Cercetări Agronomice în Moldova
Vol. XLVI , No. 1 (153) / 2013

ROLE OF ORGANIC AND INORGANIC NUTRIENT SOURCES IN IMPROVING WHEAT CROP PRODUCTION

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Received November 1, 2012

ABSTRACT. Effects of organic manures on grain yield and yield components of wheat (*Triticum aestivum* L.) cultivar Minthar-03 were studied at (RARI) Regional Agricultural Research Institute Bahawalpur, Pakistan, during 2010-2011 seasons in chemistry division. The present study have six treatments i.e. control, NPK=150-120-60 kg/ha, control, NPK= 150-120-60 kg/acre, NPK+ poultry manure 50 kg /acre, NPK + press mud 500 kg/acre, NPK + city compost 300 kg/acre, NPK + humic acid 4 kg/acre. Combinations of NPK + PM 50 kg/ha having high plant height (102.53) while number of (343) tillers/m^2 was obtained high in combination with NPK + city compost 300 kg/ha which was at par with combination (NPK + press mud 500 kg/acre) having plant height 100.90. spike length, number of grains /spike, 1000 grains weight, grain yield t/ha was 13.35 cm, 61.85, 40.60 grams and 3.14 t/ha respectively obtained in treatment (NPK + press mud 500 kg/acre). While minimum amount of plant height (94.80), number of tillers/m^2 (223), spike length (10.35 cm), number of grains/spike (43.43), 1000 grains weight (35.33g), grain yield t/ha (38.41) was found in control where no dose of organic and inorganic fertilizer were applied.

Key words: Wheat; Organic nutrients; Humic acid; Press mud; City compost.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a staple food for more than one third of the world population (Anonymous, 2007-08). Cereal crops contribute about 80% to the total food coming from plants. Wheat contributes largest part among all cereals. Wheat is cultivated in 27 countries of the world (Stubbs *et al.*, 1986). Pakistan is 8th largest wheat grower country. It is the most important agricultural commodity of Pakistan and plays a vital role in country's economy. It contributes about 14.4% to the total crop sector value added and 3.1% to the gross domestic production of Pakistan (Anonymous, 2010). It provides raw material for many

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industries and is also used in synthesis of many byproducts. Southern Punjab contributes about 44% of the total wheat production of the Province (Ahmad *et al.,* 2005). With rapidly increasing population, the demand of food is increasing, so there is great need to increase the productivity of wheat. But Pakistan in facing a yield gap of 72% between the potential and average per hectare yield (Anonymous, 1996). Nutrient deficiency, late sowing, weeds, water scarcity and imbalance fertilization are critical factors reducing the yield of wheat (Khan *et al*., 2010). Imbalanced use of macronutrient fertilizers, reduced use of organic matter, reduced recycling of crop residues and continuous cropping in the past three decades have induced secondary and micronutrient deficiencies in the IGP (Indo-Gangetic Plains) which resulted in reduced yield (Nayyar *et al.*, 2001)

To fulfill the demand of food, sustainable and high yielding crops have been grown which resulted in application of commercial inorganic fertilizers in larger amounts in the soils specially in case of the nitrogen fertilizers. These practices are not only the threats for environmental quality but also pollute the surface and sub-surface water reserves by leaching down into the soil (Avnimelech and Raveh, 1976; Baker and Johnson, 1981). Continuous application of chemical fertilizers causes soil health problems even if applied in balanced proportion (Zia *et al*., 2000). Solid wastes generated from living organisms is said to be organic material. It generally comprised of of yard trimmings, food scraps, wood waste, and paper products and human, animals and birds wastes. On decomposition it turns into organic matter comprising of humus and humic acid. Recycling of organic material can be beneficial for human health, land, air, and water. Waste reduction and recycling prevents greenhouse gases (GHG) emissions, reduces pollutants, saves energy, conserves resources, and reduces the need for new disposal facilities. It has been established that organic material improves soil health and phyto-availability of the nutrients by increasing organic matter contents in the soil and improving the soil texture (Ibrahim *et al*., 1992; Alam *et al.,* 2003). Organic materials are present as farm waste, city waste, poultry litter and industrial wastes (food, sugar, cotton and rice industry). In Pakistan there is no proper waste collection and disposal system. So, these wastes are polluting the environment badly (Economic Survey, 2006). Only the solution is to use these materials for agricultural lands. But organic nutrients alone could not be a perfect substitute for chemical fertilizers as these are not as much quick nutrient supplier as chemical fertilizers, so integrated use of organic nutrients along with chemical fertilizer has proved more beneficial (Nasir and Qureshi, 1999; Khanam *et al*., 2001; Alam *et al*., 2005). Integrated approach increases the crop yields but also sustains the

agricultural productivity, helps in water use, improve plant growth and recover soil health. Beside this, a large amount of wastes material generated in cities, towns and villages of Pakistan, polluting the atmosphere badly. By using this material along with chemical fertilizers not only reduces atmospheric pollution but also enhances soil fertility and crop productivity (Shah *et al*., 2010)

Keeping in view the above mentioned facts, an experiment was carried out to investigate the effect of organic nutrients (poultry manure, press mud, city compost and humic acid) along with recommended NPK on soil health and yield components of wheat with following objectives:

- to study the influence of organic nutrient sources on yield of wheat;

- to compare the effect of various organic and inorganic nutrient sources on crop yield.

MATERIALS AND METHODS

The following study was proposed on RARI (Regional Agricultural Research Institute), Bahawalpur, Pakistan, during 2010-11 in soil chemistry division. The experiment was comprised of **(**RCBD) randomized complete block design having three replications with net plot size 16 ft x 28 ft. A wheat cultivar name Manthar 03 was grown having seed rate 150 kg/ha. 1/3 N applied at the time of sowing; remaining as applied in split doses while all organic doses were applied at the time of sowing. Full dose of K and P are also applied at the time of sowing. First irrigation was given after fifteen days of sowing while other was applied as crop needed. Weeds were controlled by hand pulling and hoeing. Experiment has six treatments i.e. control, NPK=150-120-60 kg/acre, NPK+ poultry manure 50 kg /acre, NPK + press mud 500 kg/acre, NPK + city compost 300 kg/acre, NPK + humic acid 4 kg/acre. NPK fertilizer is same for all treatments except T1 control where on dose of fertilizer and organic matter is not used. The combinations are made to check the accessibility of nutrients. Soil physico-chemical analysis report was presented in *Table 1*. However amount of NPK absorbed from different organic sources is different (Dong *et al*., 2006). Recommended NPK fertilizer dose (NPK=150-120-60 kg/ha, respectively) was also used separately to compare organic farming with inorganic fertilizer. Soil as well as organic manures from the experimental area were taken at the beginning of experiment and were analyzed for NPK. For growth and yield parameters standard procedures were applied. Plant population was counted in m^{-2} of an area by using quadrate on randomly selected three sites. Number of fertile tillers was counted at maturity from randomly selected three sites (m^{-2}) and average was obtained. For plant height ten plants were selected randomly from each unit at maturity and plant height was measured from base of the plant to tip of spike with a meter stick and average plant height was computed. Ten mature spikes were selected at random from each plot and number of grains per spike was recorded and then average was computed. Similarly 1000-grains of every plot were counted by using seed counter (108 Count-A-Pak) and weighed on an electric balance. Data collected on different crop characteristics were analyzed statistically by using Statistic 8.01 programme and the differences among treatment means were compared by using the least significant difference (LSD) test at 5% probability level (Steel *et al.,* 1997).

Table 1 - Range and average values of physico-chemical properties of experimental sites soil samples (0. 00-15 cm)

S. No	Physico-chemical properties		
		Range	Average
1	Soil pH	7.51-8.20	7.77
2	Soil EC (dS m^{-1})	1.78-16.70	4.22
3	Organic matter, %	0.36-1.22	0.86
4	Lime, %	4.33-10.33	7.30
5	Sand, %	12.25-54.67	26.54
6	Silt, %	32.00-61.00	44.96
7	Clay, %	21.00-36.50	28.50

Table 2 - Plant height, tillers/m^2, spike length, no. of grains/spike, 1000 grain weight and grain yield t/ha is affected by different organic matter application.

Treatments kg/acre	Plant height (cm)	Tillers /m^2	Spike length (cm)	No. of grains/spike	1000 Grain weight (grams)	Grain yield (t/ha)
T1 (Control)	94.80 C	223 D	10.35 C	43.43 B	35.33 C	2.39 F
T2 (NPK=150-120-60)	101.20 AB	307 C	13.20 AB	60.20 A	38.21 B	2.89 C
T3(NPK+Poultry manure 50)	102.53 A	321 B	12.35 B	61.66 A	39.31 AB	2.60 D
T4 (NPK+Press mud 500)	100.90 A	341 A	13.35 A	61.85 A	40.60 A	3.14 A
T5 (NPK+City compost 300)	97.33 BC	343 A	13.65 A	60.90 A	40.41 A	2.97 B
T6 (NPK+ Humic acid 4)	100.93 AB	311 B	13.20 AB	60.06 A	38.41 B	2.76 D
LSD	4.16	19.81	0.99	1.90	1.59	0.08

LSD: Least significant difference

RESULTS AND DISCUSSION

Plant height

Results regarding plant height showed that maximum plant height (102.53 cm) was observed in T_3 (*Table 2),* where NPK recommended dose along with poultry manure 50 kg /acre is used, which is parallel the treatment T_4 which is (recommended dose of NPK along with 500 kg press mud) used having plant height 100.90. T6 (NPK+ humic acid 4 kg/ acre) statistically at par with the treatment T_2 (NPK= 150-120-60 kg/acre) having plant height 100.93 and 101.20, respectively. Minimum plant height was observed in T_1 (control) having plant height 94.80 cm. Plant height can be improved using organic and inorganic combinations (Delden, 2001).

Tillers /m^2

Number of tillers/m^2 shown in *Table 2*. Data regarding number of tillers per plant in m^2 reflect that maximum number of tillers per plant (343) was observed in T5 (recommended dose of NPK + city compost 300 kg/acre) which was at par with the treatment T4 (recommended dose of NPK + press mud 500 kg /acre) having 341 number of tillers per m^2 which was followed by the treatment T3 (NPK + poultry manure 50 kg/acre) having 321 number of tillers/ m^2. Minimum number of tillers/m2 was observed in T1 (control) have 223 number of tillers/m^2 . These findings are similar with the findings of Akhtar (1990).

Spike length (cm)

Data regarding spike length was presented in *Table 2*. Maximum spike length 13.65 cm was observed in T5 (recommended dose of NPK + city compost 300 kg/acre) which was statistically at par with the treatment T4 (recommended dose of NPK + press mud 500 kg /acre) having spike length (13.35) which was followed by the treatment T6 (NPK+ humic acid 4 kg/acre) and T2 (NPK=150-120-60) having spike length 13.20. Minimum spike length (10.35) was observed in T1 (control). These results are similar with the findings of Reddy *et al*. (2005).

No. of grains/spike

Data regarding number of grains/ spike was shown in *Table 2*. Maximum numbers of grains/ spike was observed in T4 (recommended dose of NPK + press mud 500 kg /acre) which was statistically at par with the treatments T3 (NPK + poultry manure 50 kg/acre), T5 (recommended dose of NPK + city compost 300 kg/acre), T2 (NPK=150-120-60), T6 (NPK+ humic acid 4 kg/ acre) having 61.66, 60.90, 60.20, 60.06 number of grains/ spike, respectively. Minimum (43.33) number of grains /spike was observed in T1 (control).

1000 grain weight (grams)

Data regarding 1000 grain weight was presented in *Table 2*. Maximum 1000 grain weight was observed in T4 (recommended dose of NPK + press mud 500 kg /acre) which was statistically similar with the treatments T5 (recommended dose of NPK + city compost 300 kg/acre) having (40.60 g and 40.41 g) 1000 grain weight, respectively T3 (NPK + poultry manure 50 kg/acre) and T6 (NPK+ humic acid 4 kg/ acre) are statistically alike having 39.31 and 38.41 g, 1000 grain weight. Minimum number of grain weight (35.33) was observed in T1 (control). Goudreddy *et al*. (1989) reported that press mud along with inorganic fertilizer improved 1000 grain weight in wheat.

Grain yield t/ha

Grain yield per hectare is the outcome of collectively contribution of various yield components, which is affected by different growing conditions and crop management practices. Statistical results showed

that maximum grain yield (3.14) was observed in T4 (recommended dose of NPK + press mud 500 kg /acre) which was followed by the treatment T5 (recommended dose of NPK + city compost 300 kg/acre) having grain yield 2.97 t/ha. Minimum grain yield (2.39 t/ha) was observed in T1 (control) where no dose of organic and inorganic fertilizer is applied as presented in *Table 2*. These results are supported by Rees and Castle (2002) and Reddy *et al*. (2005).

CONCLUSION

Plant height, tillers/m^2 , spike length (cm), no. of grains/spike, 1000 grain weight (grams) and grain yield t/ha have maximum results where T4 (NPK + press mud 500 kg/ acre) are applied.

REFERENCES

Ahmad M., L.H. Akhtar, M. Arshad, A.H. Tariq, S.Z. Siddiqi, M. Hussain, A. Rashid, G. Hussain, M. Aslam, M. Safdar, M.M. Akhtar, 2005 - Development of a high yielding wheat variety" Bahawalpur-97" for Southern Punjab, Pakistan. Pak. J. Sci. Ind. Res., 48(1): 42-46.

Akhtar C.M., 1990 - A microbial approach to boost the crop yields. In: Proc. Of the National Seminar on Economic Revival of Small Farmers'. University of Agriculture, Faisalabad, Pakistan, held on March 4-5, 1989. pp. 51-74.

Alam S.M., S.A. Shah, S. Ali, M.M. Iqbal, 2003 - Effect of integrated use of industrial wastes and chemical fertilizer on phosphorus uptake and crop yields. Pak. J. Soil Sci. 22: 81-86.

Alam S.M., S.A. Shah, S. Ali, M.M. Iqbal, 2005 - Yield and phosphorus uptake by crops as influenced by chemical fertilizer and integrated use of industrial by-products. Songkla. J. Sci. Tech. 27: 9-16.

Anonymous, 1996 - Agricultural Research Project-II, Punjab Agricultural Research Board, Lahore, Pakistan.

Anonymous, 2007-08 - Economic Survey. Government of Pakistan, Finance Div. Econ. Advisers Wing, Islamabad, Pakistan.

Anonymous, 2010 - Economic survey of Pakistan 2009-10. Federal Bureau of Statisics, Islamabad, Pakistan.

Avnimelech Y., J. Raveh, 1976 - Nitrate leakage from soils differing in texture and nitrogen load. J. Environ. Qual. 1: 79-82.

Baker J.C, H.P. Johnson, 1981 - Nitrate-nitrogen in tile drainage as affected by fertilization. J. Environ. Qual. 4: 519-522.

Delden A.V., 2001 - Yield and growth components of potato and wheat under organic nitrogen management. Agron. J., 93:1370–1385.

Dong J., H. Hengsdijk, D. Ting-Bo, W. Boer, J. Qi, C.W. Xing, 2006 - Long-term effects of manure and inorganic fertilizers on yield and soil fertility for a winter wheat-maize system in jiangsu, China. Pedosphere, 16: 25-32.

Economic Survey, 2006 - Economic Survey of Pakistan. 2006. Govt. of Pakistan, Finance Div. Econ. Advisory Wing, Islamabad, Pakistan.

Goudreddy B.S., U.S. Patil, G. D. Radder, B.M. Chttapur, 1989 - Response of rabi sorghum to nitrogen, farm yard manure and Azotobacter under irrigated conditions. J. Maharashtra Agri. Univ., 14: 266-268.

Ibrahim M., N. Ahmad, A. Rashid, M. Saeed, 1992 - Use of press-mud as source of phosphorus for sustainable agriculture. In: Proc. Symp. "Role of Phosphorus in Crop Production", NFDC, Islamabad, Pakistan. pp. 293-301.

Khan M.B., M. Farooq, M. Hussain, Shanawaz, G. Shabir, 2010 - Foliar application of micronutrients improves the wheat yield and net economic return. Int. J. Agric. Biol. 12: 953-956.

Khanam M., M.M. Rahman, M.R. Islam, 2001 - Effect of manures and fertilizers on the growth and yield of BRRI Dhan 30. Pak. J. Biol. Sci. 4: 172-174.

Nasir N.M., M. A. Qureshi, 1999 - Response of sugarcane to bio-compost prepared from filter cake and silage. Pak. J. Soil Sci. 16: 75-80.

Nayyar V.K., U.S. Sadana, T.N. Thakkar, 2001 - Methods and rates of application of Mn and its critical levels for wheat following rice on coarse texture soils. Fert. Res., 8: 173-178.

Reddy S.S., B. Shivaraj V.C. Reddy, 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.

Rees R., K. Castle, 2002 - Nitrogen recovery in soils amended with organic manures combined with inorganic fertilizers. Agron. J., 22: 739–746.

Shah S., S. Mahmood Shah, W. Mohammad, M. Shafi, H. Nawaz, S. Shehzadi, M. Amir, 2010 - Effect of integrated use of organic and inorganic nitrogen sources on wheat yield. Sarhad J. Agric. Vol. 26, No. 4: 559-563.

Steel R.G.D., J.H. Torrie, D.A. Dickey, 1997 - Principles and Procedures of Statistics: A Biometrical Approach. 3rd ed. McGraw Hill Book Co., Inc., New York. pp: 400-428.

Stubbs R.W., J.M. Prescot, E.E. Saari, H.J. Dubi, 1986 - Cereal Disease Methodology Manual. Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico.

Zia, M.S., R.A. Mann, M. Aslam, M.A. Khan and F. Hussain, 2000 - The role of green manuring in sustaining rice-wheat production. In: Proc. Symp. “Integrated Plant Nutrition Management”, NDFC, Islamabad, Pakistan. pp. 130-149.