of the vegetative and root total of the mung bean plant (18.38 and 1.58) $g.plant^{-1}$, respectively, compared with mono treatments. The treatment of triple interference between poultry waste and bacterial vaccination and urea at the second level (OBM_2) resulted in the highest average of the dry weight of the vegetative and root total of the mung bean plant (19.73 and 1.34) $g.plant^{-1}$, respectively, compared with mono and bilateral treatments.

Key words : *Pseudomonas fluorescens*, poultry waste, urea, organic carbon, total nitrogen.

Introduction

The area of the roots surrounding (rhizosphere) is known as the zone of vital activity of plant roots. Recent studies have shown that this region is a place for the occurrence of the most biological interactions between microorganisms and the environmental soil system. These activities decline outside this region by (bulk soil), Hinsinger *et al.,* (2006). The root zone contains root secretions that encourage the growth of microorganisms as they are a source of energy and carbon necessary for their growth. Among these secretions are organic acids, amino acids, carbohydrates, and some inorganic compounds such as (CO_2) and inorganic ions. Root secretions also contain enzymes that are released to the rhizosphere, (Shulka, and Varma, 2011; Al-Taweel and Abo-Tabikh, 2019).

The important role of the organic matter in the soil comes through the products of its decomposition. When it is applied as animal or plant waste to the soil, it is subject to attack by microorganisms that work to decompose these materials. The application of organic waste to the soil improves its physical, chemical, and fertile properties, as well as its biological activities, and contributes to increasing agricultural production by supplying the plant with the nutrients necessary for its growth, (Abu Naqta, 2004).

Bio-fertilizer is also described as a product that contains natural microorganisms that are free of chemical compounds that settle plant roots or enter plant tissues and encourage and stimulate its growth through their ability to supply nutrients and resist them to certain environmental conditions, Lakshmana (2000). Bio-fertilization helps in the availability of nutrients with different mechanisms, including reducing the degree of interaction of the soil (pH) through the secretion of organic acids and their production of phytohormones and their production of antibiotics to protect themselves and protect the plant from bacterial and fungal diseases, Vessey (2003); Khaeim *et al.,* (2019). Biological fertilizers are not only like mineral fertilizers that added nutrients to the soil but also help in preparing nutrients through the various natural processes in the soil and increase the plant's susceptibility to fighting diseases.

As for the main objective of application of mineral fertilizers, it is to equip the plant with the appropriate quantities of nutrients in a balanced and fast way to compensate for the shortage present in the soil from those elements and to obtain the highest production that requires balanced quantities of these elements, according to the need of the crop and what is available in the soil in an available manner. The importance of the rhizosphere region for plant growth and soil fertility, with its secretions that stimulate organisms' growth.

The goal of this study was to estimate the organic carbon and total nitrogen for the rhizosphere and bulk soils of mung bean plant after (30 and 60) days after planting under the effect of poultry waste, urea and bacterial vaccination with *Pseudomonas fluorescens*, as well as to measure some of the growth characteristics of the mung bean crop.

Materials and Methods

Site work of experimenting

The soil prepared for planting was taken from the extension station, in the Shafia sub-district of the Agricultural Extension Department in Diwaniya. The experiment was conducted in the greenhouse in one of the fields of the College of Agriculture - University of Qadisiyah. Random samples were taken from this soil from the surface layer at a depth of (0 - 30 cm), air dried, then crushed and sifted with a sieve with a diameter of (2) mm holes. It was mixed well to obtain homogeneity, and some chemical, physical and biological analyzes were performed before planting, (Table 1).

Experimental design

The factorial experiment was designed according to Completely Randomized Design (CRD). The number of experimental treatments was (12) and six replicates, as the number of experimental units becomes (72) unites, and the experiment included the following treatments:

Two levels of nitrogenous fertilizer (urea)

M_1 = application of (20) kg.N.h^{-1} (50% of fertilizer recommendation)

M_2 = application of (40) kg.N.h^{-1} (100% of fertilizer recommendation)

A level of organic fertilizer (poultry waste)

O = application of (10) ton.h^{-1}.

A level of bio-fertilizer *Pseudomonas fluorescens*

B = *Pseudomonas fluorescens* contamination (10) kg.bio-fertilizer.kg^{-1}.seeds.

Control transaction

Pots experience

Pots with a capacity of (20) kg were used in the experiment. The pots intended for cultivation were filled with soil after the soil was mixed well for homogenization and then passed through a sieve with a diameter of (4) mm holes before filling with pots. Local variety (Khedrawi) of mung bean seed (*Vigna radiate* L.) obtained from the Seed Inspection and Certification Department in Al-Diwaniyah Governorate at a rate of (6) seeds per pot. The seedlings rugged out to (3) plants a week after germination.

The experiment was conducted to study the effect of the bacterial bio-fertilizer with *Pseudomonas fluorescens* obtained from the Agricultural Research Center in Zafaraniah and organic (poultry waste) and mineral (urea) and their interaction on organic carbon and total nitrogen in the soil of the root zone (rhizosphere) and bulk soils of the mung bean crop. The seeds were sterilized for biological fertilization treatments using (1)% sodium hypochlorite for five minutes, then the seeds were washed with distilled water several times to remove the sterile material from them. The inoculated with *Pseudomonas fluorescens* carrying fertilizer (10) g.kg^{-1}.seed bio-fertilizer using (10)% Arabic gum (was prepared by adding (10) g per (100) ml distilled water). This runs into autoclave striation under (121)°C and pressure of (15) bar for an hour. After that, the gum is left to cool and then contaminated with *Pseudomonas fluorescens* and mung bean seeds and left for an hour.

Table 1: Some chemical and physical properties of the soil before planting.

Trait		Value	Unit	Reference
Reaction Degree (pH) (1:1)		7.60	....	Black, (1965)
Electrical Conductivity (EC) (1:1)		3.42	DesiSmens.M^{-1}	
Cation exchange capacity (CEC)		23.73	Cml.charge.kg^{-1}.soil	Papanicolaou
Organic carbon		0.84	g.kg^{-1}	Black, (1965)
Organic matter		1.46		
Total nitrogen		0.39		
Cationic dissolved ions	Ca^{2+}	25.45	Cml.charge.L^{-1}	Black, (1965)
	Mg^{2+}	13.44		
	Na^{1+}	40.58		
	SO_4^{2-}	17.95		
	HCO_3^{1-}	16.8		
	CO_3^{-2}	Nill		
	Cl^-	41.56		
Available phosphorous		16.30	Mcg.m^{-1}	Page *et al.,* (1982)
Available potassium		164.40		
Total bacteria		13.21*10^6	CFU.g^{-1} dry soil	Black, (1965)
Total fungi		1.4*10^3		
Bulk Density		1.36		
Soil Separators	Sand	270	g.kg^{-1}	Black, (1965)
	Loam	540		
	clay	190		
Texture type		Silt Loam		

Poultry waste was applied at the level of (10) tons.h^{-1} and urea were applied at two levels (20 and 40) kg.N.h^{-1} twice, the first at the planting date and the second after (20) days of the first application. The application of triple superphosphate fertilizer in one lot at planting date according to the fertilizer recommendation (80) kg.h^{-1}, and the application of

Table 2: Some chemical and physical properties of the poultry wastes.

Trait	Unit	Value
pH	......	6.4
Organic matter	%	65.0
Total nitrogen	%	4.2
C / N	%	9.0
Phosphorus (P_2O_5)	%	3.0
Potassium (K_2O)	%	2.8

potassium fertilizer in form of potassium sulfate in two batches with urea according to fertilizer recommendation (40) $kg.h^{-1}$.

Laboratory experiments

Soil samples were taken from the area around and outside the root (rhizosphere and bulk soils) of the mung bean plants (30 and 60) days after planting the crop. These samples were stored in plastic containers in the refrigerator for the analysis of organic carbon and total nitrogen.

Soil analyzes

Some chemical, physical and biological tests were done for the study soil before planting, which was randomly taken at a depth of (0-30) cm, including the following:

Physical analysis

It is estimated according to the methods mentioned in Black (1965) as follows:

Soil tissue

The soil separators were estimated by the absorbent method.

Bulk density

The bulk density was estimated using a cylindrical ring method (Core sample)

Chemical analysis

It is estimated according to the methods mentioned in Black (1965) as follows:

Degree of soil reaction (pH)

Estimated in soil extract: water (1: 1) using pH meter.

Electrical conductivity (EC)

Estimated in soil extract: water (1: 1) using an EC-meter.

CEC cation exchange capacity

The cation exchange capacity was estimated by selling the soil with $CaCl_2$ (1.0) standard solution and then displacing with a standard (1.0) sodium nitrate solution according to the Papanicolao method (1976).

Calcium carbonate $CaCO_3$

It was estimated by calculating the loss in CO_2 after treating the soil with (3.0) hydrochloric acid.

Positive and negative dissolved ions

They were estimated in an extract (1: 1) according to the methods mentioned in Black (1965a) as follows:

Calcium (Ca^{+2}) and magnesium (Mg^{+2})

They were estimated by dissolving with a solution of fersnite (Na_2-EDTA).

Sodium (Na^{+1}) and potassium (K^{+1})

They were estimated using the Flame photometer.

Carbonates and Bicarbonate (HCO_3^{-1})

They were estimated by leaching with standard

Table 3: The distribution of the experimental treatments with their symbols.

TS	The application
Cont.	No application
O	10 $tons.h^{-1}$ compost (poultry waste)
M1	Mineral fertilizer (urea) (50 % of fertilizer recommendation) 20 $kg.N.h^{-1}$
M2	Mineral fertilizer (urea) (100% of fertilizer recommendation) 40 $kg.N.h^{-1}$
B	Biological vaccine *Pseudomonas fluorescens*
OM1	Mineral fertilizer (urea) (50% of fertilizer recommendation) + organic fertilizer (poultry waste) 20 $kg.N.h^{-1}$ + 10 $tons.h^{-1}$
OM2	Mineral fertilizer (urea) (100% of the fertilizer recommendation) + organic fertilizer (poultry waste) 40 $N.h^{-1}$ + 10 $tons.h^{-1}$
OB	10 $tons.h^{-1}$ Organic Fertilizer (Poultry Waste) + *Pseudomonas fluorescens*
BM1	Mineral fertilizer (urea) (50% of fertilizer recommendation) 20 $kg.N.h^{-1}$ + *Pseudomonas fluorescens*
BM2	Mineral fertilizer (urea) (100% of the fertilizer recommendation) 40 $kg.N.h^{-1}$ + *Pseudomonas fluorescens*
OBM1	Mineral fertilizer (urea) (50% of fertilizer recommendation) 20 $kg.N.h^{-1}$ + organic fertilizer (poultry waste) 10 $tons.h^{-1}$ + *Pseudomonas fluorescens*
OBM2	Mineral fertilizer (urea) (50% of fertilizer recommendation) 40 $kg.N.h^{-1}$ + organic fertilizer (poultry waste) 10 $tons.h^{-1}$ + *Pseudomonas fluorescens*

sulfuric acid 0.01.

Chloride (Cl^{-1})

The Titrations with silver nitrate ($AgNO_3$) of (0.005) standard.

Sulfate (SO_4^{-2})

Estimated by sedimentation with acetone.

Organic carbon

The organic matter was estimated by oxidation with a standard (1.0) dipotassium chromate solution using concentrated sulfuric acid and the correction with ammonia ferrous sulfate using the Diphenylamine reagent according to the Weakley - Black method contained in 1965 (Black).

Total nitrogen

The total nitrogen was estimated by digesting the soil sample with concentrated sulfuric acid and using a micro-Kjeldahl steam distillation apparatus in the estimation according to Bremner's (1965) method mentioned in (1965) Black.

Available Phosphorous

The available phosphorous was measured by extracting it from sodium bicarbonate (0.5) molar and developed the blue color using ammonium molybdate and ascorbic acid. Then the available phosphorus was estimated with the spectrophotometer at (882) nm wavelength, according to the method described in Page *et al.,* (1982).

Available potassium

It was estimated by extracting it using standard (1.0) % ammonium acetate. The potassium content is measured using a flame photometer according to the method mentioned in Black (1965).

Biological analyzes

The numbers of total bacteria and fungi

Series of decimal diluted solutions from (10^{-1} to 10^{-6}), the diluted solutions of apprehensions (10^{-5} and 10^{-6}) to grow bacteria using the Nutrient Agar medium. To counting the fungi, pancakes (10^{-3} and 10^{-4}) using the Martin medium as reported. In Black (1965).

Plant measurements

Three plants were chosen from each experimental unit after the end of the growing season for the mung bean after the dark brown color appeared on the pods and the following measurements were made:

Height of plant (cm^{-1})

The plant height was measured using the tape measure the height of the plant was measured from the site of the plant's contact with the soil to the end of the stem of each plant for each of the experimental unit plants.

The dry weight of vegetable and root part (gm^{-1})

At the end of the season, three plants were taken from each experimental unit. The plants were extracted completely and carefully and then according to the dry weight of the vegetative and root system by separating the root system from the vegetative and washing the root system with water to remove the soil adhering to it. Botanical samples were placed in special bags and tagged. The plant samples were dried using the electric oven at a temperature of (65)°C until the weight remained constant, and then calculated the dry weight of the root and vegetable group by scale.

Results and Discussion

The effect of the bio-fertilizer *Pseudomonas fluorescens*, poultry wastes, and urea on organic carbon ($gm.kg^{-1}$.soil) in and outside the rhizosphere of the mung bean after 30 and 60 days of the planting date.

Organic carbon in the soil ($g.kg^{-1}$.soil) 30 days after planting

The results in table 4 present that the treatment of poultry waste (O) significantly increased the organic carbon ratio in both of the rhizosphere and bulk soils with a value of (14.67 and 13.35) $g.kg^{-1}$.soil continuously compared to the comparison treatment (Cont) that resulted in the lowest value of the organic carbon (6.45 and 6.24) $g.kg^{-1}$soil. The reason is that the organic matter application increases the organic carbon in the soil. The organic carbon makes up (45)% of it, the microorganisms present in the soil are used as an energy source. Organic carbon also participates in many complex compounds that are dissolved in the soil solution by having effective groups of humic acid such as OH^- and $COOH^-$ that are involved in most biochemical reactions in the soil, Al Taweel (2015). Srivastava and Singh (1989) found that when mung bean planted soil was treated with poultry waste, there was an increase in organic carbon due to the rapid decomposition of the organic matter by microorganisms and thus an increase in nutrient availability in the soil.

The results also show that the organic carbon in the soil has increased significantly with increased levels of the applied nitrogen fertilizer (M_1 and M_2) with a value of (7.90 and 8.08) $g.kg^{-1}$soil, respectively for the rhizosphere and with a value of (7.80 and 7.86) $g.kg^{-1}$soil, respectively in bulk soil compared to the control.

Table 4: The effect of the study treatments on the organic carbon in the soil (kg^{-1}.soil) 30 days after planting.

Treatments	Sampling area	
	Rhizosphere soil	Bulk soil
Cont	6.54	6.24
O	14.67	13.45
M1	7.90	7.80
M2	8.08	7.86
B	9.73	9.35
OM1	14.53	13.30
OM2	14.94	13.57
OB	16.00	13.92
BM1	10.44	10.12
BM2	10.62	10.43
OBM1	15.36	14.30
OBM2	16.30	15.26
L.S.D.0.05	Treatment	Area
	0.35	0.50

The increase in the soil content of organic carbon is attributed to the importance of urea as an activating initiation that activates vital groups in the soil, including the microorganisms in the plant rhizosphere, as well as the importance of nitrogen in increasing the growth of roots and increasing their organic secretions in the root zone of the plant, Abdullahi *et al.,* (2014). Besides this, the nitrogen cycle is closely linked with the carbon cycle, and other nutrient cycles in the soil, Havlin *et al.,* (2005).

The organic carbon also increased significantly in the soil when treating *Pseudomonas fluorescens* (B) in the area inside and outside the rhizosphere with a value of (9.73 and 9.35) g.kg^{-1}soil, respectively, compared to the comparison treatment (Cont). *Pseudomonas fluorescens* work to produce organic acids on the one hand, and pollination increases the biological community in the soil through encouraging secretions produced by these bacteria, which are substances that are subject to the work of other bacteria and increase their numbers, thus increasing the proportion of organic carbon that these neighborhoods prepare, as well as after Her death and decomposition, Katila *et al.,* (2013).

The vaccination of *Pseudomonas fluorescens* increased the organic carbon in the soil. The microorganisms in the rhizosphere increase the organic carbon, and the total sum of the root activities make the root environment an exceptional environment that differs from the surrounding soil that is not affected by this activity, which is the bulk soil, Yassin, (2010).

The bilateral interactions for the treatment of poultry waste with urea fertilizer (OM_1 and OM_2), the interaction of the treatment of poultry waste with the biological fertilizer *Pseudomonas fluorescens* (OB) and the interaction of urea fertilizer with the biological fertilizer *Pseudomonas fluorescens* (BM_1 and BM_2) had a significant effect on soil content of organic carbon. The treatment of the interaction between poultry residues and bio-fertilizer of *Pseudomonas fluorescens* (OB) resulted in the highest increase in the amount of organic carbon in the soil compared to the mono treatments, as the average organic carbon (15.22 and 13.92) gm^{-1}.soil for both the rhizosphere and bulk soils, respectively. The reason is attributed to the increase in the activity of *Pseudomonas fluorescens* applied to the soil, in addition to providing an energy source for it and most of the nutrients it needs in the cellular metabolism process, especially nitrogen, carbon, phosphorus, potassium, iron, and sulfur that work to encourage the growth and reproduction of the biological community in the plant rhizosphere, Chandrasekar *et al.,* (2005).

The other bilateral treatments (OM_1, OM_2, BM_1, and BM_2) increased the value of both the regions inside and outside the rhizosphere. The effect of the bilateral interactions was better at increasing the organic carbon content in the soil compared to the mono treatments.

It is clear from table 4 that the treatment of triple interference between poultry wastes and urea at the second level, and *Pseudomonas fluorescens* (OBM_2) of (16.30 and 15.26) g.kg^{-1}soil made the highest increase in the value of organic carbon in the soil for the rhizosphere and bulk soils, respectively, compared to unilateral and binary treatments.

Organic carbon in the soil (g.kg^{-1}.soil) 60 days after planting

(Table 5) presents the soil content of the organic carbon with the study treatments for a period of 60 days after planting. The application of poultry waste increased the value of organic carbon in the soil (15.36 and 14.90) g.kg^{-1}.soil into the rhizosphere and in bulk soils, respectively, by comparison with the comparison treatment, which made the lowest value of organic carbon (7.00 and 7.80) g.kg^{-1}.soil. The increase in organic carbon is an indication of increased biomass in the soil, which use carbon to maintain their vital effectiveness as well as nutrients contained in poultry fertilizer, John and others, (2014), Rajamani *et al.,* (2009) indicated that the application of poultry waste to soil planted with mung beans has improved its productivity by increasing its content of organic carbon and other nutrients in the soil as well as improving soil composition.

The mean soil content of organic carbon was affected

Table 5: The effect of the study treatments on organic carbon in the soil (kg^{-1}.soil) after 60 days of the planting date.

Treatments	Sampling area	
	Rhizosphere soil	Bulk soil
Cont	7.00	6.93
O	15.36	14.90
M1	8.19	7.95
M2	8.59	8.32
B	11.40	11.06
OM1	14.63	13.46
OM2	15.16	13.57
OB	16.00	15.16
BM1	14.54	13.30
BM2	15.16	14.10
OBM1	16.40	14.83
OBM2	16.61	15.40
L.S.D.	Treatment	Area
	0.69	0.27

by the application of urea fertilizer in the treatment of (M_1 and M_2), which significantly outperformed the value of organic carbon within the rhizosphere, (14.67 and 13.57) $g.kg^{-1}$ soil, respectively, compared with the comparison treatment. As for the area outside the rhizosphere, it was (7.95 and 8.32) $g.kg^{-1}$ soil, respectively. The reason is that the application of a mineral nitrogen source speeds up the process of decomposing the organic matter in the soil, otherwise the period of decomposition may take several months, Mille and Miller, (2000).

Hoflich *et al.*, (2000) indicated that bacterial activity, particularly *Pseudomonas fluorescens*, increases in the rhizosphere of wheat and maize crops well when adding mineral fertilizer, thereby increasing organic carbon and total nitrogen in the soil. Bio-fertilizer (B) resulted in a significant increase in the value of soil carbon content of organic matter (11.40) $g.kg^{-1}$ soil in the rhizosphere and (11.06) $g.kg^{-1}$ soil in the area outside the rhizosphere, respectively, compared with the comparison treatment (Cont), Which recorded the lowest value for organic carbon.

The reason for the increase is attributed to the role of *Pseudomonas fluorescens* by secreting organic acids as well as the secretion of plant hormones that encourage root growth, leading to an increase in organic carbon in the soil, Verma *et al.,* (2010). Sinsabaugh (2005) found in his study the effect of *Pseudomonas fluorescens* on organic carbon in the soil that this vaccination increased the organic carbon in the soil by 2% and the reason was due to the microorganisms increasing the decomposition of the organic matter.

The effect of the application of poultry wastes with the fertilizer *Pseudomonas fluorescens* significantly increased the soil carbon content. The interference treatment (OB) resulted in the highest increase in the value of the soil content of the organic carbon (16.00 and 15.16) gm^{-1}.soil for the regions of the rhizosphere and outside it, respectively, in comparison with the mono treatments. The reason for this is due to the role of organic fertilizer in equipping the bacteria and plants with nutrients in a balanced manner, thus increasing the organic carbon in the soil. Sinsabaugh (2005) found in a study of the effect of *Pseudomonas fluorescens* on organic carbon in the soil that this vaccination increased the amount of organic carbon in the soil and attributed the reason to the biology decomposition of organic matter.

The effect of the biological fertilizer in *Pseudomonas fluorescens* with urea fertilizer at the second level (BM_2) significantly affected the soil content of organic carbon. The average of organic carbon for the regions inside and outside the rhizosphere was (15.16 and 14.10) $g.kg^{-1}$ soil, respectively, compared to the mono treatments, although the treatment (BM_2) increased the amount of organic carbon, it did not differ significantly from the (BM_1) treatment in its effect on the average carbon organic soil. The reason for this increase is attributed to the supply of urea by the biological community with carbon and nitrogen, which is involved in building the proteins that bacteria need in their growth and reproduction, increasing their numbers and sustaining their vital activities, Sinsabaugh *et al.,* (2005).

The highest values of organic carbon in the soil resulted from the triple interaction between the treatment of poultry waste and urea fertilizer at the second level and the biological fertilizer of *Pseudomonas fluorescens*, a significant increase in the value of organic carbon. The treatment (OBM*2*) gave the highest value of the organic carbon average (16.61 and 15.40) $g.kg^{-1}$ soil for the regions inside and outside the rhizosphere, respectively, compared to the mono and bilateral treatments.

In general, Table 4, 5 shows an increase in the organic carbon values in the rhizosphere from the area outside the rhizosphere for a period of (30 and 60) days from cultivation. The reason is attributed to the role of the roots in the rhizosphere and its secretions that attract microorganisms, making them a region rich in biochemical reactions. Okabe *et al.,* (2012) indicated that the number of bacteria increases significantly in the rhizosphere compared to the soil outside the rhizosphere because the roots of plants provide oxygen to the microorganisms close to them through the air tissue, which enhances the presence of the air organisms that have a major role in the transformations of the elements and increase their readiness in that region.

(Table 5) shows that the amount of organic carbon at a period of (60) days was higher than a period of (30) days, and the reason for this is due to the growth and increase of the area of the root group and the increase in its secretions in the soil as well as the time required for the decomposition of most organic matter, Juan *et al.,* (2010).

The effect of bio-fertilizer (*Pseudomonas fluorescens*), poultry wastes, and urea on total nitrogen (g.kg^{-1}.soil) in and outside the rhizosphere of the mung bean crop after 30 and 60 days of the planting date.

Total nitrogen in the soil (g.kg^{-1}.soil) 30 days after planting

The results of table 6 present a significant increase in the value of the total nitrogen in the soil as a result of the application of poultry waste (into the rhizosphere and in bulk soils) with an average of (1.89 and 1.48) g.kg^{-1}.soil, respectively, compared to the control that had the least value of total nitrogen with an average of (0.60 and 0.40) g.kg^{-1}.soil for both soils, respectively. The application organic matter to the soil exposed to mining by the microorganisms present in the rhizosphere, so the total nitrogen ratio increases, as well as it reduces the loss of nutrients and increases the numbers of microorganisms because they contain available-to-feed elements that increase nitrogen availability in the soil, Ali *et al.,* (2002).

The organic matter also has a role in improving chemical properties of the soil, such as increasing the cation exchange capacity of the soil and its work as a chelating material that maintains the nutrients from washing and sedimentation as well as lowering the pH values of the soil in the root zone by producing hydrogen ion and organic acids when decomposed, Ali *et al.,* (2014).

The results also show that the total nitrogen in the soil has increased significantly with increased levels of the applied urea fertilizer ($M_1$and M_2) that valued at (1.03 and 1.05) g.kg^{-1}.soil, respectively, for the rhizosphere (0.81 and 0.84) g.kg^{-1}.soil in the bulk soil, respectively, compared to the control. The increase in total nitrogen is attributed to the role of mineral fertilizers (urea) application in increasing the concentration of the non-reciprocal ammonium ion in the soil, which is more readily available than the ammonium originally present in the soil and works to stimulate the microorganisms in general and especially the growth-promoting ones, Hartmann *et al.,* (2009).

The amount of total nitrogen increased significantly in the soil when bio-fertilizer *Pseudomonas fluorescens* (B) was applied in the area inside and outside the rhizosphere (1.11 and 1.00) g.kg^{-1}.soil, respectively compared to the comparison treatment. The reason is attributed to the role of the *Pseudomonas fluorescens* in nitrogen fixation, increasing its availability, the importance of roots and their attractive secretions to microorganisms, especially in the rhizosphere, which increases the ammonium supply in the soil, making the rhizosphere a region with unique properties, Abdullahi *et al.,* (2014); Gholami and Abbasllokt, (2010) found that *Pseudomonas fluorescens* increase nitrogen in the soil, due to the efficiency of these bacterial isolates in nitrogen fixation, nutrient release, and bacterial cell decomposition after their death that add a quantity of nitrogen to the soil.

(Table 6) presents that the bilateral interactions between the treatment of poultry waste and urea (OM_1 and OM_2) and poultry waste with *Pseudomonas fluorescens* OB) and urea with the biological fertilizer *Pseudomonas fluorescens* (BM_1 and BM_2) had a significant effect on total nitrogen increase. The treatment of poultry waste and urea fertilizer at the second level (OM_2) resulted in the highest significant increase in the average total nitrogen value (1.55) g.kg^{-1}.soil for the area inside the rhizosphere and (1.49) g.kg^{-1}.soil for the area of bulk soil compared to the factors Mono. The other bilateral treatments (OM_1, OB_1, BM_1, and BM_2) also showed a significant increase in total nitrogen in both regions.

The treatment of triple treatments between the treatment of poultry waste and urea fertilizer at the second

Table 6: The effect of the study treatments on total nitrogen in the soil (g.kg^{-1}.soil) 30 days after planting.

Treatments	Sampling area	
	Rhizosphere soil	Bulk soil
Cont	0.60	0.40
O	1.89	1.48
M1	1.03	0.81
M2	1.05	0.84
B	1.11	1.00
OM1	1.69	1.45
OM2	1.93	1.49
OB	1.66	1.39
BM1	1.51	1.20
BM2	1.55	1.39
OBM1	1.97	1.77
OBM2	2.03	1.81
L.S.D.	Treatment	Area
	0.12	0.04

level and the biological fertilizer *Pseudomonas fluorescens* (OBM2) of (2.03 and 1.81)) g.kg^{-1}.soil resulted in the highest significant increase in the total nitrogen value of the two regions (inside and outside the rhizosphere), Respectively, concerning unilateral and bilateral treatments. The reason for the increase in total nitrogen is due to the availability of urea fertilizer used as mineral fertilizer from nitrogen available by 46% in addition to increasing the activity of organisms in the decomposition of organic matter and nitrogen fixation in the soil. That is, when nitrogen fertilizers are applied, the accumulated amount of nitrite, nitrate, and ammonium increases. This is consistent with what Jokela (1992) and Bronson *et al.,* (1992) stated that the application of nitrogen fertilizer increases the amount of nitrite, nitrate, and ammonium in the soil.

Total nitrogen in the soil (g.kg^{-1}.soil) 60 days after planting

The results in table 7 show a significant increase in the activity value of total nitrogen in the soil with the application of poultry waste in the rhizosphere and bulk soils with an average of (2.61 and 1.62) g.kg^{-1}.soil, respectively, compared to the comparison treatment that had the least total nitrogen value is an average of (0.80 and 0.60) g.kg^{-1}.soil. The increase in total nitrogen is attributed to the application of the organic matter, which increases the activity of microorganisms, which in turn degrade that substance and increase the supply of ammonium, Kara and Bolat *et al.,* (2008).

Mulvaney *et al.,* (2001) showed that mineralization of nitrogen from organic matter is significantly correlated with total nitrogen content and that soil with high organic matter content also stabilizes ammonium by bonding with the negative hydroxyl ion. In general, the fixation process for ammonium is not a loss of nitrogen from the soil, Hassan *et al.,* (1990); Bundick *et al.,* (2009).

The results also indicate that the total nitrogen in the soil increased significantly with increased urea levels of the treatments of (M_1 and M_2) (1.21 and 1.29) g.kg^{-1}.soil, respectively, for the rhizosphere (0.99 and 1.00) g.kg^{-1}.soil, respectively, in bulk soil, compared to the treatment of comparison. The reason is attributed to the role of urea in encouraging the growth and reproduction of nitrogen-fixing bacteria by providing important nutrients for their decomposition of living organisms. This means increasing the bacterial community fixing atmospheric nitrogen in the soil, Edward and Anna *et al.,* (2015).

The total nitrogen in the soil increased significantly in the soil when using the fertilizer (B) *Pseudomonas fluorescens* in the area inside and outside the rhizosphere, (1.39 and 1.29) g.kg^{-1}.soil Pseudomonas, respectively, compared to the comparison treatment. The reason is attributed to the application of bacteria in the form of a vaccine to the medium of plant growth, as it works to stabilize the nitrogen in a freeway, and thus increase nitrogen in the soil, Linweber *et al.,* (1995).

Yassin (2010) emphasized the role of vaccination with *Pseudomonas fluorescens* in increasing total nitrogen in the soil due to the vital processes of the of root activities that makes the root environment an exceptional environment for nitrogen-fixing microorganisms that differ from the surrounding soil that is not affected by this activity in bulk soil.

(Table 7) showed that the bilateral interactions between poultry waste treatments with urea (OM_1 and OM_2) and poultry residues with *Pseudomonas fluorescens* (OB) and urea with *Pseudomonas fluorescens* (BM_1 and BM_2) had a significant effect on the total nitrogen in the soil. The treatment of poultry waste and urea at the second level of urea (OM_2) achieved the highest increase in the activity value (2.29) g.kg^{-1}.soil for the area inside the rhizosphere and (1.59) g.kg^{-1}.soil for the area outside the rhizosphere compared to the single treatments. The reason is attributed to the fact that urea fertilizer contains 46% available nitrogen, in addition to the great role of the organic matter in increasing the numbers of bacteria that fix nitrogen, activating it, and increasing its activity in fixing nitrogen. Thus increasing the amount of nitrogen in the soil in addition to the nitrogen contained in the organic fertilizer. Mahmood *et al.,* (2005) explained that the application of

Table 7: The effect of the study treatments on the total nitrogen in the soil (g.kg^{-1}.soil) after 06 days of planting.

Treatments	Sampling area	
	Rhizosphere soil	**Bulk soil**
Cont	0.80	0.60
O	2.16	1.62
M1	1.21	0.99
M2	1.29	1.00
B	1.39	1.29
OM1	1.99	1.48
OM2	2.29	1.57
OB	1.79	1.47
BM1	1.78	1.29
BM2	1.79	1.41
OBM1	2.43	2.39
OBM2	2.53	2.50
L.S.D.	Treatment	Area
	0.12	0.04

the urea fertilizer led to the acceleration of the decomposition of the organic matter and thus freeing the important nutrients of the plant and the biology and increasing the organic nitrogen in the soil.

The treatment of triple overlap between poultry waste, urea fertilizer at the second and biological level *Pseudomonas fluorescens* (OBM2) resulted in the highest increase in the total nitrogen value in the soil (2.53 and 2.50) g.kg^{-1}.soil for the two regions (inside and outside Risosphere), respectively, compared to mono and binary treatments. This increase in total nitrogen is attributed to the success of vaccination with *Pseudomonas fluorescens* and the important role of microorganisms in the decomposition of organic nitrogen (proteins, amino acids, and nucleic acids) to obtain carbon and energy and release excess nitrogen in the form of ammonium ion, Haochena *et al.,* (2018).

In general, Tables 6 and 7 present that there was an increase in the total nitrogen values in the rhizosphere than the (bulk soil). The reason is attributed to the total root activities, which makes the rhizosphere an exceptional environment that differs from the surrounding soils not affected by this bulk soil activity. This huge amount of liberated compounds in the rhizosphere for growing plant soil is often organic compounds that are the usual components of the plant such as polysaccharides, polysaccharides, amino acids, organic, and fatty acids in addition to sterols, enzymes and any other that they came from photosynthesis and other metabolic plant processes, Pinton *et al.,* (2007).

The total nitrogen content in the soil at a period of (60) days was higher than a period of (30) days and the reason is due to the accumulation of root secretions and the accumulation of dead microscopic cells and the decomposition of their bodies as well as the accumulation of the decomposing organic matter in the rhizosphere, Pavani *et al.,* (2015).

The effect of Pseudomonas fluorescens, poultry, and urea waste on the studied plant growth characteristics.

Height of plant (cm^{-1})

The results of the statistical analysis in table 8 present that there were significant differences between the plant height means. The treatment of poultry waste resulted in the highest average height of the plant (29.20) cm^{-1} compared to the control that recorded the lowest value of the average height mung bean plant (23.60) cm.plant^{-1}. The reason is attributed to the beneficial effects of the important organic wastes in stimulating root growth and the containment of important nutritional elements such as nitrogen and phosphorous, as well as the importance of organic fertilizer in increasing the activity of microorganisms in the soil and is added to the organic matter, which was reflected on the nutritional status of the plant and increasing its height, Al Taweel, (2015).

The biological fertilizer for bacteria (B), *Pseudomonas fluorescens*, led to a significant increase in the height of the mung bean plant (28.10) cm.plant^{-1} compared with the comparison treatment (Cont). The reason is attributed to the fact that biofertilizer of the plant with bacteria leads to the secretion of plant hormones beneficial to the plant such as the important oxins in the elongation process in addition to providing it with the necessary nutrients such as nitrogen and phosphorous, which is reflected in the accumulation of nutrients in the plant. This is consistent with what the narrator and others (2001) found about the role of these microorganisms in the production of growth regulators, including the indole of acetic acid and gibberellin that lead to cell elongation and division in addition to nitrogen, phosphorous and potassium elements applied to the soil, which increases its concentration and then increases the amount absorbed by the plant, which reflects positively on plant growth and increases in height as a result of better root growth.

This is confirmed by Nelson (2004), *Pseudomonas fluorescens* works to increase the availability of nutrients in the bacterial endemic region of the bacterium, which stimulates plant growth by producing compounds with hormonal effects, such as salicylic acid, which in turn stimulates the production of growth hormones whose effect is reflected in increasing plant height.

The results presented in table 8 also show a significant increase in the average height of the mung bean for the treatment of urea fertilizer at the second level (M_2) that valued at (27.40) cm.plant^{-1}, compared with the comparison treatment (Cont). The reason is attributed to the role of nitrogen, which has a fundamental role in the construction of tryptophan acid, which is important in encouraging plant cell elongation, which increases plant height, Shuai, (2011).

Hasan and others (1990) showed the role of urea fertilizer in preparing the nitrogen element quickly to easily dissolve in water, which leads to its availability and rapid availability for the plant as it enters into the chlorophyll molecule and in the synthesis of some important compounds such as proteins, nucleic acids, enzymes, and their accompaniments and energy compounds that all affect increasing elongation the plant.

The bilateral interactions of the effect of poultry, urea, and bio-fertilizer fertilizer (*Pseudomonas fluorescens*) on plant height are presented in (Table 8). The treatment poultry waste + bacterial pollination achieved a significant increase in the height of the livestock, plant as it reached (31.56) cm.plant^{-1} compared with the mono factors. The reason is attributed to the fact that the organic matter contains many important nutrients in plant growth, such as nitrogen, phosphorus, potassium, and others, as well as the role of pollination with bacteria that leads to an increase in the number of root nodes and an increase in their weight, which increases the vital process of nitrogen fixation and then increases the growth and length of the plant, Khalil and Al Kartani (2018).

The treatment of poultry waste + urea at the second level (OM_2) resulted in the highest significant increase in plant height as it reached (34.50) cm.plant^{-1} in comparison with the mono treatments. The reason is attributed to the role of urea in providing the nitrogen component in the formation of proteins, enzyme accompaniments, amino acids, and organic bases that are part of the important nucleic acids in the formation of chlorophyll and cytochrome necessary in photosynthesis important to plant growth, Muhammad *et al.,* (1985).

The poultry waste works to improve the properties of the soil, including fertility. Therefore, it improves the medium of plant growth, especially the roots, so that its growth and activity increase in the absorption of nutrients from the soil solution. This reflects positively in the plant growth and the increase in building amino acids, which is the first nucleus of growth and the consequent significant increase in height, Pang *et al.,* (2000). BM_1 and BM_2 treatments (inoculation with bacteria + urea) achieved a significant increase in plant height, as it reached (28.26 and 31.16) cm.plant^{-1}, respectively, compared with mono treatments. The reason is attributed to the role of mineral fertilizers (urea) in increasing the bacterial community and thus increasing its vital activity in the rhizosphere as well as the increase in its various secretions, which include growth regulators that help increase growth in the plant, et al. Nnabude, (2015).

(Table 8) indicates that the triple overlap (OBM_2) (poultry waste + bacterial inoculation + urea at the second level) resulted in the highest significant increase in height as it reached (36.23) cm.plant^{-1} (OBM_2) r in comparison with mono and bilateral treatments. This indicates that the complementary applications to the different types of fertilizers gave encouraging and good results indicating the interplay between mineral, organic, and bio-fertilization, where many studies confirmed the role of organic matter in activating the fluorescens. Thus increasing their effective numbers for fixing atmospheric nitrogen and

Table 8: The effect of study parameters on plant height (cm.plant^{-1}).

Treatment	Plant heightcm.plant^{-1}
C	23.60
O	29.20
M1	25.10
M2	27.40
B	28.10
OM1	32.90
OM2	34.50
OB	31.56
BM1	28.26
BM2	31.16
OBM1	34.83
OBM2	36.23
L.S.D.	3.38

increasing the secretion of phytohormones by providing the bacteria with energy that is a prerequisite for reproduction, Sinsabaugh *et al.,* (2005).

The dry weight of the root and vegetative population of the mung bean (gm^{-1})

A significant difference in the vegetative and root weight of the plant between the treatments was presented in (Table 8). The treatment of poultry waste resulted in the highest average weight of the vegetable and root group (13.53 and 1.37) g.plant^{-1}, respectively, in comparison with the comparison treatment that made the least value of the average weight of the vegetable and root group (10.84 and 0.45) g.plant^{-1}, respectively. The reason is due to the ability of the organic fertilizer to supply the plant with the nutrients and organic acids that increase the readiness of the elements, including phosphorous, in addition to the nitrogen component that leads to an increase in the mass of the protoplasm and the cellular division, thus increasing the growing volume of the vegetable and root system, Zeiger and Taiz, (2003). These results are consistent with Abbasi and Kamal, (2011) and Al-Taweel, (2015).

The biological fertilizer for (B), *Pseudomonas fluorescens*, resulted in a significant increase in the weight of the vegetative and root groups as it reached (12.95 and 1.21) gm^{-1}, respectively, compared with the comparison treatment (Cont). The reason is due to the ability of *Pseudomonas fluorescens* to secrete stimulants and growth regulators that led to increased root system growth and increased absorption of nutrients in the plant, which led to the availability of the nutrient. The presence of these bacteria in the root environment contributed to the increase of available-made phosphorous in the soil and thus encouraged the absorption of phosphorous by this plant. Besides this, the bacteria produce phytohormone plant hormones that stimulate the growth of the roots, which in turn increases the absorption of nutrients, Allison, (2005).

Khalil and Al-Kartani (2018) presented the increase in the weight of the root vegetable group of the plant when treated with *Pseudomonas fluorescens*, and the reason was due to its increase in dissolving phosphates and its production of indole acetic acid IAA and its production of chelating compounds for iron and other minor elements.

The results are shown in table 9 also show a significant increase in the mean weight of the vegetable and root group for urea fertilizer treatment at the second level (M_2), as it reached (11.74 and 0.78) gm^{-1}, respectively, compared with the comparison treatment. The reason is attributed to the fact that the application of chemical fertilizers in moderate proportions, especially urea, increases the activity of the roots and organisms present in the soil, especially in the rhizosphere, Adediran *et al.,* (2004). This is consistent with what Devlin and others (1993) found to increase the weight of the vegetative and root system of the plant when the application of mineral elements, including nitrogen, and its entry into vital processes that occur within the plant, which increases its activity in carrying out these processes that lead to an increase in the rate of cell division and thus weight gain.

(Table 9) shows the effect of bilateral interactions between the poultry wastes, urea fertilizer, and the *Pseudomonas fluorescens* bio-fertilizer on the weight of the vegetable and root system. The treatment of (OB) (poultry residue + bacterial insemination Pseudomonas fluorescens) achieved a significant increase in the weight of the vegetable and root group of the plant (17.60 and 1.43) gm^{-1} compared to mono and bilateral treatments. The reason is attributed to the fact that the application of organic fertilizer works to increase the availability of the nutrients and improve the properties of different soils, as well as the ability of the biological fertilizer to produce plant hormones such as oxins. These oxins encourage the expansion of cells under the developing summit by their indirect effect on the entry of water into the cell, causing elongation, which positively reflected the dry matter yield of the root and vegetative part, Meena (2017).

The treatment of (OM_2) (poultry waste + urea at the second level) resulted in the highest significant increase in the weight of the vegetable and root group, as it reached (18.38 and 1.58) gm^{-1}. plant, respectively, compared with the mono treatment. The reason is attributed to the importance of the application of mineral fertilizer (urea) in increasing the absorbed amount of nitrogen, phosphorus, and potassium in the vegetative group due to the role of these elements in forming a strong and efficient root system in absorbing nutrients from the soil, Havlin *et al.,* (2005).

Table 9: The effect of the study treatments on the vegetative and root weight of the plant (gm^{-1}).

Treatment	The dry weight of the shoot system	The dry weight of the root system
C	10.84	0.45
O	13.53	1.37
M1	11.47	0.53
M2	11.74	0.78
B	12.95	1.21
OM1	17.77	1.52
OM2	18.38	1.55
OB	17.60	1.43
BM1	15.63	1.12
BM2	15.78	1.34
OBM1	17.98	1.57
OBM2	19.73	1.62

Organic fertilizers work to improve the properties of the soil, including fertility. Therefore, an improvement in the medium of plant growth, especially the roots, increases its growth and activity in absorbing nutrients from the soil solution. This reflects positively in the growth of the plant and the increase in building amino acids, which is the first nucleus of growth and the consequential moral increase in plant height. This confirms the role of organic fertilizers in increasing the speed of germination in improving the cradle of the plant, which increases the speed of growth and increases the weight of roots and vegetative group, Kamal and others, (2016).

The (BM_1 and BM_2) treatments (inoculation with bacteria + urea) resulted in a significant increase in the weight of the root and vegetative groups, (15.63, 15.78, 1.12, and 1.34) gm^{-1}, respectively, compared with the mono treatments. The reason is attributed to the role of biofertilizers in improving the absorption of nitrogen and ready-made phosphorous in the soil and the secretion of organic acids and growth regulators such as oxine, which can form roots and gibberellin that increase the rate of root growth, stems, and cytokinin, which is involved in most basic processes that have an important role in increasing plant growth. The formation of a strong root system helped increase nutrient accumulation in the plant, Shchata *et al.,* (2012).

(Table 9) indicates that the (OBM_2) triple overlap (poultry waste + bacterial inoculation + urea at the second level) resulted in the highest significant increase in the weight of the vegetative and root groups (19.73 and 1.34) gm^{-1}, respectively, compared with mono and bilateral treatments.

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