GSC Biological and Pharmaceutical Sciences
eISSN: 2581-3250 CODEN (USA): GBPSC2
Cross Ref DOI: 10.30574/gscbps
Journal homepage: https://gsconlinepress.com/journals/gscbps/

(RESEARCH ARTICLE)

Check for updates

# Study of the effect of poultry manure on the concentration Nutrients N, P, K, Cu, Zn in wheat plants growing in two types of soil

Sami Hamad Sultan *

*Department of Food Sciences, College of Medicinal and Industrial Plants, University of Kirkuk, Kirkuk, Iraq.*

GSC Biological and Pharmaceutical Sciences, 2025, 32(02), 036-042

Publication history: Received on 25 June 2025; revised on 02 August 2025; accepted on 04 August 2025

Article DOI: https://doi.org/10.30574/gscbps.2025.32.2.0310

## Abstract

The experiment was conducted during the winter season of 2023-2024 at the College of Medicinal and Industrial Plants, University of Kirkuk, to study the role of poultry manure and two types of soil calcareous and gypsum on wheat plant growth the experiment was conducted in pots using a completely randomized design (CRD) the experiment included 36 experimental units resulting from matching six levels of fertilization and two types of soil (calcareous and gypsum) with three replicates on wheat plants, the fertilization treatments of 400 g/pot showed an increase in all studied characteristics, as it gave in calcareous soils 91.3 cm plant length, 15.9 g plant$^{-1}$ dry weight and 5.9, 4.6, and 5.3% concentration of each of K, P, and N in the plant and 2.4 and 2.8 mg g$^{-1}$ concentration of each of the elements Zn, Cu in the results showed that in gypsum soils, plant length was 82.6 cm, dry weight was 14.1 g. plant$^{-1}$ and 5.1, 4.1 and 5.0% concentration of each of K, P, N in the plant and 1.7 and 1.9 mg. g$^{-1}$ concentration of each of Zn, Cu in the plant compared with the control sample, which gave the lowest values in gypsum soils and reached 62.4 cm plant length, dry weight was 10.2 g. plant$^{-1}$ and 1.1, 0.9 and 1.9% the concentrations of K, P, and N in the plant were 1.7 and 1.9 mg g$^{-1}$, and the concentrations of Zn and Cu in the plant were 1.7 and 1.9 mg g$^{-1}$. The addition of poultry manure at 400 g/anvil was the best treatment, as it increased all growth characteristics and nutrient concentrations. Calcareous soils were superior to gypsum soils in all traits.

**Keywords:** Wheat (Triticum aestivum L.); Poultry manure; soil types; Macronutrients and Micronutrients (N, P, K, Cu, Zn); Nutrient concentration; Plant growth

## 1. Introduction

Wheat (*Triticum aestivum* L.) is considered one of the most important food crops worldwide, serving as the staple diet for over one-third of the global population and playing a critical role in achieving global food security. It is a primary source of carbohydrates and also provides substantial amounts of protein, fats, and essential minerals such as iron and zinc, making it vital for human growth and proper nutrition [1]. In addition to its nutritional value, wheat exhibits high adaptability to a wide range of ago-ecological conditions from cold to hot and arid regions making it the most widely cultivated crop in terms of global acreage [2]. Wheat ranks first among cereal grains in terms of global consumption, ahead of rice and maize, and it is extensively used in the production of bread, pasta, and various food products, which underscores its economic and strategic importance for many nations [3], organic fertilizers are used in agriculture, which are considered the most important source for improving the nutritional level of the soil it contributes to increasing the availability of nutrients, especially nitrogen, and is used for most crops. Poultry manure is one of the most important of these organic fertilizers, as it contains the highest percentage of nutrients. It also works to improve the composition and aeration of the soil and increase the soil's ability to hold water and nutrients the importance of organic fertilizers is not only estimated by their high content of nutrients but through its high content of organic acids that work to reduce the degree of soil reaction and the dissolution of some insoluble compounds and [4] that the addition of poultry manure led to improving soil productivity by increasing its content of microorganisms and carbon organic

* Corresponding author: Sami Hamad Sultan

fertilizers also improve soil structure and availability of nutrients in the soil, and N is a major component of poultry manure [5]. Soil is one of the most important natural resources and the first pillar of agriculture. In Iraq gypsum soils are widespread, as they constitute about 20% of the area of Iraq and extend from the north of Iraq to its south. these soils are characterized by it has low fertility characteristics due to the dissolution of gypsum in the soil solution, which leads to nutritional imbalance in these soils due to the saturation of the soil solution with calcium and sulfate ions[6], which in turn affects the availability of nutrients necessary for plant growth [7]as for mixed soils, they are among the most suitable soils for agriculture due to the availability of most of the nutrients The study aims to investigate the effect of adding poultry manure to two types of soil on increasing the availability of certain nutrients, as well as the impact of these additives on wheat plant growth . Objectives of the study.

- To study the effect of poultry manure on the concentrations of Cu and Zn in wheat plants grown in two soil types.
- To determine the effect of soil type on the growth characteristics of wheat plants.

## 2. Materials and Methods

The experiment was carried out during the winter season 2023-2024 in the College of Medicinal and Industrial Plants / University of Kirkuk. 5 kg was added / pot and planted on 11/4/2023 in pots at a rate of 6 plants / pot of the type Abaa (95). The first factor was two types of gypsum and calcareous soil, and the second factor was six levels of fertilization with poultry waste (0, 100, 200, 300, 400, 800) g / pot. The treatments were distributed randomly according to the complete random design (CRD) with three replicates to become (36) Experimental unit. The soil was air dried, ground, sieved with a sieve with a diameter of 2 mm, and mixed well to homogenize it. A sample was taken from each soil and the physical and chemical analyses were conducted in Table No (1) the soil was incubated after adding the waste for ten days and the pH was measured after incubation Table (2). Some properties of poultry waste were measured (Table (3) light three plants were planted per pot. Manual weed control was carried out. Field measurements were taken 12 weeks after planting, and the following traits were studied: plant height (cm), dry weight, and elemental concentrations of Cu and Zn in the plant. Statistical analysis was carried out using the least significant difference (LSD) test at a 5% probability level [8].

**Table 1** Some chemical and physical characteristics of the study soils

| Soil / type | Soil components | | | Texture type | EC | Ph |
|---|---|---|---|---|---|---|
| | clay% | silt% | sand% | | | |
| calcareous | 27.9 | 51.8 | 20.3 | Loam sandy | 0.4 | 7.9 |
| gypsum | 11.1 | 43.3 | 45.6 | Loam clay | 2.2 | 7.3 |

**Table 2** Shows the pH values after incubation

| Amount of waste g/pot / Soil type | T1 0 | T2 100 | T3 200 | T4 300 | T5 400 | T6 800 |
|---|---|---|---|---|---|---|
| Calcareous soil | 8.1 | 8.4 | 8.3 | 8.2 | 8.4 | 8.5 |
| Gypsum soil | 7.8 | 8.3 | 8.5 | 8.4 | 8.6 | 8.7 |

**Table 3** Shows some properties of poultry waste

| Ph | Eco | N% Total | P% Total | K% Total | C/N |
|---|---|---|---|---|---|
| 7.1 | 10.42 | 4.12 | 1.48 | 3.24 | 8.17 |

## 3. Results and Discussion

### 3.1. Analysis of Variance

It is noted from Table (4) of the analysis of variance that the treatments differed significantly from each other. The results showed highly significant differences between treatment (A) and soil type in the traits Zn, Cu, K, P, N, Dry Weight, and Plant Height, and significant differences at a 5% probability level in the trait N. This is due to the effect of soil type on the traits.

While all traits showed highly significant differences at a 1% probability level between treatments (B) and the level of waste addition, regarding the (A*B) overlap, traits K, N, and Zn showed highly significant differences among themselves at a 1% probability level, while the remaining traits (Cu, P, Dry Weight, and Plant Height) did not reach the statistical significance level.

**Table 4** Analysis of variance for treatments

| S. o. V. | Plant Height | Dry weight | N | P | K | Cu | Zn |
|---|---|---|---|---|---|---|---|
| R | 8.33 | 0.59 | 0.17 | 0.01 | 0.05 | 0.11 | 0.08 |
| A | 434.03** | 15.73** | 0.93* | 1.52** | 2.89** | 0.93** | 0.84** |
| B | 505.09** | 17.67** | 13.05** | 9.98** | 6.64** | 0.38** | 0.46** |
| A*B | 19.52ns | 0.58ns | 0.60n.s | 0.13n.s | 0.36n.s | 0.02N.S | 0.03n.s |
| Error | 10.08 | 1.48 | 0.15 | 0.07 | 0.05 | 0.03 | 0.02 |

** = Significant at the 1% probability level * Significant at the 5% probability level. N.S. = Not significant Texture soil = A Spray parameter = B

### 3.2. Plant Height

Table (5) shows the plant height value the table shows significant effect that soil type and poultry manure have a on plant height the treatment containing 400 grams of poultry manure gave the highest plant height, reaching 91.3 cm, compared to the rest of the treatments. the lowest height was for the comparison treatment, reaching 63.2 cm in calcareous soils. As for the soils gypsum treatment with 400 grams of poultry waste gave the highest height, reaching 82.6 cm, and the lowest height for the comparison treatment, reaching 62.4 cm. This increase came as a result of adding poultry waste, which increased the plant's supply of nutrients, especially nitrogen, and improved the physical properties of the soil [9], which led to better growth conditions and thus increased the plant's height. thus, the characteristic Plant height was affected by soil type as calcareous soil outperformed gypsum soil due to its calcium and sulfate content, which restricts nutrients and makes them unavailable to the plant [10]. As for the best soil addition, calcareous soil outperformed the soil with the addition of 800 grams of poultry manure giving the highest plant height [11] the interaction between the two factors was not significant at the plant length.

**Table 5** Arithmetic averages of spray treatments, soil texture, and their interaction for wheat plants in terms of plant height (cm)

| Soil type / Compost Levels g/pot | Calcareous soil | Gypsum soil | Fertilization coefficient averages |
|---|---|---|---|
| 0 | 63.2 | 62.4 | 62.8 |
| 100 | 75.6 | 64.2 | 69.9 |
| 200 | 79.9 | 72.7 | 76.3 |
| 300 | 81.7 | 76.3 | 79.0 |
| 400 | 91.3 | 82.6 | 86.95 |
| 800 | 89.2 | 81.1 | 85.15 |
| Soil averages | 80.15 | 73.21 | |
| LSD 5% | LSD(A)=2.20 | LSD(B)=3.8 | LSD(A*B)=ns |

### 3.3. Dry weight

Table (6) shows the significant effect of adding poultry manure to the soil. The treatment with 400 g of poultry waste gave an increase in dry weight of 15.9 g. plant$^{-1}$ and 14.1 g. plant$^{-1}$ compared to the control treatment, which gave the lowest dry weight, which amounted to 11.3 g. plant$^{-1}$, 10.2 g. plant$^{-1}$ in calcareous and gypsum soils, respectively [12]. Adding poultry manure to the soil improved the chemical and physical properties of the soil by providing nutrients [13] and increased the soil's ability to prepare water and increased aeration, which encouraged vegetative growth [14]. While calcareous soil outperformed gypsum soil in increasing dry weight, the best addition was with the soil, the treatment was 800 grams of poultry waste, while the lowest dry weight was achieved by the gypsum soil with the control sample, the interaction between the two factors was not significant at the dry weight.

**Table 6** Arithmetic averages of spray treatments, soil types, and their interaction for wheat plants in terms of dry weight (g/plant$^{-1}$)

| Soil type / Compost Levels gm/pot | Calcareous soil | Gypsum soil | Fertilization coefficient averages |
|---|---|---|---|
| 0 | 11.3 | 10.2 | 10.75 |
| 100 | 12.1 | 11.0 | 11.55 |
| 200 | 12.8 | 11.8 | 12.3 |
| 300 | 13.5 | 12.4 | 12.8 |
| 400 | 15.9 | 14.1 | 15.0 |
| 800 | 14.8 | 13.9 | 14.35 |
| Soil averages | 13.4 | 12.23 | |
| LSD 5% | LSD(A)=0.84 | LSD(B)=1.64 | LSD(A*B)=ns |

### 3.4. Concentration of plant nutrients (N, P, K)

Table (7) shows the effect of adding poultry manure to the soil it was found that there is a significant effect on the concentration of elements N,P,K the 400 g treatment of poultry manure was superior as it resulted in an increase in the concentration of the elements K, P, and N in the plant compared to the control treatment, which resulted in the lowest concentration of these elements in the plant increasing the amount of poultry manure led to an increase in the availability of nutrients and growth regulators in the soil[15], which encouraged the plant to absorb a larger amount of the nutrients, which led to an increase in the accumulation of nutrients in the plant, while the calcareous soil outperformed the gypsum soil in the concentration of nutrients, and the best addition was with the calcareous soil 400 g of poultry manure, as it gave the highest amount and reached 5.9, 4.6, 5.1% of the elements N.P, K, respectively while the lowest amount of elements was achieved by the gypsum soil with the comparison treatment and reached 1.1, 0.9,1.9 % for the elements N, P, and K. the resulting increase may be attributed to the efficiency of the calcareous soil in providing nutrients to the plant [16] however the interaction was not significant between the two factors: soil type and poultry manure levels.

**Table 7** Arithmetic averages of spray treatments and soil types and their interaction in wheat plants in the concentration of major nutrients N, P, and K%

| Soil type / Compost Levels gm/pot | Calcareous soil% | | | Gypsum soil% | | |
|---|---|---|---|---|---|---|
| | N | P | K | N | P | K |
| 0 | 1.5 | 1.2 | 2.3 | 1.1 | 0.9 | 1.9 |
| 100 | 2.0 | 1.9 | 3.9 | 1.8 | 1.4 | 2.4 |
| 200 | 3.4 | 2.4 | 4.1 | 2.4 | 2.0 | 3.6 |
| 300 | 4.7 | 3.3 | 4.6 | 4.7 | 2.8 | 4.1 |
| 400 | 5.9 | 4.6 | 5.3 | 5.1 | 4.1 | 5.0 |
| 800 | 4.7 | 4.0 | 4.6 | 4.8 | 3.7 | 4.1 |
| LSD 5%N | LSD(A)=0.26 | | | LSD(B)=0.46 | | |
| LSD 5% P | LSD(A)=0.17 | | | LSD(B)=0.31 | | |
| LSD 5% K | LSD(A)=0.16 | | | LSD(B)=0.27 | | |

### 3.5. Concentration of Cu and Zn elements in wheat plants

Table (8) shows the effect significant of adding poultry manure to two types of soil the treatment of 400 g of poultry manure to calcareous soil was superior, as it gave the highest concentration of Zn and Cu elements,[17] compared to the comparison treatment with gypsum soil, which gave the lowest concentration of Zn and Cu elements the addition of poultry manure improved the chemical properties of the soil, which led to an increase in the concentration of the elements Zn, Cu, while the calcareous soil with the addition of 400 g of poultry manure was superior, as it gave the highest concentration of 2.4, 2.8 mg. $g^{-1}$ for Zn, Cu, respectively, compared to the control sample , which gave 1.9, 2.2 mg. $g^{-1}$ for Zn, Cu, respectively, while in the gypsum soil with the addition of 400 g of poultry manure it gave 1.9, 2.2 mg. $g^{-1}$. for Zn, Cu respectively, and the lowest concentration was achieved by the gypsum soil with the comparison treatment, as it reached 1.7, 1.9 mg. $gm^{-1}$ for Zn, Cu respectively. The reason for the superiority of the calcareous soil treatment over the gypsum soil treatment may be attributed to the increased availability of nutrients in the calcareous soil due to the low presence of calcium and sulfate ions that combine with the ions of the elements It leads to the precipitation of elements and transforms them into more stable compounds [18]. The reason for the superiority of the 400-gm treatment in calcareous soils over the other treatments may be due to the positive effect of the interaction between the two factors: the calcareous soil factor and the increase in the addition of poultry waste, which was reflected in an increase in the concentration of Zn and Cu. [19]. The interaction between the two factors was not significant, including adding poultry manure and types of soil.

**Table 8** Arithmetic averages of spray treatments, soil types, and their interaction together for wheat crops in the concentration of Cu and Zn elements (mg. $g^{-1}$)

| Soil type / Compost Levels gm./pot | calcareous soil (mg. $g^{-1}$) | | Gypsum soil (mg. $g^{-1}$) | |
|---|---|---|---|---|
| | Cu | Zn | Cu | Zn |
| 0 | 1.9 | 2.2 | 1.7 | 1.9 |
| 100 | 1.6 | 1.8 | 1.4 | 1.6 |
| 200 | 1.7 | 2.0 | 1.3 | 1.8 |
| 300 | 2.0 | 2.4 | 1.8 | 2.1 |
| 400 | 2.4 | 2.8 | 1.9 | 2.2 |
| 800 | 2.1 | 2.2 | 1.7 | 2.0 |
| LSD 5%Cu | LSD(A)=0.11 | | LSD(B)=0.19 | |
| LSD 5%Zn | LSD(A)=0.11 | | LSD(B)=0.19 | |

## 4. Conclusion

- Calcareous soil outperformed other soils in all studied characteristics
- The 400 g poultry manure treatment outperformed all studied treatments
- The combined treatment of calcareous soil and 400 g of poultry manure was superior in all studied characteristic

*Suggestions*

- We recommend studying other trace elements.
- Use other soil types with additives at different time intervals.

## References

[1] Al-Mafarji TRT, Al-Jubouri JMA. Combining Ability and Gene Action of Half Diallel Crosses in Bread Wheat (Triticum aestivum L.). IOP Conf Ser Earth Environ Sci. 2023;1262(5). https://doi.org/10.1088/1755-1315/1262/5/052027

[2] Al-Mafarji TRT, Al-Jubouri JMA, Kanbar A. Estimate Combining Ability and Gene Action of Yield, and Some Qualitative Traits of Bread Wheat Genotypes (Triticum aestivum L.) of Half-Diallel Crosses. Tikrit J Agric Sci. 2024;24(3):182–196. https://doi.org/10.25130/tjas.24.3.15

[3] Al-Mafarji T, Al-Jubouri J. Heterosis, Correlations and Path Analysis of Grain Yield Components in Bread Wheat (Triticum aestivum L.). Kirkuk Univ J Agric Sci. 2023;14(3):34–46. https://doi.org/10.58928/ku23.14304

[4] Akanni DI, Ojeniyi SO. Residual effect of goat and poultry manures on soil properties nutrient content and yield of Amanranthus in South Nigeria. Res J Agron. 2008;2(2):44–47.

[5] Dauda SN, Aliyu L, Chiezey UF. Effect of seedling age at transplant and poultry manure on fruit yield and nutrients of garden egg varieties. J Trop Sci. 2005;5(2):38–41.

[6] Atta Allah SA, Mohamed GA. Response of wheat grown in newly reclaimed sandy soil to poultry manure and nitrogen fertilization. J Agric Sci Mansoura Univ. 2003;28(10):7531–7538.

[7] Mansur A, Al-Eshaqy JM, Al-Obaidy KS. Effect of organic fertilizer levels on olive fruits yield, local cultivar (Bashiki) at Al-Hawija – Kirkuk. Kirkuk Univ J Agric Sci. 2012;3(2):14–21. https://doi.org/10.58928/KU12.03202

[8] Al-Zubaidi KMD, Al-Jubouri KKA. Design and analysis of genetic experiments. Amman, Jordan: Al-Wadah Publishing House; 2016.

[9] Khalil AA, Nasef MA, Ghazal FM, El-Emam MA. Effect of integrated organic manuring and bio-fertilizer growth and nutrient uptake of wheat plants grown in diverse textured soils. Egypt J Agric Res. 2004;82(2):221–234.

[10] Gong Y, Cao Q, Sun Z. The effects of soil bulk density, clay content and temperature on soil water content measurement using time-domain reflectometry. Hydrol Process. 2023;17(18):3601–3614. https://doi.org/10.1002/hyp.1358

[11] Abdulazeez SD, Salih RF. Growth and yield of linseed (Linum usitatissimum L.) enhanced through adding organic and inorganic fertilizers. Journal of Medicinal and Industrial Plant Sciences. 2025;3(1):80–89. https://doi.org/10.32894/MEDIP.25.3.7

[12] Sugri I, Abukari A, Yahaya I. Effect of chicken manure, compost and cow dung on the growth and yield of sweet potato [Ipomoea batatas (L.) Lam.] under Guinea Savannah agroecological zone of Ghana. Open Access Libr J. 2024. https://doi.org/10.4236/as.2024.1511069

[13] Albaraznchi OAR. Effect of shading, organic fertilizer and gibberellic acid on the flowering growth of (Lavandula angustifolia) growing in Kalar city. Kirkuk Univ J Agric Sci. 2023;14(4):227–234. https://doi.org/10.58928/KU23.14420

[14] Havlin JL, Beaton JD. Soil fertility and fertilizers: An introduction to nutrient management. 7th ed. New Delhi: Prentice Hall of India; 2005. p. 150–160.

[15] Umoh FO, Osodeke VE, Edem ID, Effiong GS. Application of Langmuir and Freundlich models in phosphate sorption studies in soil of contrasting parent materials in South-Eastern Nigeria. Open Access Libr J. 2014;1(7). https://doi.org/10.4236/oalib.1101045

[16] Khalil AA, Nasef MA, Ghazal FM, El-Emam MA. Effect of integrated organic manuring and bio-fertilizer growth and nutrient uptake of wheat plants grown in diverse textured soils. Egypt J Agric Res. 2004;82(2):221–234.

[17] Al-Juheishy WKS, Abdulateef MA, Almashhadany AMA. Response of rapeseed varieties (Brassica napus L.) to foliar application of zinc. J Med Ind Plant Sci. 2025;3(1):90–101. https://doi.org/10.32894/MEDIP.25.3.8

[18] Hassan HH, Kaleef AAA. Effect of potassium nitrate on seed priming for wheat cultivars (Triticum aestivum L.). Kirkuk Univ J Agric Sci. 2024;15(2):52–56.

[19] Kareem N, Mohammed B, Aziz T, Hussein N. Response of black seed (Nigella sativa L.) varieties to seed priming with zinc on germination and seedling parameters. Journal of Medicinal and Industrial Plant Sciences. 2025;3(2):53–70. https://doi.org/10.32894/MEDIP.25.3.2.5