*INT. J. BIOL. BIOTECH.*, 10 (4): 577-580, 2013.

# COMPARATIVE EFFICIENCY OF ORGANIC AND INORGANIC FERTILIZERS ON GROWTH AND YIELD OF WHEAT IN RAINFED CONDITIONS

**Muhammad Ali Khan*, M.R.Chattha, M. Z. Awan, A.S.Anjum, M. Imran, Sher Muhammad, Sikander Khan and M. Imran Kasana**

*National Institute of Organic Agriculture, NARC, Park Road, Islamabad, Pakistan*
*Corresponding author's email: alikhan.fos@gmail.com

## ABSTRACT

A field research was undertaken to evaluate the comparative efficiency of farmyard manure and chemical fertilizers (NPK) levels with or without farmyard manure on the growth, grain yield and germination count of wheat (Triticum aestivum L. Chakwal-50) The experiment was laid out under Randomized Complete Block Design (RCBD) with 5 replications at Bhone Research Station Chakwal during 2011- 2012. . The soil of the experiment site was clay, alkine, calcareous in nature with low fertility and deficient in available phosphorus. Single super phosphate as N @ 100 Kg/ha, P source @ 75Kg/ha, and Recommended dose of K @ 75 kg/ha. was applied to all the treatments at the time of sowing except control treatment. Because of different combinations of fertilizers NPK and FYM, statistically significant differences in grain yield and yield components of wheat were recorded. Maximum grain yield of 5334 Kg/ha$^{-1}$ was recorded with the application of full fertilizer and FYM. Minimum grain yield 2680 Kg/ha$^{-1}$ was obtained with no fertilizer control treatment.

**Keywords:** Farm yard manure, inorganic fertilizer, wheat, yield and yield components

## INTRODUCTION

Wheat is major food crop of Pakistan. Of the total cultivated area about 1043 million hectare is under rainfed conditions, where benefits of chemical fertilizers are linked with timely rainfall. Organic farming is a production system which avoids or excludes the use of synthetic or inorganic fertilizers, pesticides and growth regulators. Among various yield determining factors, soil fertility is of prime importance. Our soils ate generally low in fertility due to continue cropping, inadequate use of organic and mineral fertilizers. According to Chaudhry and Thakur (2007), soil fertility is a vital component of technology package for increasing crop production. In order to ensure better crop production, efforts are needed to maintain soil fertility through the use of either organic matter or inorganic material. No doubt, mineral fertilizers easy to handle and produce quick results but their non-judicious use cause ill effects to both environments and human beings. It is convenient to provide organic manure to replace the inorganic material partly or completely. It is therefore, important to promote economically viable and environment friendly inventions for sustainable agriculture. FYM is considered good source of organic matter and plant nutrients and when incorporated into the soil (Fan *et a*l., 2005; Akhtar *et al*., 2011). Addition of FYM and inorganic fertilizers to soil has been reported to increase the efficiency of applied fertilizers (Ahmad *et al*., 1998). Residual effects of FYM or green manure plus 100% recommended dose of NPK significantly increased the yield of wheat over 100% recommended dose of NPK. Addition of green manure or FYM resulted in higher removal of nutrients by the crops as compared to chemical fertilizers and built up of soil N, P, K, Zn and organic carbon while reduced the soil Ph (Sharma *et al*., 2001) concluded that productive tillers m$^{-2}$, 1000-grain weight and grain yield were significantly increased over control when 600 Kg ha$^{-1}$ FYM was applied with 120-60-60 Kg ha$^{-1}$ NPK. They also found that DAP premixed with FYM gave the highest value cost ratio of 2.64. Jan and Noor (2007) indicated that significantly increased higher No. of productive tillers m$^{-2}$, grains spike$^{-1}$ and grain yield were recorded with application of 30 Kg FYM ha$^{-1}$ and 90 Kg N Ha$^{-1}$ Akhtar et al. (2011) observed 473 and 475 productive tillers m-$^{2}$ with the application of 25 ton ha$^{-1}$ FYM+ 150- 100- 50 Ha$^{-1}$ NPK during 2006-07 and 2007- 08, respectively. Ibrahim *et al*. (2008) concluded that plant height m$^{-2}$, 1000-grain weight and grain yield were improved with the integrated use of organic and inorganic fertilizers. Optimal production requires sustainable cultural practices including proper fertility management. Hence, a field experiment was conducted to investigate the influence of FYM and different doses of NPK on various growth and yield parameters of wheat.

## MATERIALS AND METHODS

A field experiment was conducted at Bhone Research Station Chakwal, Punjab, Pakistan during 2011- 2012.to determine the effects of FYM in combination with different doses of phosphatic fertilizer on the growth and yield of wheat variety Chakwak-50. The experiment was laid according to randomized complete block design (RCBD) with

three replications. Plot size measured as 6m X 8.5m. The Treatments were T1 = Control (no NPK or FYM); T2 = (FYM @ 10 tonnes/ha), T3 = (NPK @ 100, 75, 75 Kg/ha), T4 = Full NPK + 10 tonnes/ha, T5 = ½ NPK + 10 tonnes/ha, T6 = 1/3 NPK + 10 tonnes/ha. Well decomposed 10 tonnes FYM was premixed according to the treatments and incorporated into the soil at the time of seed bed preparation. Nitrogen and potassium were as urea and sulphate of potash, respectively. Full P, K and half of N were applied at the time of sowing while remaining N with first irrigation. Soil texture of the experimental site was clay loam and the chemical analysis of the soil was presented in Table 1. The row to row spacing was maintained as 25 cm using seed rate of 125 Kg $ha^{-1.}$

All the agronomic practices and plant protection measures were kept uniform for all the treatments. Plant height (cm) was noted for twelve plants from each plot. Productive tillers were determined from an area of one square meter marked randomly at three different locations in each plot. Number of grains $spike^{-1}$ was noted from twelve tillers at random from each plot. The 1000-grain weight was taken by three samples from each plot. The grain yield was recorded from an area of one square meter harvested from three different places in each plot and converted in Kg $ha^{-1}$. The data was carried out using STATISTICS software and the differences among the treatments means were compared by the least significant differences (LSD) test at 5% probability level (Gomez and Gomez, 1984)

## RESULTS AND DISCUSSION

### Seed germination

Wheat seed germination was 20% higher after 24 hours with farmyard manure. NPK alone showed the same effect after 48 hours. Dual combinations of both fertilizers also had similar effect. However integrated use of organic and inorganic fertilizers together improved wheat seed germination by 40% when compared to unfertilized control (Table 2). Similar results were showed that seed germination were improved with biofertilizers in maize by 25% after 24 hours of inoculation (Khokhar *et al.*, 2006). Effect on seed germination can be related with the uptake of nutrients production by the fertilizers.

### Growth and Yield

All the fertilized treatments increased plant height, number of tillers, grains / spike, 1000-grain weight and grain yield indices as compared to control. Though organic and inorganic combined treatments differed among themselves in different indices, yet comparable to when full NPK applied.

### Plant height

The data regarding plant height (Table 4) indicated that FYM in combination with different doses of NPK fertilizer did not significantly influence plant height. However, maximum plant height of 25.23 cm was observed in the plots receiving combination of FYM and recommended NPK and all the other treatments showed non significant differences in plant height.

### Number of productive tillers $m^{-2}$

Farmyard manure in combination with different doses of phosphatic fertilizer significantly increased the productive tillers $m^{-2}$ during the study year (Table 4). The data showed that maximum increase in productive tillers 335.20 were recorded by the application of FYM + Full NPK treatment and it was followed by 320.87 with the application of farmyard manure + ½ NPK treatment respectively. Dixit and Gupta (2000) also concluded that crop growth may be improved by the use of organic materials. Previously it was studied that FYM enhanced nutrient use efficiency by slow releasing of nutrients and reducing their losses (Muneshwar et al., 2001) the results were also in accordance with Jan and Noor (2007) and Akhtar *et al*. (2011)

### Number of grains spike-$^{1}$

Results revealed that numbers of grains $spike^{-1}$ were affected significantly by the use of FYM in combination with different doses of chemical fertilizer (Table 4). The data depicted that maximum number of grains $spike^{-1}$ 43.77 were observed with FYM + recommended NPK while other treatments showed non significant differences among themselves and the minimum 32.24 grains $spike^{-1}$ were obtained from the control plots. The effect of mineral NPK with 10 ton /$ha^{-1}$ FYM was distinctive when compared with other NPK treatments with or without FYM. A similar pattern was also registered with respect to number of productive tillers. The increase in grains per spike as well as number of productive tillers and 1000-grain weight due to adequate fertilizer nutrition in terms of possible increase in nutrient mining capacity of plant as a result of better root development and increased translocation of carbohydrates from source to growing points in well-fertilized plots (Sing and Agrawal, 2001).

Table 1. Soil characteristics of experimental site.

| Characteristics | Value |
|---|---|
| Organic matter (%) | 0.57 |
| Total nitrogen (%) | 0.043 |
| Available phosphorus (ppm) | 1.68 |
| Available potassium (ppm) | 144 |
| pH | 8.52 |
| ECe (dS $m^{-1}$) | 1.91 |
| Soil texture class | Clay loam |

Table 2. Effect of organic and inorganic fertilizers on wheat seed (CH-50) germination (percent).

| Treatments | Day 1 | Day 2 | Day 3 |
|---|---|---|---|
| $T_1$ = Control | 40 | 60 | 80 |
| $T_2$ = Farm yard manure | 60 | 80 | 100 |
| $T_3$ = Recommended NPK | 60 | 80 | 100 |
| $T_4$ = Recommended NPK + FYM | 80 | 80 | 100 |
| $T_5$ = ½ NPK + FYM | 60 | 80 | 100 |
| $T_6$ = ⅓ NPK + FYM | 60 | 80 | 100 |

Table 3. Chemical analysis of FYM used in the experiment.

| Characteristics | Value |
|---|---|
| Nitrogen (%) | 0.598 |
| Phosphorus (%) | 0.219 |
| Potassium (%) | 0.617 |

Table 4. Effect of FYM with different doses of NPK on growth and yield of wheat (CH-50).

| Treatments | Plant Height (cm) | Productive tillers ($m^{-2}$) | Grains $spike^{-1}$ | 1000 grain weight (g) | Grain yield ($kg/ha^{-1}$) |
|---|---|---|---|---|---|
| T1 = Control | 62.20 | 200.20e | 32.24d | 28.66d | 2680.3d |
| T2 = Farm yard manure | 64.30 | 276.63d | 34.12d | 33.24c | 4319c |
| T3 = Recommended NPK | 65.70 | 307.63c | 36.22c | 34.67bc | 4587b |
| T4 = Recommended NPK + FYM | 67.50 | 335.20a | 43.77a | 37.49a | 5334.0a |
| T5 = ½ NPK + FYM | 66.70 | 320.87b | 41.63b | 35.59ab | 4642.0b |
| T6 = ⅓ NPK + FYM | 66.20 | 310.90c | 40.40b | 35.24b | 4520.3bc |
| LSD(0.05) | NS | 7.45 | 2.073 | 1.942 | 203.08 |

**1000-grain weight**

Significant differences were observed in 1000-graim weight with the application of FYM in combination with different doses of chemical fertilizer. It was observed that maximum 1000-grain weight of 37.49 g was produced where FYM + Full NPK were applied and it was followed by 35.59 g was observed with the application of FYM + ½ NPK were applied. It was studied that triplicate combination of diazotrophs with phosphorus – solublizing bacteria produced 1000-grain weight equal to recommended NPK in Maize (Khokhar *et al*., 2006). Improvement in crop yield and nutrient accumulation with biofertilizers has been reported by various workers (Hammouda *et al*.,

2001; Samad *et al.*, 2002). The present results indicate that organic and inorganic fertilizers in relation to metabolic transport needs to be studied more intensively.

**Grain yield**

Data regarding grain yield /ha is presented in Table (4) .The differences in grain yield with the application of FYM in combination with different doses of phosphatic fertilizer were significantly higher grain yield over control. Data showed that maximum grain yield of 5334 Kg/ha$^{-1}$ was recorded with FYM + recommended NPK Treatment 4, which was followed by 4642 Kg/ha$^{-1}$ was obtained with the application of FYM + 1/3 NPK and 4520 was recorded with FYM treatment against the minimum grain yield of 2680 Kg/ha$^{-1}$ with control Treatment respectively. Reddy *et al*. (2005) reported higheanr yield and maximum uptake of phosphorus when FYM was pre-mixed with phosphatic fertilizers. Yadav *et al*. (2002) recorded higher yield in plots applied with enhanced rates of NPK fertilizer than recommended dose with FYM. The results were in line with the findings of Fan *et al*. (2005) and Chaudhary and Thakur (2007)

**Conclusion**

It was concluded that application of FYM and NPK fertilizer improve the growth and yield of wheat. FYM (80 kg/ha$^{-1}$) and NPK gave the maximum yield. FYM @ 80 kg/ha$^{-1}$ is highest and recommended for wheat production under rain-fed conditions.

**REFERENCES**

Ahmad, S. S.Y. Naz and M.R. Raja (1998). Effect of farm yard manure, crop residues and mineral fertilizers on wheat yield under rain fed conditions. *Pak. Soil Sci*., 14: 111-114.

Akhtar N. A. Ali, Z. Ali, J. Iqbal, M.A. Nadeem and A. Sattar (2011). Effect of integrated use of organic manures and inorganic fertilizers on grain yield of wheat. *J. Agri. Res*., 49: 181-186.

Chaudhary, S.K. and R.B. Thakur (2007). Efficient farm yard manure management for sustained productivity of rice-wheat cropping system. *Ind. J. Agri. Sci*., 77: 443-444.

Dixit, K.G. and B.R. Gupta (2000). Effect of FYM, chemical and biofertilizers on yield and quality of rice (*Oriza sativa* L.) and soil properties. *J. Ind. Soc. Soil Sci*., 48: 773-780.

Fan, T., W. Yong, J. Luo and Y. Gao (2005). Long term fertilizer and water availability effect on cereal yield and soil chemical properties in North West China. *Soil Sci. Soc. Am. J.*, 69: 842-855.

Hammouda , F.M. K.A. Faiza and M.N. Dawalat (2001). The potential improvement of some different biofertilizers on rice crop and their residual effect on succeeding wheat crop. *J. Agric. Sci. Mansoura Univ*., 2: 1021-1030.

Ibrahim M., A.U. Hassan , M. Iqbal and E.E Valeem (2008). Response of wheat growth and yield to various levels of compost and organic manure. *Pak. J. Bot*., 40: 235-2141.

Jan, A. and M. Noor (2007). Response of wheat to farm yard manure and nitrogen under rainfed conditions . *African Crop . Sci. Conf. Proc*., 8: 37040.

Khokhar, S, N. M. A. Khan, A. Afzal and R. Ahmed (2006). Interaction of Diazotrophs with Phosphorus Solublizing bacteria: their effect on seed germination, growth and yield of maize, under rainfed conditions. *Int. J. Biol. Biotech*., 3(4): 773-777.

Muneshwar, S., V.P. Sing, K.S. Reddy and M. Sing (2001). Effect of integrated use of fertilizer nitrogen and farm yard manure or green manure on transformation of N, K and S and productivity of rice-wheat system on a vertisol. *J. Ind. Soc. Soil Sci*., 49: 430-435.

Reddy, S.S., B. Shivaaj, V. C. Reddy and M.G. Ananda (2005). Direct effect of fertilizer and residual effect of organic manure on yield and nutrient uptake of maize (*Zea mays* L.) in groundnut-maize cropping system. *Crop Res. Hsiao*., 29: 390-395.

Samad, M. A., C.A. Meisner, A. Rehman, M. Rehman, J.M. Duxbury and J.G. Lauren (2002). Wheat root growth in Phosphorus Depleted Soils. Pp: 14-21. 17$^{th}$ WCSS, Thiland.

Sharma, M.P., S.V. Bali and D.K. Gupta (2001). Soil fertility of rice-wheat cropping system in an Inceptisol as influenced by integrated nutrient management. *J. Ind, Soc, Soil Sci*., 71: 82-86.

Sing, R. and S.K. Agrawal (2001). Analysis of growth and productivity of wheat in relation to levels of FYM and nitrogen. *Indian J. PL. Physiol*., 6: 279-83.

Yaav, R.L., S.S. Tomar and U.C. Sharma (2002). Output-input ratios and apparent balances of N, P and K inputs on a rice-wheat system in North West India. *Exp. Agri*.., 38: 457-68.

(*Accepted for publication September 2013*)