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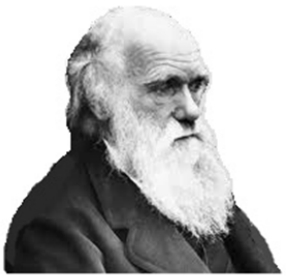

World News of Natural Sciences

An International Scientific Journal

WNOFNS 20 (2018) 23-30 EISSN 2543-5426

Application of different organic manures in optimizing optimum yield for wheat in calcareous soil

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ABSTRACT

A field experiment was conducted during winter season of 2014-2015 at a farm field located in Swabi Khyber Pakhtunkhwa, Pakistan, with the main aim to evaluate the influence of different organic manures on wheat (*Triticum aestivum* L.) production. The experiment was laid out in a randomized complete block design (RCBD), with four replications. The treatments were: T1 (control, no manure), T2 (Cattle manure), T3 (Poultry manure), and T4 (Sheep manure). All the organic manures were applied at the rate of 10 $t \cdot ha^{-1}$. At maturity, plant height (cm), number of grains per spike, grain yield, and biological yield were recorded. Results led to the conclusion that T3 (poultry manure) gave the best results, as compared to other treatments. The values of plant height, biological yield and grain yield were 87 cm, 13.66 $t \cdot ha^{-1}$ and 5.750 $t \cdot ha^{-1}$, respectively, for poultry manure treatment. Results for number of grains per spike and 1000-grain weight were found non-significant in the prevailing soil condition.

***Keywords*:** Organic manures, calcareous soil, wheat, *Triticum aestivum*

1. INTRODUCTION

Wheat (*Triticum aestivum* L) is the most important cereal crop in the world and used as a staple food almost in every part of the world because it is a cheap source of carbohydrate and also contains a significant amount of protein, minerals and vitamins in traces [1]. Due to the rapid growth of world population, an increase in yield of wheat per unit area must be and is

(Received 14 July 2018; Accepted 25 July 2018; Date of Publication 25 July 2018)

paramount. Proper fertilization and use of high yielding varieties of wheat are the important factors which can help in increasing the production of wheat.

The average production of wheat in Pakistan is much lower as compared to other developed countries, and this is because of the improper fertilizer management and given less preference to organic fertilizers [2]. Increased in soil erosion and loss of soil fertility become an alarming issue due to imbalance inorganic fertilizers application and no use of organic fertilizers. Agricultural scientists are engaged in establishing an agricultural system which can lower production cost and conserve the natural resources. Therefore, recent interest in manuring has re-emerged because of high prices of inorganic fertilizers and the importance of green, farmyard and other types of organic manures that provide long term soil productivity, besides meeting nutrient requirements becomes obvious [3]. Organic farming is a production system which provides almost all essential nutrients to crops and improves both the physical and chemical properties of soil [3] and decreased pollution [4]. Pakistani soils are generally low in organic matter content (<1%), because of arid climate resulting in rapid decomposition of organic matter and also because of very little organic matter is added to soils during cultivation. Addition of organic matter and utilization of minerals can increase soil fertility [5] and in combination render greater beneficial effects on plant growth and yield [6].

Due to depletion in soil fertility worldwide there is a growing interest in the use of organic manures. Organic fertilizers, like farmyard manure (FYM), sheep manure, and poultry manure may be utilized for crop production as a substitute of chemical fertilizers because the importance of organic manures cannot be ignored [3]. On the other hand, continuous application of chemical fertilizers to soil creates soil health problems even when applied at balanced proportion [2] production of chemical fertilizers consumes a large amount of energy and money and also creates polluting effects in the environment, hence an organic farming approach with or without chemical fertilizers seems to be the best possible solution for these problems. An organic material added to the soil improves soil characteristics and nutrient supply to the crops variably [7] as well as increasing organic matter contents in the soil and improving the soil texture [4]. The organic or natural manure has many attributes. It supplies a wide variety of nutrients which in turn increased fertility of soil and its application also found environmental friendly. The positive interaction between organic manures and NPK fertilizers has also been reported [8]. However, in the long term use, organic manures hold a great promise for improving soil characteristics [9]. The application of organic manures in wheat cropland is an alternative method to reduce environmental pollution threats [3] and also used to achieve an integrated farming system [6]. Therefore in developed countries, farmers are being encouraged to convert their existing farms into organic farms [7] and the potential hazards of chemical fertilizers were identified [3]. Keeping in mind all the above facts, the present study was organized to evaluate the effect of different organic fertilizers on wheat crop production in highly calcareous soil of Swabi, Pakistan.

2. MATERIALS AND METHODS

In order to evaluate the influence of different organic manures on wheat crop, a field experiment was conducted during winter season of 2014-2015 at farmer field located in Swabi Khyber Pakhtunkhwa Pakistan. Different organic manures like cattle manure, poultry manure and sheep manure were utilized in the experiment.

2. 1. Treatments and Experimental design

The experiment consists of four treatments: T1 = Control, T2 = Cattle manure, T3 = Poultry manure and T4 = Sheep manure. All the treatments were arranged in RCB design with four replications of each treatment. Each treatment size was 20 m^2. All the treatments were applied at the rate of 10 $t \cdot ha^{-1}$. The wheat variety ATTA-HABIB-2010 was used as the test crop during the experiment and was sown with a seed rate of 120 kg seed ha^{-1}, and maintained row to row distance of 30 cm. The crop was irrigated at continuous intervals according to the need of crop and the weeds which emerged during crop growth were manually pulled from whole of the experimental area. All other agronomic practices were adopted as per recommendation. The data, regarding growth parameters like plant height (cm), number of grains per spike were collected at crop maturity stage and yield parameters like 1000 grain weight grain yield and biological yield ($t \cdot ha^{-1}$) were collected after harvesting the crop.

Before the experiment, a composite soil sample was also collected from 0-15 cm depth and analyzed for various physico-chemical properties by the methods used by [10]. The under study soil was found silty clay loam in texture, alkaline in reaction, having pH value of 8.7, EC 1.5, highly calcareous in nature ($CaCO_3$ = 17.8), low in organic matter content (0.91). The soil was also found poor in available phosphorous, however the concentration of potash was found optimum for the crop growth (**Table 1**). Organic manures were also subjected to nutrient analysis, with the results presented in **Table 2**.

3. STATISTICAL ANALYSIS

The collected data were statistical analyzed by conducted ANOVA technique and RCB design for the experiment using Statistix 8.1 software. After that LSD test of significance was used to compare the treatment differences at 5% level of probability.

Table 1. Soil physico-chemical properties (0-15 cm depth)

Property	Unit	Value
Clay	%	25
Silt	…….	47.8
Sand	…….	28
Textural class	……	Silty clay loam
pH (1:5)		8.7
EC	dsm^{-1}	1.5
Organic matter	….%.....	0.91
Lime ($CaCO_3$)	……..	17.8
AB-DTPA P	$mg \cdot kg^{-1}$	5.32
AB-DTPA K	……..	160

Table 2. Chemical properties and nutrient analysis of organic manures used in the study.

Property	pH (1:5)	EC (dsm^{-1})	Nitrogen (%)	Phosphorous (%)	Potash (%)
Cattle manure	7.77	2.05	1.15	0.52	0.87
Poultry manure	7.46	13.51	1.82	4.12	1.23
Sheep manure	8.05	5.26	1.56	2.2	1.33

4. RESULT AND DISCUSSION

Results with relevant discussion on the impact of various organic manures on yield and yield components of wheat crop are presented below.

4. 1. Plant Height (cm)

Plant height was significantly increased with application of organic manures; maximum plant height of 87.0 cm was recorded at T3 receiving poultry manure at 10 $t{\cdot}ha^{-1}$ closely followed T4 in which plant height was increased up to 83.05 cm (**Table 3**). T3 was found significantly different from T1, T2, and T4 in the plant height, however no significant difference was found between T2 and T4 for this trait (Table 3). Poultry manure increased the plant height by 11.6% as compared with control treatment (no application of organic fertilizers). Our result was in line with published literature; many investigators reported increase in the wheat plant height with application of organic manures [11, 12]. Similarly, the significant effect of organic fertilizers on the plant growth was also reported by [6, 13]. Significant increase in the plant height of spring wheat by application of FYM was also reported by [14]. Application of vermi-compost at 3.8 $t{\cdot}ha^{-1}{}_{+}$ poultry manure 2.45 $t{\cdot}ha^{-1}$ recorded significantly higher plant height (86.30 cm) [15].

4. 2. Number of Grains per Spike

Data for the number of grains per spike for all the treatments were found statistically similar, however, the maximum number of grains at 55 was recorded in T2, followed by T3 (Table 3), the overall effect of all treatments on number of grains per spike was found non-significant. Many published literature reported that organic fertilizers had a significant effect on the number of grains per spike [16, 17]. However, in our study the result of number of grains per spike was found non-significant.

4. 3. 1000-Grain weight

Similar to the number of grains per spike the 1000-grain weight of wheat was also not significantly affected by different applied organic manure, the maximum 1000-grain weight of 45.612 g was produced by T4, followed by T3 with 44.450 g of 1000-grain weight (Table 3). Our result was in disagreement of [2, 16]; they found a significant increase in 1000-grain weight of weight with the application of organic fertilizers. These non-significant results for 1000-

grain weight and the number of grains per spike might be due to the short term experiment (only for one growing season).

4. 4. Biological yield (t·ha^{-1})

Statistical analysis of the data revealed that the applied organic manures significantly improved biological yield of wheat crop. Maximum biological yield of 13.66 t·ha^{-1} was observed in T3 treatment, receiving 10 t·ha^{-1} poultry manure followed by T4 with 10.99 t·ha^{-1} biological yield with the application of 10 t·ha^{-1} sheep manure (Table 3 and Figure 1).

The highest biological yield in T3 might be due to the fact that poultry manure directly supplies the essential nutrients, like NPK more than other fertilizer source. It has been reported that the role of organic manures in improving crop yield is attributed to the supply of all essential nutrients due to their continuous mineralization [3].

Application of organic manure leaves a considerable amount of nutrients for the succeeding wheat and economizes 25% inorganic NPK for both, the crops [18] and 50% NPK for wheat [11]. Though the poultry manure had a large portion of nitrogen in organic fraction, yet 20-40% nitrogen is present in inorganic form, which enhances the crop production and it might be the strong reason that poultry manure performed better than other applied organic manures [3]. Our result was in line with the published literature; many investigators reported a significant effect of organic manures on the wheat crop production [19, 17]. Similarly the dominant effect of poultry manure on wheat biological yield was also reported by [20]. In another study, maximum biological yield (22.2 t·ha^{-1}) of maize was obtained with application of 12 t·ha^{-1} poultry manure [21]. Organic manures supply direct available nutrients, such as nitrogen to the plant and improve the proportion of water stable aggregates of the soil [6].

4. 5. Grain Yield (t·ha^{-1})

Table 3 clearly showed that the maximum wheat grain yield (5.750 t·ha^{-1}) was recorded at T3, followed by T4 with 4.850 t·ha^{-1}. However, T3 had a significant difference from all other treatments (Table 3). Maximum grain yield in the poultry manure treatment might be due to and optimum concentration of nitrogen in poultry manure (Table 2). Crop yields and nutrients availability were found higher in the poultry manure than FYM, indicating that poultry manure was found more effective in producing crop yield and providing nutrients, thus enhancing the grain yield [20].

Our result was in line with [22], reported maximum grain yield of wheat with application of organic fertilizers. The higher yield may be due to the fact that these organic manures supply direct available nutrients, such as nitrogen to the plants, and these organic manures improve the proportion of water stable aggregates of the soil [6]. Similarly [23] also reported that the poultry manure significantly increased the grain yield.

4. 6. Harvest Index (%)

Data regarding the harvest index exhibited significant difference between T1 and T3, and also between T1 and T4, however T3 and T4 were found statistically similar one to each other. The highest value of harvest index was 49.73% from T1, and the lowest value was 42% from T3 (Table 3).

Table 3. Effect of different manures on yield and yield component of wheat

Treatments	Plant height (cm)	No. of grains Spike^{-1}	1000-grain weight (g)	Biological yield (t·ha^{-1})	Grain yield (t·ha^{-1})	Harvest Index %
T1	77.90 c	50.00 a	45.372 a	8.991 a	4.472 a	49.73 a
T2	80.45 bc	55.00 a	43.560 a	9.791 a	4.750 a	48.51 a
T3	87.0 a	54.00 a	44.450 a	13.66 b	5.750 b	42.00 b
T4	83.05 b	48.00 a	45.612 a	10.99 c	4.850 a	44.13 bc

Means of each category followed by the same latters are not significantly different at 5% level of probabilities, and means of each category followed by different latters are significantly different at 5% level of probabilities.

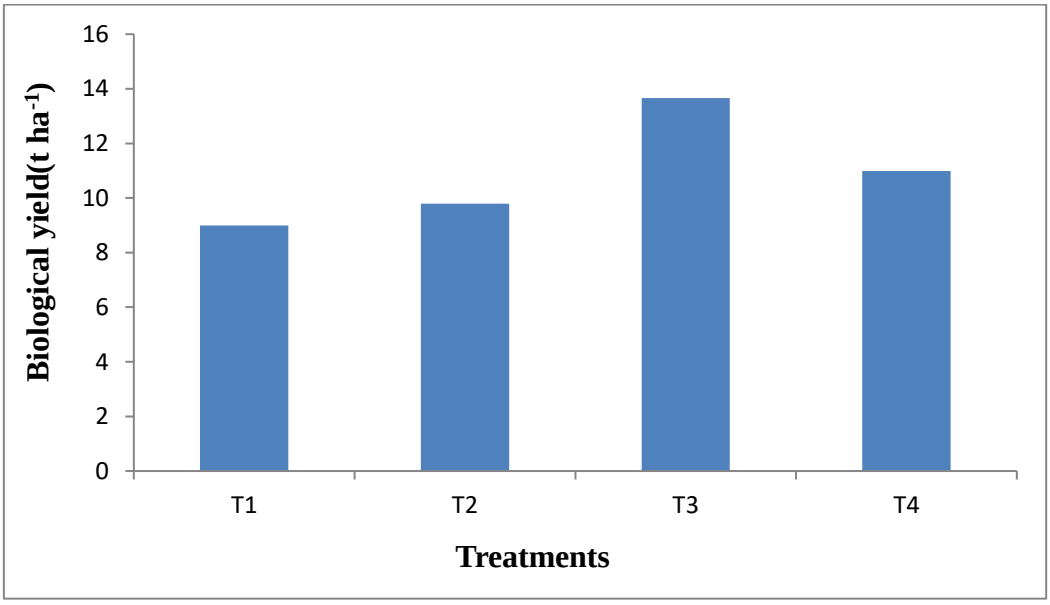

Figure 1. Effect of different organic manures on biological yield of wheat crop

5. CONCLUSIONS

It was concluded from the study that the poultry manure is the most effective manure among all the manures used, moreover poultry manure had a dominant and positive effect on biological and grain yield of wheat crop as compared to other treatments used. Organic manure is a cheap and easily available source of nutrients for most of the agriculture crops, however the slow release of nitrogen from manure and building of P and K in the soil solution, may cause the potential environmental implications.

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