RESEARCH ARTICLE Agricultural Science Digest, Volume 45 Special Issue: 79-84 (November 2025)

Effect of Adding Urea and Organic Fertilizers on the Growth and Productivity of Faba bean (*Vicia faba* L.)

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10.18805/ag.DF-722

ABSTRACT

Background: The experiment was conducted in pots to study the effect of adding organic fertilizer and levels of urea fertilizer and the interaction between them on the growth and yield of bean plant (*Vicia faba*) (plant height, number of bacterial nodes, dry weight of bacterial nodes, dry weight of vegetative total and total yield).

Methods: Organic fertilizer (decomposing poultry waste) was added at five levels, namely (0,1,2,3,4) tons/ha^{-1} and five levels of urea fertilizer, which are (0, 25, 50, 75 or 100) kg/dunum to the soil before planting .

Result: Result showed the superiority of urea fertilization treatment plants 75 kg/dunum in increasing plant height, dry weight, number of bacterial nodes, dry weight and total yield of seeds with a decrease in the degree of soil interaction compared to the comparison treatment plants that gave the lowest values of the above traits with the highest values of the degree of soil interaction. The addition of organic fertilizer (3 tons/ha) also led to the superiority of all the qualities under study plants in plant height, dry weight, number of bacterial nodes, dry weight and total yield of seeds, while reducing the degree of soil interaction compared to plants not treated with organic fertilizer. Interference treatment plants of 75 kg/dunum urea and 3 tons/ha^{-1} organic fertilizer showed the highest values for the traits under study with the lowest value of the degree of soil interaction.

Key words: Bean (*Vicia faba*), Organic fertilizer, Urea.

INTRODUCTION

The bean crop (*Vicia faba* L.) is one of the important leguminous seed crops, it is a leguminous plant belonging to the Fabaceae family and is a staple food for millions of people living in impoverished countries due to its high protein content (Willer and Lernoud, 2017) , which can reach 23 to 42% (Fouad *et al*., 1995), as well as its use as animal feed (Ali *et al*., 1990). Additionally, it enhances soil fertility and stabilizes atmospheric nitrogen through the formation of bacterial nodules on its roots, (Al-Jabri, 2016) and maintains the soil from erosion where it is used as crops to cover the soil and leguminous crops work to provide nitrogen to the crops planted after it, especially grass The soil's nitrogen content is subject to continuous depletion through plant absorption, irrigation and rainfall. Additionally, the process of denitrification further reduces nitrogen levels in general. To address this deficiency, farmers employ both organic and mineral fertilizers (Aldolaimy *et al*., 2024).

Aldolaimy and Abduljabar (2024) and other combinations. However, a significant portion of nitrogen replenishment occurs through biological nitrogen fixation, particularly by leguminous plants. Legumes play a crucial role in enhancing soil fertility through their symbiotic relationship with Rhizobia bacteria, which fix atmospheric nitrogen (Aldolaimy and Abduljabar, 2024). Nitrogen is paramount in plant nutrition, being essential for cell growth, development and division, as well as protein and amino acid synthesis. It is the most demanded nutrient by plants and its availability throughout growth stages, especially during branching and elongation, is critical for optimal crop productivity (Jan *et al*., 2010). Organic matter significantly influences soil properties by improving soil-water-plant relationships, bulk density, total porosity and water use efficiency (Shaaban and Okasha, 2007). Organic fertilizers are environmentally friendlier and provide a slow release of nutrients through microbial activity. This process converts organic matter into readily available mineral elements, promoting better plant growth, as demonstrated by Sabh and Shallan (2008). A study on the application of marine algae powder as an organic fertilizer yielded significant improvements in various growth indicators of the bean plant (*Vicia faba*), (Muhammad *et al*., 2024). These improvements encompassed plant height, stem diameter, branch and leaf count, leaf area, plant dry weight and both quantity and quality of yield. Due to the importance of the foregoing, this study has been applied to find out the effect of organic and nitrogen fertilization on the growth and yield of bean plant (*Vicia faba*) materials and working methods. An experiment was carried out in one of the agricultural field stations in Abu Ghraib during the winter

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How to cite this article: Mohsen, T.K. (2025). Effect of Adding Urea and Organic Fertilizers on the Growth and Productivity of Faba bean (*Vicia faba* L.). Agricultural Science Digest. **45 (Special Issue):** 79-84. doi: 10.18805/ag.DF-722.

Submitted: 07-02-2025 **Accepted:** 30-05-2025 **Online:** 11-07-2025

season 2014-2015 to study the effect of adding organic fertilizer and urea fertilizer formulations and the interaction between them on the growth and yield of (Vicia faba) bean plants by using the complete random design (CRD) as an experimental design with three repeaters, organic fertilizer (decomposed poultry waste) was added at four levels: (0, 1, 2, 3, 4) tons/h and five combinations of urea fertilizer: (0, 25, 50, 75, 100) kg/dunum. Soil samples were taken from the spray field. Clean the soil of impurities, then sift with a sieve 2 mm diameter. Then the soil was weighed by (5) kg and added to each container (anvil). Noting that the number of pots in the experiment amounted to (90) containers, which were divided into (5) groups of each group. It consists of (18) pots according to the percentage of adding organic matter. The material was mixed, the organic matter was mixed with the soil for (4) days before planting to analyze the organic matter, then the pots were planted with bean plant (*Vicia faba*) seeds, a Spanish variety of Barcelona origin (10) seeds, the pots were planted and then the pots were watered with the first irrigation after planting on 4/11/2014. Studies show that it can fix 50-330/kg N/ha and thus, faba bean inclusion in crop rotation decreases the need for inorganic N fertilizer (Jan *et al*., 2010). The soil samples utilized in the experiment were obtained from a depth of 0-30 cm. Some of the soil's physical and chemical properties were quantified and are presented in Table 1. The soil was analyzed in the laboratories of the College of Agricultural Engineering Sciences-University of Baghdad to study the physical and chemical properties (Table 1).

MATERIALS AND METHODS

The experiment was conducted in *rabi* session of 2023-2024. The experiment was conducted in pots to study the effect of adding organic fertilizer and levels of urea fertilizer and the interaction between them on the growth and yield of bean plant (*Vicia faba*) (plant height, number of bacterial nodes, dry weight of bacterial nodes, dry weight of vegetative total and total yield). Organic fertilizer (decomposing poultry waste) was added at five levels, namely (0,1,2,3,4) tons/ha^{-1} and five levels of urea fertilizer, which are (0, 25, 50, 75 or 100) kg/dunum to the soil before planting. The results showed the superiority of urea fertilization treatment plants 75 kg/dunum in increasing plant height, dry weight, number of bacterial nodes, dry weight and total yield of seeds with a decrease in the degree of soil interaction compared to the comparison treatment plants that gave the lowest values of the above traits with the highest values of the degree of soil interaction. The addition of organic fertilizer (3 tons/ha^{-1}) also led to the superiority of all the qualities under study plants in plant height, dry weight, number of bacterial nodes, dry weight and total yield of seeds, while reducing the degree of soil interaction compared to plants not treated with organic fertilizer. Interference treatment plants of 75 kg/dunum urea and 3 tons/ha^{-1} organic fertilizer showed the highest values for the traits under study with the lowest value of the degree of soil interaction.

RESULTS AND DISCUSSION

From Table 2, there are significant differences in the height of the bean plant (*Vicia faba*) attributed to the addition of urea fertilizer levels. The highest elevation of the bean plant (*Vicia faba*) is 73.6 cm at the level of 75 kg. Dunum, while the lowest degree of height of the bean plant in the comparative treatment was (54.9) cm, hence the effect of addition. Nitrogen increases plant height and as the same table shows, organic residues have a significant impact on plant height. The addition of organic waste at the level of (3 tons.ha^{-1}) gives the highest height of 69.7 cm with great superiority. On the other hand, compared to the rest of the levels of addition of organic waste, while it was while

Table 1: Some physical and chemical properties of study soil.

Characteristic	Measurement	Unit of measurement
Tissue	Mix	
pH	7.5	
C.E	5.30	Desi Siemens. M^{-1}
Field capacity	26.7	%
Organic matter	13.6	g, kg^{-1}
Lime alkals	145	g, kg^{-1}
All-ready nitrogen	75.30	mg. Kg^{-1}
All-ready phosphorus	10.10	mg. Kg^{-1}
All-ready potassium	285	mg. Kg^{-1}
Bulk density	1.24	Mica.gm^{-3}

Table 2: Effect of organic and urea fertilizers on the height of the bean plant (cm) (*Vicia faba*) and the interactions between them.

Organic fertilizer addition	Urea fertilizer levels kg/dunum					
level (tone.H^{-1})	0	25	50	75	100	Average
Without addition	50.1	58.0	66.7	67.9	60.3	60.6
1	55.1	64.2	62.4	70.0	65.0	63.3
2	52.2	63.9	62.9	71.2	66.1	63.2
3	52.4	65.2	71.4	81.9	68.2	67.8
4	54.3	64.3	70.1	75.0	65.4	65.8
Average	52.8	63.1	66.7	73.2	65.0	
LSD values at 0.05	Compost addition level = 6.211					
	Urea fertilizer levels = 6.211					
	Intervention = 13.021					

the lowest average plant height when plants treated the comparison 60.9 cm and with regard to the interaction between the two factors (organic residues and urea), the results of the same table showed that the highest degree of elevation of the plant gave the plants treatment with the interaction between the level of addition of 3 tons ha^{-1} at a level of 75 kg/dunum (Anant *et al.*, 2006). Urea fertilizer gave the highest rate of (75.0) cm, while the intervention treatment was given without adding organic fertilizer or nitrogen (Mohsen and Alwan, 2019). Moreover, the minimum plant height was (1.50) cm. The increase in plant height can be attributed to the multifaceted role of nitrogen in plant physiology and the beneficial effects of organic matter on soil properties. Nitrogen plays a crucial role in enhancing meristematic tissue activity and cell division, while also serving as a key component in the synthesis of amino acids such as tryptophan. Tryptophan is a precursor for auxin production, a class of plant hormones that regulate cell division and expansion (Loddo and Gooding, 2011).

Organic matter contributes significantly to plant height enhancement through various mechanisms. Furthermore, organic fertilizers have the capacity to lower soil pH, which subsequently increases nutrient availability and facilitates improved absorption by plant roots. Additionally, these fertilizers provide a diverse array of nutrients and enhance their uptake by the root system. Moreover, the more they reduce the fertility and quality of the soil on plant cultivation lands (Barbarick, 2006). the organic acids present in organic fertilizers play a pivotal role in solubilizing phosphate rock, thereby increasing the concentration of available phosphorus in the soil and promoting its absorption by plants. The synergistic effects of nitrogen and organic matter on plant growth are manifested in increased plant height and overall vigor. This observation aligns with the findings reported by Barakat *et al*. (2012), underscoring the importance of integrated nutrient management strategies in optimizing plant growth and development. According to the results in Table 3 the control treatment was (38.0) grams $plant^{-1}$ shows the effect of nitrogen supplementation on dry weight, but for full-grown bean plants as shown in the same table, organic residues have a significant effect on the dry weight of the plant. Add organic waste (3 tons.ha^{-1}.)

The highest rate reached (65.8) grams. $plant^{-1}$ while the comparative treatment gave the lowest levels, reaching (37.58) grams. $Manufactured^{-1}$ k.g for interaction between workers (organic residues and urea). The results of the same table showed that the highest average dry weight of the bean plant (*Vicia faba*) received the interaction

Table 3: The effect of adding organic fertilizer and urea fertilizer and the interactions between them on the dry weight of the vegetative total of the bean plant (*Vicia faba*) (g. $plant^{-1}$).

Organic fertilizer addition	Urea fertilizer levels kg/dunum					
level (tone.ha^{-1})	0	25	50	75	100	Average
Without addition	21.7	23.4	43.1	64.7	35.0	37.58
1	36.5	31.8	52.1	67.6	41.0	45.8
2	34.4	50.1	60.6	68.6	54.0	53.54
3	40.0	55.5	77.1	83.4	70.0	65.2
4	52.6	67.3	66.8	73.8	59.1	63.9
Average	37.04	45.62	59.94		51.82	
LSD values at 0.05	Compost addition level = 18.312					
	Urea fertilizer levels = 18.312					
	Intervention = 37.114					

Table 4: The objective of this study was to investigate the effect of organic and urea fertilizers on the dry weight of bacterial nodes (mg. $plant^{-1}$) and to determine the interactions between these two factors.

Organic fertilizer addition	Urea fertilizer levels kg/dunum					
level (Ton.h^{-1})	0	25	50	75	100	Average
Without addition	2.7	8.8	17.7	22.9	15.6	13.54
1	35.3	68.3	125.1	295.8	94.6	123.82
2	45.4	79.2	133.5	296.9	142.2	139.44
3	70.6	128.9	205.7	575.7	831.1	362.4
4	51.7	85.6	164.7	299.9	149.8	150.34
Average	41.14	74.16	129.34	298.24	246.66	
LSD values at 0.05	Compost addition level = 40.081					
	Urea fertilizer levels = 40.081					
	Intervention = 82.513					

treatment between the fourth level of addition (3 tons.ha^{-1}). At the level of 75 kg. An acre of urea fertilizer to give the highest percentage (85.4) plants gm^{-1} while the intervention treatment produces tons.ha^{-1} (without the addition of organic fertilizers or urea) The lowest average dry weight of the plant was (21.7) g. plant^{-1}, It has been demonstrated that the increase in dry weight observed in plants when varying the amount of nitrogen fertilizer applied can be attributed to the promotion of meristem activity and expansion by nitrogen, which in turn enhances the number and area of plants. The improvement in the plant's capacity to absorb light energy, as evidenced by the expansion of leaves, is a further consequence of this process. As evidenced by Table (4), the application of elevated levels of urea fertilizer has resulted in a notable increase in the weight of bacterial nodules on bean plants. The highest average dry weight of bacterial nodules is up to 298.24 mg. plant^{-1} at 75 kg/dunum, while the lowest mean dry weight of root nodules in the comparative treatment was 41.14. Plant Amalgam^{-1}. From the same table, organic residues also have a significant effect on the dry weight of bacterial nodules and the addition of organic residues 3 tons. ha^{-1} reaches a peak of 362.4 mg. plant^{-1}. The comparison treatment gave the lowest levels of 13.54 mg. plant^{-1}. With regard to the interaction between the two factors (organic nitrogen and urea), the results of the same table showed that the highest average dry weight of the bacterial nodules of the bean plant (*Vicia faba*) came from the interaction treatment between the level of addition of 3 tons. With the fourth level 100 kg/dunum urea fertilizer to give the highest rate of 831.1 mg. plant^{-1}, while the intervention treatment produced tons.ha^{-1} (without the addition of organic fertilizers and urea), the lowest average dry weight of bacterial nodules was 2.7 mg. plant^{-1} and in a study conducted by Ohara *et al*. (2001) in some legumes that the addition of nitrogen leads to a significant increase in the weight of bacterial nodules, which is consistent with what Youssef and Saad (1996) shown. It was found that the addition of nitrogen with bacterial inoculation had a beneficial effect on some leguminous plants. The pronounced effect increases the weight of bacterial nodules formed in legumes. As Sangkkar (1996) point out, the addition of organic fertilizers increased the dry weight of bacterial nodules in legumes and in a study conducted by Yahiya and Samiullah (1995), it was demonstrated that the incorporation of varying levels of organic matter resulted in a notable increase in the number of bacterial nodules. The investigation also revealed a correlation between the presence of these nodules and the dry weight gain and nitrogen content observed in chickpea plants. The addition of urea fertilizer levels significantly affected the number of bacterial nodules of bean plants and the results in Table (5) show that the third level exceeds 75 kg urea/dunum nitrogen fertilizer to give the highest average number of active bacteria. joints, where it reached 33.8 bacterial knots, while the lowest percentage of the same trait was the comparative treatment was 6.6 bacterial knots. From the same table, it is also clear that organic fertilizers have a significant effect on the number of effective bacterial nodules. Adding organic fertilizer to the third level brought 3 tons.ha^{-1}. The highest rate was 29.0 bacterial knots, while the lowest rate for the same trait was in treated plants. The comparison is 3.7 bacterial knots. As for the interaction between the two factors (organic fertilizer and urea). The results of the same table showed that the highest rate of the number of active petriol nodes gave him the interference treatment between the fourth addition level of urea 75 kg/dunum and the fourth level of organic fertilizer 3 tons.ha^{-1} was 64.1 bacterial node while the plants gave the comparison treatment the lowest rate of the number of bacterial nodes as it reached 0.7 bacterial nodes as the results of this experiment are consistent with what was stated by both (Hartwig and Nosberger, 1994). Furthermore, the element nitrogen was identified as a crucial factor in the proliferation of bacterial nodes in the roots of leguminous plants. This increase was attributed to the positive impact of nitrogen on the vital activities of these organisms, as well as on the structures and enzymes that are essential for biological processes and biochemical reactions within the plant. Experimental results have shown that applying organic fertilizer has provided the soil with essential nutrients for plant growth and development, helping plants absorb nutrients better

Table 5: Illustrates the impact of incorporating organic and urea fertilizers, as well as their interactions, on the number of active bacterial nodes.

Organic fertilizer addition	Urea fertilizer levels kg/dunum					
level (l. ha^{-1})	0	25	50	75	100	Average
Without addition	0.7	2.7	5.0	6.7	3.5	3.7
1	0.8	10.5	12.2	27.2	12.5	12.6
2	7.5	11.2	17.5	29.5	13.3	15.8
3	11.5	18.9	29.3	64.1	19.2	28.6
4	10.3	14.2	25.3	40.7	17.1	21.5
Average	6.1	11.5	17.8	33.6	13.1	
LSD values at 0.05	Compost addition level = 8.348					
	Urea fertilizer levels = 8.348					
	Intervention = 16.524					

than using 100% NPK. Tugume (2018) show that organic fertilizers can be considered soil conditioners De Britto and Girija (2006). In addition to providing more macroNitrogen provides bacteria with the energy and nutrients they require to establish themselves in the root nodes. As previously noted by Tamimi (1988), the incorporation of organic matter has resulted in an increase in the number of bacterial nodes. This increase can be attributed to the presence of organic matter (Al-Maamouri, 2020), which contains essential nutritional components for microorganisms, including sugars and enzymes. The availability of nutrients and organic matter required by microorganisms leads to the proliferation and activation of large numbers of microorganisms.

CONCLUSION

In conclusion, the results of this study provide compelling evidence for the synergistic effects of organic and inorganic fertilizers on the growth and yield parameters of *Vicia faba* (bean plant). The experimental design, which employed a pot-based approach, permitted a meticulous examination of the impacts of varying levels of urea fertilizer and decomposing poultry waste as an organic amendment on key plant metrics. Furthermore, the results clearly indicate that a balanced fertilization regime is the most effective approach. In particular, the application of urea at a rate of 75 kg/dunum proved to be the most effective inorganic fertilizer level, significantly enhancing several key plant metrics, including plant height, dry weight, nodulation (in terms of both the number and dry weight of bacterial nodes) and total seed yield. Concurrently, this treatment effectively mitigated fluctuations in soil pH, thereby maintaining a more favorable rhizosphere environment in comparison to the control group. Similarly, the application of organic fertilizer at a rate of 3 tons/ha was found to be the most efficacious, resulting in significant improvements across all studied parameters. The organic amendment not only enhanced plant growth and yield metrics but also facilitated soil health by moderating soil reactions.The most notable outcome of this study is the interaction effect between inorganic and organic fertilizers. The combination of urea at 75 kg/dunum and organic fertilizer at 3 tons/ha yielded the most pronounced enhancements across all measured traits while simultaneously achieving the lowest soil reaction values.

Conflict of interest

All authors declared that there is no conflict of interest.

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