The Effect of Application of Two Types of Organic Manures on Some Soil Properties and Growth Traits of Barley, (*Hordeum vulgare* L.)

Mahmood Abdullah Ali, Walaa Salam Kadhim
Department of Soil Sciences and Water Resources, College of Agriculture, University of Al-Qadisiyah, Iraq
Corresponding e-mail: mahmood.ali@qu.edu.iq

Abstract
This pot study was designed to investigate the effects of two types of organic manures (poultry and sheep) on various physical and chemical properties of sandy loam soil, including hydraulic conductivity, electrical conductivity (EC), soil alkalinity (pH), organic matter (OM), and available nitrogen (Av.N). And investigates the effects of these manures on the growth traits of barley crops, such as plant height, leaf area, and the dry weight of the vegetative part. Four application levels of both manures were tested: 0, 5, 10, and 15 $Mg.ha^{-1}$. The results showed that the application of organic manure improved soil properties. Poultry manure (PM) had a greater impact than sheep manure (SM), resulting in lower soil pH and hydraulic conductivity at all levels, while increasing the soil EC, OM content, and the Av.N. Additionally, organic manure enhanced the growth traits of the barley plants. PM significantly increased plant height, leaf area, and dry weight compared to SM. Particularly, applying poultry manure at the highest level of 15 $Mg.ha^{-1}$ yielded significant positive results.

Keywords: Organic manures, Barley, Poultry manures.

Introduction

Barley is one of the oldest cultivated field crops, belonging to the Poaceae family and the Hordeum genus [1]. In Iraq, it is typically grown from mid-October to mid-November [2]. Barley is the second most important crop in Iraq, following wheat, and it accounts for approximately 36% of the total area devoted to grain crops [3]. This crop is tolerant of drought, soil salinity, and climate variability, making it suitable for cultivation even in less fertile or newly reclaimed soils. It can also thrive in fertile soils that offer good drainage [4]. Additionally, barley can be successfully grown in calcareous clay soils and sandy clay soils that contain lime [5]. Barley responds well to both mineral and organic fertilizers. Mineral fertilization is most effective when soil salinity is below 10 dS/m. For optimal growth, it requires 100 kg of nitrogen, 48 kg of phosphorus pentoxide, and 40 kg of potassium oxide. Organic fertilizers should be applied before planting [6].

Organic fertilizers are essential for enhancing the organic matter content of the soil. They help preserve nutrients from deterioration and loss and boost biological activity in the soil, thereby improving its physical and chemical properties [7]. Additionally, organic matter increases soil moisture and provides essential nutrients such as nitrogen, phosphorus, and potassium, which are easily released after decomposition [8]. As a result, organic matter plays a crucial role in promoting plant growth [9].

[10] presents the idea that soil properties, organic matter content, nutrient levels, plant growth, and yield quality are influenced by the type and amount of fertilizer added to the soil. [11] highlighted that the use of organic fertilizers has increased the protein, fiber, fat, manganese, iron, and zinc content of seeds, as well as boosting ash content. [12] explained that adding organic fertilizer to the soil improved barley plant growth and increased crop productivity to 50 $Mg\ ha^{-1}$.

Material and Methods

Soil sampling:

Samples were collected randomly from the surface soil layer at a depth of 0-30 cm from the field soil. These samples were taken in plastic bags to the laboratory. The

soil was air-dried, then ground with a wooden mallet to break up aggregates, and passed through a 2 mm sieve.

Soil analysis:
Some physical and chemical properties for study soil were estimated according to the methods described in [15], [16], [17], and [18] as presented in Table (1).

Experimental Design:
This pot experiment was conducted at the College of Agriculture, University of Al-Qadisiyah. It was designed using a Completely Randomized Design (C.R.D) with three replicates and four levels of both organic manure (PM) and (SM), which were 0, 5, 10, and 15 $Mg.ha^{-1}$. The soil used in the study was placed in 10 kg pots, in which 10 seeds of barley were initially sown and later thinned to 5 seeds per pot. The pots were then irrigated as needed. At the end of the experiment, the soil from the pots was tested to assess the effects of the manures on the physical and chemical properties of the soil. Three growth parameters were measured before the spike formation stage: plant height, leaf area, and dry weight of the vegetative part. The effects of the organic fertilizers were analyzed using analysis of variance (ANOVA).

Table 1. Physical and chemical properties of the study soil before planting

Particle Size Analysis %			Texture	pH	EC dSm^{-1}	OM %	Av.N $mg.kg^{-1}$	Hydraulic conductivity $cm.min^{-1}$
Sand	Silt	Clay						
75	15	10	Sandy Loam	7.26	5.3	1.37	13.98	0.34

Results and Discussion

Organic matter OM
Table 2 shows that organic manure increased the proportion of organic matter (OM) in the soil. The most significant increase was observed with the application of 15 Mg ha^{-1} of PM. PMs were more effective in enhancing the OM levels compared to SM. These findings are consistent with the results reported by [19].

Hydraulic conductivity
The results indicate that applying organic manure to the soil enhances its ability to retain water. This is evidenced by the lower hydraulic conductivity values observed in soil treated with organic manure compared to untreated soil. PM appears to have a greater impact than other types of manure (SM), as it significantly reduces soil hydraulic conductivity values, which aligns with the findings of [8]. This effect is likely due to PM's ability to form soil aggregates and improve soil structure, as supported by [19]. Additionally, there is an inverse relationship between the amount of manure added and the hydraulic conductivity values, as shown in Table 2.

Electrical Conductivity EC
The application of organic manure resulted in an increased EC of the soil compared to the control. This increase can be attributed to the high salt content found in organic manure. As shown in Table 2, the soil EC values rose with the increasing amounts of manure applied, consistent with the findings of [20]. Notably, the rise in soil EC from using SM was significantly greater than that from PM.

Table 2. Effects of Manures on Soil Properties

PM (Mg.ha^{-1})	OM* (%)	Hydraulic conductivity (cm.min^{-1})	EC (dSm^{-1})	pH	Av.N (mg.kg^{-1})
5	2.34 d*	0.22 b	6.43 f	6.18 c	37.28 c
10	3.44 b	0.12 e	6.87 e	6.35 bc	41.95 b
15	3.72 a	0.11 e	8.30 d	6.22 c	46.63 a
SM (Mg ha^{-1})					
5	1.68 e	0.23 b	9.50 c	6.74 b	18.63 e
10	2.34 d	0.19 c	10.80 b	6.68 b	27.97 d
15	2.74 c	0.18 d	11.27 a	6.47 bc	37.33 c
control	1.37 f	0.34 a	5.36 f	7.36 a	13.83 f

*The numbers with the same letter or similar letters do not have any significant differences between them.

Soil pH

The application of organic manure reduced soil pH due to the release of organic acids from these manures, which in turn reduced soil pH. PM reduced soil pH more than SM at all levels. These findings are consistent with the research conducted by [21].

Available nitrogen Av.N

The results demonstrate that PM (presumably poultry manure) has a significant advantage over SM (presumably another soil amendment) in terms of nutrient content, particularly nitrogen. This observation is consistent with the findings of [22], which show an increase in the soil's available nitrogen content. Furthermore, the reduction in soil pH enhances the availability of various nutrients, including nitrogen, as supported by the research of [23].

Plant height

Table 3 shows that the application of organic manure significantly impacted plant height. The organic manure increased both the nitrogen concentration and the chlorophyll content in the leaves, thereby enhancing photosynthesis and promoting plant growth. Specifically, the addition of PM to the soil increased the plant height compared to the control soil, which aligns with the findings of [24]. Notably, the application of 15 Mg.ha-1 of PM produced the greatest increase in plant height, surpassing the results achieved with SM, and this difference was statistically significant at the 0.05 level.

Plant leaf area

The results presented in Table 3 indicate that the leaf area of the plants increased with higher levels of manure application for both types of manure. This increase can be attributed to the nutrient content of the manures, particularly nitrogen, which plays a crucial role in cell division and plant growth. This, in turn, enhanced the efficiency of the roots in nutrient absorption, leading to an increase in leaf area. These findings are consistent with the research by [22]. Additionally, there were no significant differences in leaf area based on the type of manure applied to the soil.

Dry Weight

The results indicate that applying organic fertilizer to the soil increased the dry matter weight of the plants. The most significant increase in dry weight occurred at an

application rate of 15 $Mg.ha^{-1}$ of PM compared to other levels of the same manure and compared to different levels of SM. This increase in dry weight may be attributed to the high nitrogen content in PM, which has a low carbon-to-nitrogen (C/N) ratio. These findings are consistent with those of [23]. Additionally, the rapid decomposition of PM leads to a quicker release of nutrients than SM.

Table 3. Effects of Manures on the growth traits of barley crop

PM ($Mg.ha^{-1}$)	**Plant height (cm)**	**Plant leaf area (cm^2)**	**Dry weight (gm)**
5	32.67 d	22.73 e	2.87 d
10	42.67 b	29.77 c	3.16 c
15	49.67 a	35.33 a	5.27 a
SM ($Mg\ ha^{-1}$)			
5	30.30 e	20.83 f	1.73 f
10	37.67 c	26.40 d	2.43 e
15	41.30 b	33.43 b	4.48 b
control	28.00 f	17.27 g	1.63 g

Conclusion

Appropriate fertilizer application is a crucial management practice for enhancing soil fertility and increasing crop production. This study demonstrated the beneficial effects of two types of organic fertilizers (sheep and poultry manure) on plant growth traits and improved soil properties. Notably, an application rate of 15 $Mg.ha^{-1}$ of poultry manure produced significant results. Therefore, poultry manure is an effective fertilizer that should be recommended and encouraged for use.

References

[1]El-Hashash, E. F., & El-Absy, K. M. (2019). Barley (Hordeum vulgare L.) breeding. Advances in Plant Breeding Strategies: Cereals: Volume 5, 1-45.

[2]Mhaibes, I. J., & Al-Taiy, H. K. (2019). Proposals for improving the agricultural innovation system (AIS) performance in the field of developing barley cultivation in Iraq from agricultural researchers point of view. *Plant Archives*, 19(2).

[3]Mahmoud, Z. H., (2010). Economic Analysis of the Response of Barley Crops in Iraq and the Irrigated and Demilitarized Areas for the Period 1990-2007, Al-Anbar Journal of Agricultural Sciences, 8(4), Special Issue of the conference, College of Agriculture, University of Baghdad.

[4]Acquaah, G. (2009). Principles of plant genetics and breeding, 2nd edn. Blackwell, Malden.

[5]Zakaria, W. (2002). Field Crops Cultivation, part1, Reslan Alaeddin Foundation, Damascus, Syria.

[6]Ghany, A. J. and Salman, K. A., (2011). Barley from agriculture to harvest. General Authority for Agricultural Research. http://agriculturresearch.blogspot.com/2013/05/ blog-post.html

[7]Acquaah, G. (2007). Principles of plant genetics and breeding, 1st edn. Blackwell, Malden.

[8]Akanni, D. I. & Ojeniyi, S.O. (2008). Residual effect of goat and poultry manures on soil properties nutrient content and yield of Amanranthus in southwest Nigeria. Research Journal of Agronomy, 2(2), 44-47.

[9]Abdelrazzag, A. (2002). Effect of chicken manure, sheep manure and inorganic fertilizer on yield and nutrients uptake by onion. *Pakistan journal of biological sciences*, 5(3), 266-268.

[10]Unsal, T. (2001). Description of characteristics of humic substances from different waste materials. Bio resource Technology 78 (3), 239-242.

[11]Othman, A. J., Al-Karim, A. Y. and Nasr, O. E., (2011). The effect of organic fertilization on the productivity and quality of wheat yield (Triticum aestivum L.) compared with inorganic fertilization, Journal of the African University of Sciences, 2: 19-51.

[12]Zhang, M., Heaney, D., Solberg, E. and Heriquez, B. (2000). The effect of MSW compost on metal uptake and yield of wheat, barley and canola in less productive farming soils of Alberta. *Compost Science and Utilization* 8(3), 224–235.

[13]Brady, N. C. & Weil, R. R. (2008). The nature and properties of soils. 13, 662-710. *Upper Saddle River,* NJ: Prentice Hall.

[14]Šourková, M., Frouz, J., Fettweis, U., Bens, O., Hüttl, R. F., & Šantrůčková, H. (2005). Soil development and properties of microbial biomass succession in reclaimed post mining sites near Sokolov (Czech Republic) and near Cottbus (Germany). *Geoderma*, 129(1-2), 73-80.

[15]Richards, L. A. (1954). Diagnosis and improvement of saline and alkali soils. U.S. Agric., Handbook, No.60, U.S. Dept. Agric., Washington D.C., 69-82.

[16]Jakson, M. L.1958 .Soil chemical analysis. Prentice-Hall. Inc .Engel Wood, cliffs. N. J.

[17]Black, C. A., Evans, D. D. , White, L. L., Ensminger, L. E. and Clark, F. E. (1965). Method of soil analysis. Agronomy, 9 Amer. Soc. Agron. *Inc. Publisher, Madison, Wisconsin, USA*. No. 9 part I&II.

[18]Page, A. L., Miller, R. H. and Keeney, D. R. (1982). Methods of soil analysis Part 2-"Chemical and microbiological properties". Part II. ASA-SSSA. Agronomy, Madison, USA.

[19]Adeleye, E.O., Ayeni, L.S & Ojeniyi, S.O. (2010). Effect of PMon soil physico-chemical properties, leaf nutrient contents and yield of yam (*Dioscorea rotundata*) on Alfisol in Southwestern Nigeria. *Journal of American Science,* 6(10), 817-878.

[20]Dikinya, O. and Mufwanzala, N. (2010). Chicken manure-enhanced soil fertility and productivity: Effects of application rates. Journal of Soil Science and Environmental Management. 1(3): 46-54.

[21]Deepa, J. K., Gediya, S. G. and Birari, M. M. (2016). Effect of organic manures on soil and quality parameters of cowpea (*Vigna unguiculata* L.) under middle Gujarat conditions. Agric. Sci. Digest., 36 (3): 216-219.

[22]Dauda, S. N., Ajayi, F. A. and Ndor, E. (2009). Growth and yield of watermelon (*Citrullus lanatus*) as affected by PM application. EJEAFChe, 8(4) : 305-311.

[23]Singh, T. B., Ali, A., Prasad, M., Yadav, A., Shrivastav, P., Goyal, D., & Dantu,

P. K. (2020). Role of organic fertilizers in improving soil fertility. *Contaminants in agriculture: sources, impacts and management*, 61-77.

[24]Abdelhamid, M. T. , Horiuchi, T. & Oba, S. (2004). Composting of rice straw with oilseed rape cake and PMand its effects on faba bean (*Vicia faba* L.) growth and soil properties. *Bioresource Technology*, 93(2), 183–189.

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