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ROLE OF VARIOUS NUTRITIONAL SOURCES FOR IMPROVING THE YIELD OF WHEAT UNDER SALINE-SODIC SOIL ENVIRONMENT

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Effect of various organic and inorganic materials on yield and yield parameters of wheat was studied as pot experiment. Saline-sodic soil was collected, brought to wire house and filled in pots after chemical analysis for various parameters. Chemical analysis of various organic materials like farmyard manure (FYM), press mud, compost, poultry manure and *Sesbania* green manure was made. There were 12 treatments with three replications. After an appropriate time for the decomposition, organic treatments were applied using completely randomized design (CRD). Wheat seeds of Sahar-2006 cultivar were sown. Maximum plant height, number of productive tillers, were recorded before harvesting while total biomass and grain yield were noted after harvesting the wheat. All collected data were analyzed statistically. It was noted that combined application of compost and chemical fertilizer (T10) improved grain yield, total biomass, number of productive tillers per plant and maximum plant height.
Keywords: Marginal land, organic matter, yield parameters, soil fertility, *Sesbania*

INTRODUCTION

Land is one of the major non-renewable assets that is posing serious hazard of degradation. Occurrences of degraded soils are common in the world. In Pakistan salinity is threatening about 6.67 M ha area in irrigated belt (Anonymous, 2002). Efforts are being made to utilize these soils for sustainable agriculture from decades. The nature of Pakistani soils is alkaline and calcareous (Ahmad, 2000). In spite of having potential to produce a crop, the yield per hectare is very low. There are several constraints for it including low organic matter, alkaline soil pH, calcareousness, mining of nutrients with extensive cropping, use of micronutrients free NPK fertilizers and less use of organic manures. Soils are being depleted in nutrients due to extensive cultivation. Hence, restoration and maintenance of fertility status of soil is important, for which the addition of organic materials along with other field practices is essential (Anonymous, 1998; Ahmad, 2000).

Like most of the world, wheat is the most widely cultivated cereal crop and it is served as food for majority of population in Pakistan. Low fertility status of Pakistani soils is one of the major reasons behind reduced wheat yield. Fertility status of soils can be enhanced significantly by integrated use of organic and mineral nutritional sources (Akhtar *et al*., 2007). Wheat is cultivated over an area of 8.69 M ha with average yield of 2.43 tons ha^{-1} (Anonymous, 2013). Salinity reduces growth of wheat (Arshad *et al*., 2012). Maximum grain yield was obtained when FYM was applied @ 10 t ha^{-1} along with wheat straw @ 10 t ha^{-1} and NPK @ 120-90-60 kg ha^{-1}. In another experiment conducted by Sarwar *et al*. (2008) it was concluded that wheat yield significantly increased with the application of chemical fertilizers in combination with compost, FYM and *Sesbania* green manure, respectively, when compared with control. Similarly, maize crop fertilized by integrated application of chemical fertilizers (250-120-125 kg N-P_2O_5--K_2O ha^{-1}) and FYM (15 t ha^{-1}) produced the highest grain yield of 8.47 t ha^{-1} and 8.22 t ha^{-1} during 2009 and 2010, respectively (Randhawa *et al*., 2012).

Ibrahim *et al*. (2008) found that application of various organic manures significantly increase crop yield on sustained basis. The efficacy of combined application of inorganic and organic N sources (FYM, poultry manure and filter cake) on yield and N uptake of wheat was evaluated by Shah *et al*. (2009). Results revealed that better grain and straw yield were recorded in treatment receiving organic and mineral fertilizers in the ratio of 25:75. Keeping in view the beneficial impacts of organic and inorganic nutritional sources the present study was designed in order to find out the efficacy of various nutritional sources on yield and yield components of wheat under saline-sodic soil environment.

MATERIALS AND METHODS

***Experiment location and treatments*:** A pot experiment was conducted at University College of Agriculture, University of Sargodha, Sargodha, during the year 2009-10, to study the effect of various organic and inorganic nutritional sources on yield of wheat. The selected soil was shifted to sample room, air dried, ground, sieved and filled @ 7 kg per pot. The experiment comprised of 12 treatments replicated thrice;

Table 1. Analysis of various organic nutritional sources used in experiment

Determinations	Unit	FYM	Press mud	Compost	Poultry manure	*Sesbania* green manure
pH (1:1)	-	8.11	7.65	7.78	8.21	7.22
Organic matter	%	35.57	31.20	40.80	38.91	24.96
Organic carbon	%	20.68	18.14	23.72	22.62	14.51
Total nitrogen	%	1.67	1.65	2.34	1.81	1.08
C/N ratio	-	12.38	10.99	10.14	12.50	13.4
Available phosphorus	%	0.67	1.28	1.37	0.81	0.71
Potassium	%	1.12	0.45	1.03	0.95	3.55

[T_1]- control (recommended NPK), [T_2]- ½ recommended NPK, [T_3]- FYM @ 1.5% by soil weight, [T_4]- press mud @ 1.5% by soil weight, [T_5]- compost @ 1.5% by soil weight, [T_6]- poultry manure @ 1.5% by soil weight, [T_7]- *Sesbania* green manure (dried) @ 1.5% by soil weight, [T_8]- T_2+FYM @ 0.75% by soil weight, [T_9]- T_2+press mud @ 0.75% by soil weight, [T_{10}]-T_2+compost @ 0.75% by soil weight, [T_{11}]- T_2+poultry manure @ 0.75% by soil weight, [T_{12}]- T_2+*Sesbania* green manure @ 0.75% by soil weight. These treatments were applied following Completely Randomized Design (CRD) and appropriate time was given to decompose these organic nutritional sources. Wheat seeds of Sehar-2006 cultivar were sown. Various agronomic practices were applied as and when required.

***Agronomic data collection*:** At maturity, maximum plant height and number of productive tillers were recorded before harvesting the crop. Total biomass and grain yield were noted after harvesting the wheat.

***Statistical analysis*:** All collected data were subjected to analysis of variance technique (ANOVA) as described by Steel *et al*. (1997).

RESULTS

***Maximum plant height*:** It was observed that height of wheat plants was increased significantly with the addition of organic amendments alone and in combination with chemical fertilizers. In this regard, response of compost was more pronounced when combined with chemical fertilizer (Fig. 1). Thus, application of compost proved superior to all other treatments. Minimum plant height of 63.6 cm was observed in T2 (chemical fertilizer @ ½ recommended dose) that was increased to the maximum level of 75.33 cm (T10) where compost was applied (@ 0.75% by soil weight) in combination with chemical fertilizer. Treatments T1 (recommended dose of chemical fertilizer), T3 (FYM @ 1.5 % by weight), T4 (press mud @ 1.5% by soil weight), T5 (compost @ 1.5% by soil weight) and T12 (*Sesbania* @ 0.75% by soil weight + ½ recommended NPK) remained non significant with each other. Similarly, treatments T2 (½ recommended NPK) and T6 (poultry manure @ 1.5% by soil weight) were also at par statistically. Treatment T7 (*Sesbania* @ 1.5% by soil weight) and T8 (FYM @ 0.75% by soil weight + ½ recommended NPK) remained non-significant when compared each treatment showing values of 71.67cm for each. Similarly, T9 (press mud @ 0.75% by soil weight + ½ recommended NPK) and T11 (poultry manure @ 0.75% by soil weight + ½ recommended NPK) proved non-significant when compared with each other possessing values of 72.33 cm and 72 cm respectively. Similarly, treatments T3 (FYM @ 1.5% by soil weight) and T4 (press mud @ 1.5% by soil weight) remained at par statistically. Thus, addition of organic sources of nutrients increased height of the wheat plants.

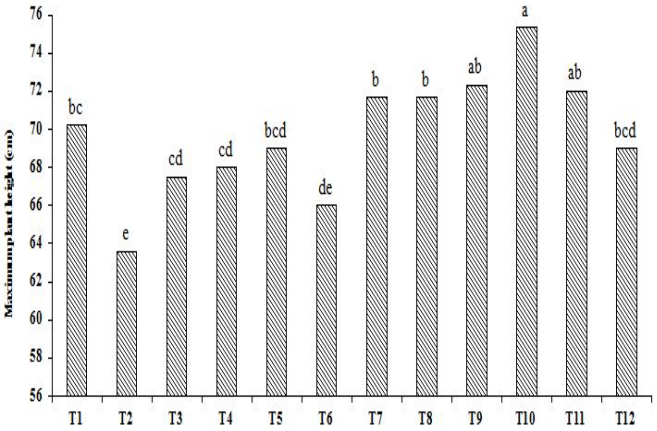

Figure 1. Effect of various nutritional sources on maximum plant height of wheat.

Number of productive tillers per plant: Differences among various treatments for number of productive tillers per plant were found significant statistically. The data revealed that combination of chemical fertilizers @ ½ recommended NPK with compost @ 0.75% by soil weight (T10) produced maximum number of tillers (4) which was followed by T8 (FYM @ 0.75% by soil weight + ½ recommended NPK) and T11 (poultry manure @ 0.75% by soil weight + ½ recommended NPK) showing value of 3.67 for each (Fig. 2). Minimum number of productive tillers (2.33) was recorded in T2 (½ recommended NPK), T6 (poultry manure @ 1.5% by soil weight) and T7 (*Sesbania* @ 1.5% by soil weight)

and these three treatments also remained at par in terms of statistics.

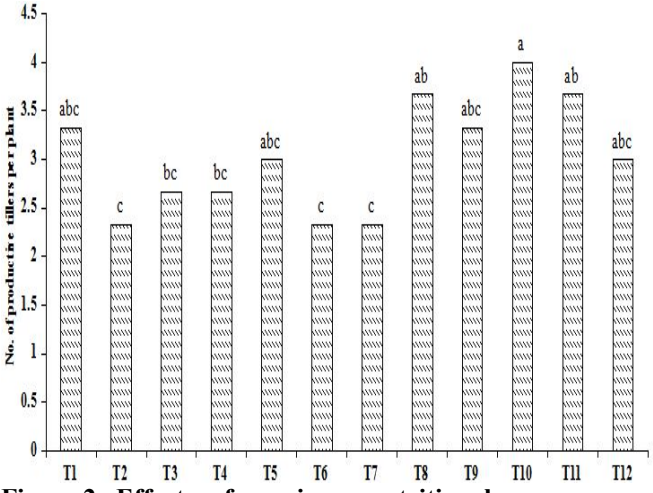

Figure 2. Effect of various nutritional sources on number of productive tillers per plant.

It is evident from the data that combined application of chemical fertilizer (½ recommended NPK) and organic nutritional sources (FYM, press mud, compost, poultry manure and *Sesbania* green manure) showed better results as compared to sole application of chemical fertilizer or organic materials. Treatments T3 (FYM @ 1.5% by soil weight) and T4 (press mud @ 1.5% by soil weight) remained at par statistically. Similarly, treatments T5 (compost @ 1.5% by soil weight) and T12 (*Sesbania* @ 0.75% by soil weight + ½ recommended NPK) also remained non-significant in terms of statistics. Addition of FYM, compost and poultry manure significantly increased the tillering in wheat crop either applied alone or in combination with chemical fertilizer.

***Total biomass*:** Combined application of organic sources of nutrients and chemical fertilizer enhanced the total biomass of wheat when compared with sole addition of chemical fertilizer (T1). The data for total biomass were found statistically significant. Maximum biomass (46.76 g) was recorded in T10 (compost was applied @ 0.75% by soil weight + chemical fertilizer @ ½ recommended NPK whereas, minimum biomass (27.21 g) was obtained in T3 where FYM was applied @ 1.5% by soil weight (Fig. 3). Differences among various treatments were significant statistically. However, treatments T2 (31.92 g) and T4 (31.04 g), T5 (36.15 g) and T6 (36.8 g), T3 (27.21 g) and T7 (28.12 g) and similarly, T9 (43.76 g) and T11 (44.71 g) proved non-significant for each other statistically. Integrated use of organic nutritional sources and chemical fertilizers enhanced the biomass significantly as compared to sole application of these materials. Addition of compost @ 0.75% by soil weight + ½ recommended NPK (T10) proved the best treatment for increasing total biomass of wheat.

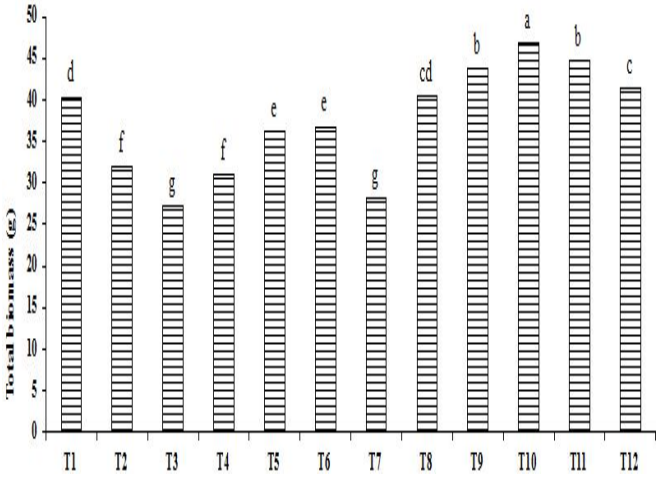

Figure 3. Effect of various nutritional sources on total biomass of wheat.

Grain yield: The data revealed that various treatments played their role effectively in increasing the yield of wheat crop. Differences among the treatments were assessed as significant statistically (Fig. 4). Statistical evaluation of the data indicated that combined application of compost @ 0.75% by soil weight + chemical fertilizer @ ½ recommended NPK (T10) was the best treatment yielding 28 g grains per pot.

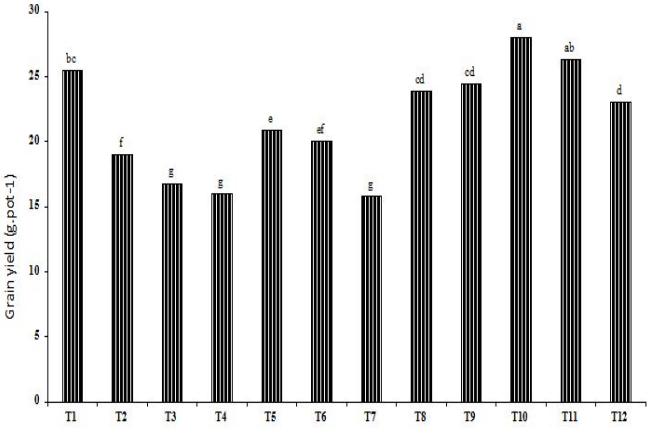

Figure 4. Effect of various nutritional sources on grain yield of wheat.

The minimum grain yield (15.8 g) was obtained in T7 where *Sesbania* was applied @ 1.5% by soil weight. Treatments T8 (FYM @ 0.75% by soil weight + ½ recommended NPK) and T9 (press mud @ 0.75% by soil weight ½ recommended NPK) remained non-significant statistically with values of 23.90 and 24.75 g, respectively. Similarly, T3 (FYM @ 1.5% by soil weight), T4 (press mud @ 1.5% by soil weight)

and T7 (*Sesbania* @ 1.5% by soil weight) indicating value of 16.8, 16.0 and 15.8 g respectively were also at par in terms of statistics. It was observed that treatments T2 (19.0) and T6 (20.0) remained at par. *Sesbania* proved inferior to FYM, pressmud, compost and poultry manure either applied alone or in combination with chemical fertilizers. Application of chemical fertilizers @ recommended NPK (T1) alone produced better yields when compared with alone application of organic nutritional sources (FYM, press mud, compost, poultry manure and *Sesbania*).

DISCUSSION

Yield is the ultimate target of farmers for increasing their income. Improvement in yield and yield components is the result of the application of various inorganic and organic amendments, and different management practices. The application of FYM, pressmud, compost, poultry manure and *Sesbania* green manure alone and in combination with chemical fertilizer increased the yield and various yield parameters of wheat significantly (Figs. 1, 2, 3 & 4). Maximum plant height, number of fertile tillers per plant, and total biomass were included in yield parameters. All these parameters ultimately contribute to increased grain yield. Application of FYM, press mud, compost, poultry manure and *Sesbania* green manure in combination with chemical fertilizer proved better than alone application. However, compost proved superior to FYM, press mud, poultry manure and *Sesbania* green manure.

A chain of phenomena was responsible for the improvement in grain yield of wheat. The percentage of soil organic matter was increased due to the application of different organic materials like FYM, press mud, compost, poultry manure and *Sesbania* green manure. This addition of soil organic matter content caused an improvement in the physical properties of soil. Due to the improvement of physical properties various acid or acid forming compounds were released from the application of various organic materials which lowered soil pH. As a result of low pH, the availability and uptake of soil nutrients by plants was enhanced. Consequently, all the above factors contributed to the improvement of different yield components like maximum plant height, number of fertile tillers plant^{-1} and total biomass positively. This improvement in yield components ultimately contributed to the grain yield of wheat. In case of saline sodic soil, the reclamation occurred and as a result of reclamation process, Na^+ salt present on the exchange site leached down and H^+ occupied its place, thus, lowering soil pH. Hence, favorable physical conditions for plant growth were created. Moreover, addition of different organic materials improved the physical properties of soil permitting more leaching of excessive salts. These hypotheses were in line with findings of other scientists. Khan *et al*. (2006) found that organic materials increased the gain yield of wheat crop. It was concluded that wheat yield significantly increased with the use of compost in combination with chemical fertilizers (Sarwar *et al*., 2008). Similarly, many other researchers like Selvakumari *et al*. (2000), Swarup and Yaduvanshi (2000), Sarwar *et al*. (2007), Shah *et al*. (2009), Abedi *et al*. (2010), Munir *et al*. (2012), Dania *et al*. (2012) and Javeed *et al*. (2013) also noted enhanced yield of wheat crop with the addition of different organic amendments applied alone and in combination with mineral fertilizers.

***Conclusion*:** Although all organic nutritional sources improved yield of wheat but integrated use of compost with chemical fertilizers proved superior to all other treatments.

REFERENCES

Abedi, T., A. Alemzadeh and S.A. Kazemeidini. 2010. Effect of organic and inorganic fertilizers on grain yield and protein banding pattern of wheat. Aust. J. Crop Sci. 4:384-389.

Ahmad, N. 2000. Fertilizer scenario in Pakistan: policies and development In: Proc. Conf. "Agriculture and Fertilizer Use", Feb. 15-16, National Fertilizer Development Centre. Islamabad, Pakistan.

Akhtar, M.J, H.N. Asghar, M. Asif and Z.A. Zahir. 2007. Growth and yield of wheat as affected by compost enriched with chemical fertilizer, L-tryptophan and rhizobacteria. Pak. J. Agri. Sci. 44(1):136-140.

Anonymous. 1998. Micronutrient in Agriculture, Pakistan perspective, National Fertilizer Development Centre, Islamabad, Pakistan.

Anonymous. 2002. Agricultural statistics of Pakistan, Ministry of Food and Agriculture, Islamabad, Govt. of Pakistan.

Anonymous. 2013. Agricultural statistics of Pakistan. Government of Pakistan, Ministry of Food, Agriculture & Livestock, Islamabad, Pakistan.

Arshad, M., M. Saqib, J. Akhtar and M. Asghar. 2012. Effect of calcium on the salt tolerance of different wheat (*Triticum aestivum* L.) genotypes. Pak. J. Agri. Sci. 49:497-504.

Dania, S.O., O. Fagbola and H.H.E Isitekhale. 2012. Effects of sawdust and organomineral fertilizer and their residual effect on the yield of maize on degraded soil. Pak. J. Agri. Sci. 49:61-66.

Ibrahim, M., U.A. Hussain, M. Iqbal and E.E. Valeem. 2008. Response of wheat growth and yield to various levels of compost and organic manure. Pak. J. Bot. 40:2135-2141.

Javeed, H.M.R. and M.S.I. Zamir. 2013. Influence of tillage practices and poultry manure on grain physical properties and yield attributes of spring maize (*Zea mays* L.). Pak. J. Agri. Sci. 50: 177-183.

Khan, M.A., N. Jan, Q. Sultana, S.R. Ahmad and A. Rahman. 2006. Effect of different organic materials and chemical fertilizers on the yield of wheat and physical properties of soil. Sarhad J. Agri. 22:437-441.

Munir, A., Anwar-ul-Hassan, S. Nawaz and M.A. Bajwa. 2012. Farm manure improved soil fertility in mungbean-wheat cropping system and rectified the deleterious effects of brackish water. Pak. J. Agri. Sci. 49:511-519.

Randhawa, M.S., M. Maqsood, S. A. Wajid and M. A. Haq. 2012. Effect of integrated plant nutrition and irrigation scheduling on yield and yield components of maize (*Zea mays* L.). Pak. J. Agri. Sci. 49(3):267-273.

Sarwar, G., H. Schmeisky, N. Hussain, S. Muhammad, M. Ibrahim and E. Safdar. 2008. Improvement of soil physical and chemical properties with compost application in Rice-Wheat cropping system. Pak. J. Bot. 40:275-282.

Sarwar, G., N. Husasain, H. Schmeisky and S. Muhammad. 2007. Use of compost an environment friendly technology for enhancing Rice-Wheat production in Pakistan. Pak. J. Bot. 39:1553-1558.

Selvakumari, G., M. Baskar, D. Jayanth and V. Mathan. 2000. Effect of integration of Flyash with fertilizers and organic manures on nutrient availability, yield and nutrient uptake of rice in alfisols. J. Ind. Soc. Soil Sci. 48:268-278.

Shah, S.A., S.M. Shah, W. Mohammad, M. Shafi and H. Nawaz. 2009. N uptake and yield of wheat as influenced by integrated use of organic and mineral nitrogen. Int. J. Plant Prod. 3:45-55.

Steel, R.G.D., J.H. Torrie and D.A. Dichey. 1997. Principles and Procedure of Statistics: A biomertrical approach, 3rd Ed. McGraw Hill Co., Inc., New York, USA.

Swarup, A. and N.P.S. Yaduvanshi. 2000. Effect of Integrated nutrient management on soil properties and yield of rice in Alkali soils. J. Ind. Soc. Soil Sci. 48:279-282.