Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.1039
*Biol. Clin. Sci. Res. J., Volume, **2024**: 1039*
Original Research Article

EVALUATING THE EFFECT OF POULTRY MANURE ON THE PERFORMANCE OF WHEAT UNDER THE AGROECOLOGICAL ZONE OF MANSEHRA, KHYBER PAKHTUNKHWA, PAKISTAN

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(Received, 20th May 2024, Revised 14th July 2024, Published 10th July 2024)

Abstract: *The conducted research aims at the effects of poultry manure on wheat (Triticum aestivum) growth, yield, and quality. Poultry manure is widely used as an organic fertilizer due to its high concentration of nutrients, particularly nitrogen, phosphorous, and potassium. This experiment was carried out in the Agricultural Research Farm, Department of Agriculture, Hazara University Mansehra in Khyber Pakhtunkhwa, Pakistan, during the summer of 2022–2023. Three replications of a randomized complete block design (RCBD) were used in the experiment. Four treatments of poultry manure application (control, 204g/3.48 m2, 340g/3.48 m2, and 680g/3.48 m2) were tested for wheat. Many morphological and yield-related characteristic data were collected, including plant height, spike length, number of spikelet's per spike, thousand-grain weight, grain yields (kg/ha-1), and biological yields (kg/ha-1) under agro-climatic conditions of Mansehra, which means that the wheat on different Poultry manure doses shows improvement in plant height, spike length, spikelet's per spike and thousand-grain weight. The findings showed that the appropriate use of poultry manure can significantly enhance wheat productivity and improve soil health. Based on these results it is recommended that wheat give the best yield in 680 grams per 3.43 m2 (100% of nutrient requirement) manure application.*

Keywords: Wheat Performance, Poultry Manure, Organic Fertilizer, Soil Fertility, Crop Productivity

Introduction

Wheat is a yearly cereal crop that serves as a primary food source for humans and livestock globally. Wheat cultivation has boosted Pakistan's economy significantly. It provides approximately 3% of Pakistan's total GDP (Ahmad *et al*,.2013). The crop is cultivated throughout the countries in both rain-fed and irrigated areas. It is a short-day, self-pollinating plant that receives photosynthetic periods. In 2017–2018, 8744.2 thousand hectares of wheat were cultivated in Pakistan, to optimize average yields of 2.917 and 25.507 tons per hectare as well as maximize overall production. Wheat-growing crops in Khyber Pakhtunkhwa province covered 0.74 million hectares over the stipulated period, The yearly output reached 1.36 million tons, with a typical grain harvest of 1726 kg per hectare (GOP-MNSFRC, Pakistan's wheat production in 2018 was significantly lower than that of Mexico and China due to uneven fertilizer application and decreased demand for organic fertilizers (Mashori *et al.,* 2013). Imbalanced application of inorganic fertilizers and the absence of organic fertilizers can lead to soil compaction, increased erosion, and loss of fertile soil. Therefore, while improving soil fertility, proper application of both organic and inorganic fertilizers can enhance soil properties. The primary sources of NPK and other essential plant nutrients are organic manures and fertilizers (Ahmad *et al.,* 2007). Crop residues, farmyard manure, and poultry dung are the main organic sources of nitrogen. The main source of air pollution is field losses of inorganic fertilizer, which are substantial. As a result, reusing agricultural organic materials can boost crop output while also reducing pollution (Alam *et al.,* 2003). Organic fertilizers are essential for improving the chemical and physical characteristics of the soil, providing a natural and sustainable alternative to synthetic fertilizers (Abbas *et al.,* 2012). Because of the high nutrient content, poultry manure can improve wheat production and quality more than other organic fertilizers (Hirzel *et al.,* 2004). Most organic fertilizers have proven that poultry manure increases wheat yield more efficiently. Poultry dung increases agricultural yield because it mineralizes more quickly and includes more basic elements than other organic fertilizers (Brady *et al.,* 1999). Poultry manure, which is rich in vital nutrients, raises the amount of chlorophyll in plants, dry matter, leaf area, and grain output (Amujoyegbe *et al.,* 2007). Global research has demonstrated that a variety of organic sources, including animal dung, chicken, pig, and residual compost, can boost crop yields. This study aims to determine the best application rate of poultry manure to maximize wheat productivity. They are assessing the impact of poultry manure on soil properties, including pH, organic matter content, and nutrient levels. Comparing the effectiveness of poultry manure with traditional chemical fertilizers in wheat cultivation. To find the effect of poultry manure application on the productivity of wheat in Mansehra.

Methodology

The experiment was carried out at the Agricultural Research Field of Hazara University Mansehra in Khyber Pakhtunkhwa, Pakistan, during the winter of 2022–2023. The wheat variety produced at various manure treatments made up the research material. At the Department of Agriculture, Hazara University Mansehra, seeds were sown in the field on October 15, 2022, at the agriculture research farm. A randomized complete block design including three

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replications was used to set up the experiment. Tillage is a crucial practice in wheat cultivation as it influences soil structure, moisture retention, nutrient availability, and weed control. Proper tillage practices can significantly enhance wheat yield and quality. The different tillage practices such as conventional tillage involve ploughing, harrowing, and leveling the field to prepare the seedbed used in wheat cultivation, particularly focusing on their impact when combined with poultry manure application. Poultry manure is a valuable organic fertilizer that provides essential nutrients, improves soil structure, and enhances microbial activity. When combined with appropriate tillage practices, poultry manure can significantly improve wheat yield and soil health. Use a row spacing of 20-25 cm to optimize light interception and reduce weed competition. Sow seeds at a depth of 3-5 cm to ensure proper germination and seedling emergence. Each replication was 4 by 31 feet. Each treatment was 4 by 9. The data was recorded on plant height, Thousand-grain weight, spike length and spikelet's per spike. The recommended rate of nitrogen for Wheat is 100kgha-1. Since each treatment has an area of 3.48 m^2 the recommended rate suggests 34g of nitrogen for each plot. Based on 5% nitrogen content of poultry manure each plot requires 680g poultry manure. Harvest the wheat when the grains reach physiological maturity and have a moisture content of around 20-25%. The data was statistically analyzed using Microsoft Excel and Statistic 8.1 software according to the model for the randomized complete block. Means of different traits were separated at a level of 5% using the minimum obvious difference (LSD) test (Steel and Torrie, 1980).

Results & Discussion

Farmers face various challenges when using chemical fertilizers, including their short-term effects, high cost, and disruption of soil structure leading to erosion and reduced soil quality and crop productivity. Many farmers, especially those with limited resources, use a combination of organic and inorganic manures without knowing which one works best on its own. With all of these concerns in mind, a research effort was conducted to enhance agriculture, and because of its long-term residual effects, it may pave the way for sustainable agriculture. The data in Tables 1,2 and 3 indicate the effect of poultry manures on wheat production characteristics. The tables showed organic manures have similar effects on plant height. Applying organic manures enhances porosity, which improves water usage efficiency and consequently biomass production it is also a similar finding (Ahmad *et al.,* 2013). It has also been reported (Sarwar *et al.,* 2009) that applying organic manures to the soil increases the fresh weight of wheat.

Plant Height (cm)

Plant height measurements were made for five chosen plants. A measuring tape was used to take the distance between the earth and the top of the plant. According to the results, plant height revealed significant differences in wheat. The mean data in (Table 1) shows that the wheat at 100% poultry manure gave maximum Plant Height (104.67 cm). The results showed that minimum plant height was recorded in Control (88.33 cm) in Wheat. The critical value of the comparison of all treatments in mean height is (5.81). Wheat grown with 100% poultry manure produced the tallest plants (104.67 cm). Organic manures combined with inorganic fertilizers improve plant development and yield (Channabasanagowda *et al.,* 2008). The application of sewage sludge has been shown to result in significant improvements in wheat growth components Application of FYM was observed to result in a considerable increase in spring wheat plant height (Sharma *et al.,* 2005) and (El-Ghamri *et al.,* 2009) discovered that maize plant heights achieved with FYM + ½ NPK fertilizers were equivalent to those obtained with full doses of NPK.

Spike Length (cm)

Five randomly chosen plants per plot had their spike lengths measured, and an average was determined. The analysis of variance for spike length in Table 1 showed that the wheat under different treatments varied significantly. Spike Length was varied from (9.33 to 12.66 cm). LSD values for Spike Length was (0.94). The maximum spike length was reported in 100% poultry dung (12.66 cm). Similarly, in the control group, the minimum spike length was 9.33 cm. The longest spike length was observed in 100% poultry dung (12.66 cm). According to (Ahmad *et al.,* 2007), organic manures are a useful way for agricultural plants to receive several nutrients, even when they differ in type and quality and increase their growth.

Table 1. Effect of poultry manure on Plant height (cm) and Spike length (cm).

Treatments	Plant Height (cm)	Spike Length (cm)
Control	88.33	9.33
30% Poultry Manure	92 .00	10.00
50% Poultry Manure	94.67	11.00
100% Poultry Manure	104.67	12.66
LSD	5.81	0.94

Spikelet's per spike

On five randomly chosen spikes from each of the chosen plants, the number of spikelet's per spike was counted, and their average was determined. The analyzed data for Spikelet's per spike in (Table 2) shows highly significant differences among the treatments. The mean data shows that the maximum spikelets $spike^{-1}$ was in 100% poultry manure (19.66), while the minimum spikelets spike-1 was in control (13.66). The critical value for comparison of these treatments is 1.15. The highest spikelet $spike^{-1}$ concentration was found in 100% poultry dung (19.66). Crop growth and yield characteristics are enhanced by plant nutrients and organic compounds produced during the decomposition of organic materials (Hendrix *et al.,* 1994).

Thousand grains weight (g)

Using a digital scale, the number of grains in each treatment was counted to calculate the thousand-grain weight. The analyzed data for the thousand-grain weight (Table 2) shows highly significant differences among the treatments. The mean data shows that the maximum thousand-grain weight was in 100% poultry manure (406.67 g), while the minimum thousand-grain weight was in control (353.33 g). These results show that the best manure application under the agro-climatic condition of the Hazara University Mansehra is 100% poultry manure. The critical value for comparison of these treatments is (15.70). The maximum grain weight in 100% poultry manure was (406.67 g). According to reports, the importance of organic manures in enhancing crop output is attributable to their constant mineralization,

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which provides all necessary nutrients. According to (Sarwar *et al.*, 2008), applying compost or organic manures to previous harvests preserves 50% of the NPK for wheat while leaving a sizable amount of nutrients for the subsequent crop.

Table 2. Effect of poultry manure on Spikelet's per spike and thousand grains weight (g).

Treatments	Spikelet's per spike	Thousand grains weight (g)
Control	13.66	353.33
30% Poultry Manure	14.66	379.00
50% Poultry Manure	17.66	383.00
100% Poultry Manure	19.66	406.67
LSD	1.15	15.70

Grain yields (kg/ha^{-1})

After threshing, the grains were separated, and the entire bundle was weighed to determine the genotype's grain yield per plot. The data was then converted to kg/ha^{-1}. The data showed in (Table 3) revealed that the use of poultry manure resulted in varying levels of yield improvement. For instance, the highest yield recorded was 4,420 kg/ha^{-1} followed closely by 4,300 kg/ha^{-1}, indicating substantial increases in grain production compared to lower yields of 3,700 kg/ha^{-1} and 3,600 kg/ha^{-1} in plots with reduced or no poultry manure application. Poultry manure improves soil physical qualities like moisture retention and aeration in addition to providing vital nutrients like nitrogen, phosphate, and potassium. These improvements in soil characteristics lead to better plant growth and production results (Ayeni *et al.*, 2010; Adekiya & Agbede, 2009).

Biological yield (kg/ha^{-1})

All the plants in a particular entry were harvested and then weight to determine biological yield plot$^{-1,}$ and then data was converted into kg/ha$^{-1.}$ The use of poultry manure as an organic fertilizer has a notable impact on the biological yield of wheat, offering a sustainable alternative to chemical fertilizers. Biological yield, representing the total biomass produced per unit area, is a critical measure of crop performance and productivity. The data showed in (Table 3) significant differences in biological yield among the treatments. The highest biological yield was 8,085.68 kg/ha^{-1}, followed by 7,754.25 kg/ha^{-1}. In contrast, plots with less or no poultry manure yielded lower biological outputs of 6,667.89 kg/ha^{-1} and 6,585.77 kg/ha^{-1}. These results showed that poultry manure substantially boosts plant growth, likely due to its rich nutrient content, which includes nitrogen, phosphorus, and potassium, essential for plant development (Ayeni *et al.*, 2010).

Table 3. Effect of poultry manure on Grain yields (kg/ha^{-1}) and Biological yield (kg/ha^{-1}).

Treatments	Grain yields (kg/ha^{-1})	Biological yield (kg/ha^{-1})
Control	3600	6,585.77
30% Poultry Manure	3700	6667.89
50% Poultry Manure	4300	7754.25
100% Poultry Manure	4,420	8085.68
LSD	120.00	150.76

Conclusion

The research conducted on the effects of poultry manure on wheat performance in the Mansehra agroecological zone highlights the substantial benefits of using poultry manure as an organic fertilizer. Key findings from the study are that applying poultry manure significantly enhances various growth parameters and yield components of wheat. Specifically, the application of 100% poultry manure resulted in the highest plant height, spike length, spikelets per spike, thousand-grain weight, grain yield, and biological yield compared to control and lower manure application rates. The findings indicate that poultry manure not only provides essential nutrients, such as nitrogen, phosphorus, and potassium but also enhances soil health by improving moisture retention and aeration. This dual benefit of nutrient supply and soil improvement makes poultry manure a sustainable alternative to chemical fertilizers, offering a way to enhance productivity while maintaining ecological balance. For the farmers in the Mansehra region, integrating poultry manure into their farming practices can lead to significant economic and environmental benefits. By increasing yields and improving soil fertility, poultry manure application can contribute to better food security and sustainable agricultural practices. The study recommends using poultry manure at the rate of 680 g/3.48 m² for optimal results, which can lead to substantial improvements in wheat production. Poultry manure is a valuable resource for improving wheat performance and can play a critical role in promoting sustainable agriculture in the Mansehra agroecological zone. Implementing these findings can lead to enhanced crop productivity and support the economic well-being of local farmers.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned.

Consent for publication

Approved

Funding

Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author contribution:

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