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# RESPONSE OF WHEAT GROWTH AND YIELD TO VARIOUS LEVELS OF COMPOST AND ORGANIC MANURE

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## Abstract

Organic manures are traditionally used for supplying plant nutrients. Their volume and other operational problems forced the farmers to use inorganic fertilizers. The recycling of organic waste is considered one of the major solutions to get rid of huge piles of wastes. The product obtained provides nutrients in an efficient way along with improving the soil conditions. Because the current practice of using inorganic fertilizers may not fulfil and maintain the soil quality needed for sustainable crop productivity. The impact of organic manure and compost on productivity of wheat (*Triticum aestivum* L. cv. Inqlab-91) was investigated in sandy clay loam soil. The amounts of various organic manures to supplement the inorganic fertilizers must be optimized to increase crop yield. Changes in growth and yield parameters of wheat relative to inorganically fertilized controls were measured. Organic amendments had positive but variable effects. The organic manures application increased the wheat yield by 11.13 (105 %) to 13.53 (128 %) g $pot^{-1}$, relative to the control. The wheat plant height, number of tillers, spike length, straw yield, grain yield and 1000-grain weight all were statistically different from that of control. The findings of the trial suggested that crop productivity may be improved significantly by the application of various organic manures for longer time. Hence, instead of using inorganic chemical fertilizer alone, the integrated use could be more effective and sustainable for environment and agriculture.

## Introduction

The organic matter is used since times to improve soil health and supplying plant nutrients. Various types and sources of organic wastes are utilized in agriculture but most of these materials remain unutilized, especially in resource poor countries. These practices pose serious threat to the environment and loss of useful pool of plant nutrients. The organic materials are available in bulk amounts as farm manure, city waste, poultry manure and wastes from industry like food, sugar, cotton and rice. If these materials are accumulated, these may become a potential source of air, land and water pollution. According to Economic Survey (Anon., 2007) no proper waste collection and disposal system is in place in Pakistan. The farmers are using various types of waste materials without knowing their economic benefit.

Huge amounts of organic materials are in the form of farm waste, city waste, sewage sludge, poultry litter and agro-industrial wastes (Lal, 2005; Kolay, 2000). Less than 60 % waste is collected in urban areas of Pakistan because there is new system for city waste collection and disposal (Anon., 2006). The various forms of organic manures are also being used in the fields for sustainable crop yield. But due to varying composition and water level and bulky nature, their application and transportation is a very big question in this fuel conscious world. The application also implies certain labour requirements, which add to the input cost and that is very un-economical for a resource poor farmer.

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Composting provides an effective and environment friendly procedure of organic waste disposal (Millner *et al*., 1998) because it is more economical and environment friendly. It also conserves natural resources and improves cycling of non-renewable resources. Keeping in view the present energy crises it is an excellent option for energy conservation because a lot of energy is utilized in fertilizer sector. This process biologically converts the organic waste material into stable humus like substances, which may be stored and applied without any environmental impacts (Gallardo-Larva & Nogales, 1987). The organic manures and compost are important in sustaining farming by providing plant N-supply (Korsaeth *et al.,* 2002).

The compost production for agriculture has got considerable attention in socio-economic conditions in Pakistan due to sudden increase in fertilizer prices and increased depletion of soil quality. This might be due to increased costs for solid waste management and increased public awareness for wastes recycling. The process of composting provides sound way to manage large volumes of organic wastes in a comprehensive manner (Lasaridi & Stetiford, 1999). The organic matter in various forms and at various stages of decomposition has been used in soil in tons $ha^{-1}$ for improvement of crop productivity (Terrance *et al*., 2004). The use of inorganic chemical fertilizers is essential for crop nutrition in order to maximize productivity. The crop yields especially of wheat are stagnant for the last couple of years. The use of organic manures and composted organic materials along with chemical fertilizers may be effective for further increase in crop yield.

Pakistan is facing a severe challenge of acute food and energy crisis and sufficient food production at least for ever growing population at 2.6 percent per annum (Qazilbash, 2002) should be made possible by the use of all available resources. It seems to be very quick and efficient method to use the mineral fertilizers but their energy costs are too high and that might not be environmental friendly and constraints may be in their use by the resource poor farmers. There are very little options available for efficient food production through the available poor resources. Attention should be focused on the efficient utilization of resources by the cereals especially wheat that is of supreme importance in Pakistani agriculture due to its cultivated area and production (Anon., 2007). For these investigations such survey should be carried out so that a comprehensive technology and production package may be developed for efficient utilization of all on farm available resources. Some work in this regard has been done by Ahmad *et al*. (2008); Zahir *et al*. (2007) and Sial *et al*. (2007). The present investigations were, therefore, performed to compare raw organic manure, compost and inorganic fertilizer for wheat growth and yield.

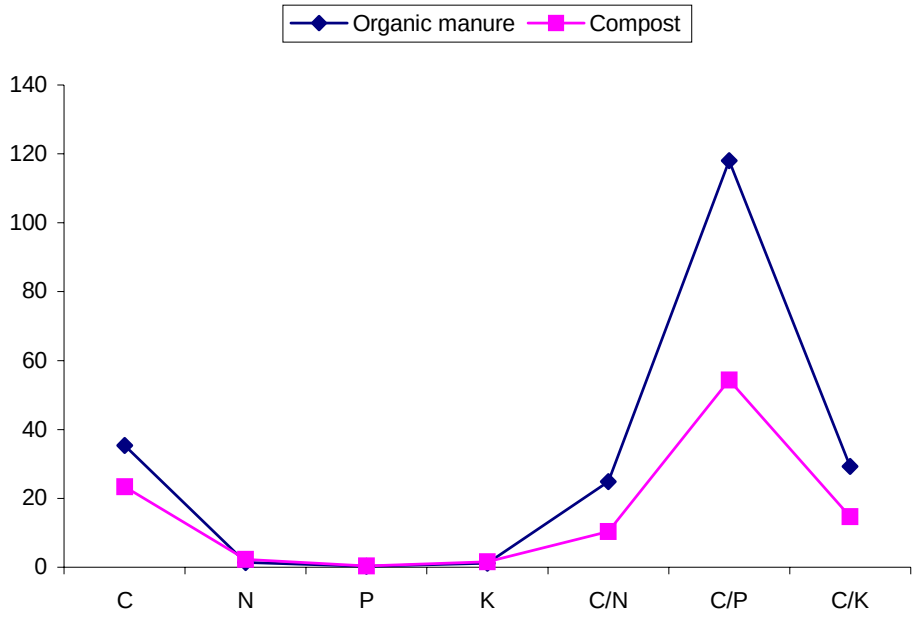
## Materials and Methods

Pot studies were conducted in the net house to see the effectiveness of raw organic manure and compost and for improving the growth and yield of wheat. Both raw organic manure and compost materials were analyzed (Fig. 1) for carbon content (Nelson & Sommers, 1996), and macro-nutrients (Ryan *et al*., 2001). The soil was collected, air-dried, ground, sieved (2 mm mesh) and analyzed for physico-chemical properties. The soil used for this experiment was sandy clay loam (53, 20.5 and 26.5 % sand, silt and clay, respectively) having a pH of 7.54; $EC_e$, 1.42 dS $m^{-1}$, saturation percentage of 33 %. It also contained organic matter 0.59 %; total N 0.046%, available P 7.5 mg $kg^{-1}$ and available K 121.7 mg $kg^{-1}$ soil.

Details of the treatments given are described below:

$T_1$ = Control
$T_2$ = Organic manure at 10 Mg $ha^{-1}$
$T_3$ = Organic manure at 20 Mg $ha^{-1}$
$T_4$ = Organic manure at 30 Mg $ha^{-1}$
$T_5$ = Organic manure at 40 Mg $ha^{-1}$
$T_6$ = Compost at 300 kg $ha^{-1}$
$T_7$ = Compost at 400 kg $ha^{-1}$
$T_8$ = Compost at 500 kg $ha^{-1}$

The pots were filled with sieved soil (15 kg $pot^{-1}$). In control, recommended N, P and K fertilizers at 120, 100 and 60 kg $ha^{-1}$, respectively were mixed as urea, single super phosphate (SSP) and sulphate of potash (SOP). The organic manure and composts were applied according to the treatment by mixing it with soil before filling of pots.




The values of C, N, P and K are in % while C/N, C/P and C/K are ratios.

Fig. 1. Analysis of organic manure and compost used in the experiment.

Eight seeds of wheat cultivar Inqlab-91 were sown in each pot and thinned to four plants. Canal water was used for irrigation throughout the experimental period. The pots were arranged according to completely randomized design with three replications. The wheat plants were harvested at maturity and data regarding growth and yield parameters were recorded. The data thus obtained were subjected to statistical analysis (Steel & Torrie, 1980). The treatment means were compared by least significant difference (LSD) test.

**Results and Discussion**

The organic manure and compost significantly increased the plant height, number of tillers, spike length, straw/grain yield and 1000-grain weight over untreated control (Table 1). The Maximum increase (16 % over control) in plant height was recorded by the application of compost at 500 kg $ha^{-1}$. The organic manure at 10 Mg $ha^{-1}$ also increased the plant height (44.06 cm). The maximum number of tiller $pot^{-1}$ (29) was also recorded in $T_8$ and $T_6$ where compost was applied at 500 and 300 kg $ha^{-1}$. The spike length was non-significant and the maximum was observed in $T_8$ and the minimum was recorded in $T_2$, $T_3$ and $T_7$. Dixit & Gupta (2000); Selvakumari *et al.,* (2000) and Khoshgoftarmanesh & Kalbasi (2002) had also concluded that crop growth may be improved by the use of organic materials.

Wheat gave highly significant response to organic manure and compost application. A comparison of fresh weight with that of control, revealed an increase of 44 % at $T_7$ and 27 % at $T_4$ (Table 1). The experimental soil contained less amount of organic matter and had a low $N_2$ supplying capacity. The response of wheat to fertilizer and manures on such soils had been reported to control wheat yields (Sarwar *et al*., 2007, 2008). Addition of various levels of organic manure and compost to wheat compensated for chemical fertilizer, which might give a substitution under field conditions (Rekhi *et al.,* 2000). The wheat grown gave a significant grain yield of 14.08, 13.98 and 13.53 g $pot^{-1}$ in treatments where compost at 400 kg $ha^{-1}$, compost at 500 kg $ha^{-1}$ and organic manure at 30 Mg $ha^{-1}$ was applied. This resulted 33, 32 and 28 % more grains over control (Table 1). Previous studies have shown that organic materials (compost, manures) enhance nutrient use efficiency by slow releasing of nutrients and reducing their losses (Chang & Janzen, 1996; Paul & Clark, 1996; Muneshwar *et al*., 2001; Nevens & Reheul, 2003). The addition of organic fertilizer increases phosphorus mobilization and soil microbial activities; it might also contribute in improving nutrition as well as crop root system.

The data regarding fresh weight of plants per pot also showed significant results at varying levels of organic manure and compost. It is evident from the data that the maximum fresh weight (57.91 g $pot^{-1}$) was recorded in $T_7$ followed by $T_4$. The increase in fresh weight has also been reported by Sarwar *et al*. (2008) concluding that favourable environment results in an increased activity and increased water and nutrient use efficiency resulting in more succulent plants (Ahmad *et al*., 2008; Sial *et al*., 2007).

Total oven dry biomass of wheat increased significantly over control with the use of organic manure and compost. The minimum oven dry weight (19.57 g $pot^{-1}$) was recorded in $T_6$ which was at par with $T_8$ and $T_3$. The reason for this increase might be the efficient use of all available resources for plant and roots because of low and continued supply of nutrients as well as more water absorption (Jagadeeswari & Kumaraswamy, 2000; Swarup & Yaduvanshi, 2000). The increase in maize growth with the use of organic materials has also been observed by Muhammad *et al*. (2007) and Iqbal *et al*., (2008). As for as 1000-grain weight is concerned, the produce at various levels of organic manure and compost revealed that the maximum 1000-grain weight (45.26 g) was produced when organic manure was applied at 30 Mg $ha^{-1}$. The difference in grain yield among different levels of manure and compost was also significant. The difference in nutrient absorption greatly influences growth and yield potential (Ahmad *et al*., 2008). These findings are in support of previous findings of Bajpai *et al*., (2002) and Pooran *et al*., (2002) who concluded that compost application improved all the growth parameters.

**Table 1. Effect of organic manure and compost on growth and yield of wheat.**

| Treatments | Plant height (cm) | No. of tillers pot$^{-1}$ | Spike length (cm) | Spikelets per spike | Fresh weight (g pot$^{-1}$) | Oven dry weight (g pot$^{-1}$) | Grain yield (g pot$^{-1}$) | 1000-grain weight |
|---|---|---|---|---|---|---|---|---|
| $T_1$ = Control | 41.47 | 24.7 | 8.6 | 13.2 | 40.18 | 15.37 | 10.54 | 40.32 |
| $T_2$ = OM at 10 Mg ha$^{-1}$ | 44.06 | 26.0 | 8.5 | 13.0 | 46.85 | 16.49 | 11.13 | 37.93 |
| $T_3$ = OM at 20 Mg ha$^{-1}$ | 40.06 | 21.7 | 8.5 | 13.9 | 40.89 | 18.26 | 11.82 | 40.42 |
| $T_4$ = OM at 30 Mg ha$^{-1}$ | 42.38 | 24.0 | 8.8 | 13.7 | 51.18 | 17.11 | 13.53 | 45.26 |
| $T_5$ = OM at 40 Mg ha$^{-1}$ | 43.77 | 25.0 | 8.6 | 12.9 | 36.25 | 16.59 | 12.96 | 43.79 |
| $T_6$ = Compost at 300 kg ha$^{-1}$ | 41.90 | 29.0 | 8.9 | 13.7 | 45.56 | 19.57 | 13.66 | 42.76 |
| $T_7$ = Compost at 400 kg ha$^{-1}$ | 40.47 | 28.3 | 8.5 | 13.9 | 57.91 | 17.80 | 14.08 | 42.39 |
| $T_8$ = Compost at 500 kg ha$^{-1}$ | 48.11 | 29.0 | 9.0 | 14.4 | 34.16 | 19.18 | 13.98 | 44.03 |
| $LSD_{0.05}$ | 5.29 | 5.43 | 0.88 | 1.08 | 16.90 | 3.52 | 2.82 | 3.99 |

OM = Organic Manure

The present investigations have demonstrated the improvement of wheat growth and yield with the use of organic manure and compost when they were compared with chemical fertilizer. It is quite possible to get higher wheat yield by the integrated use of organic and inorganic fertilizers. This will result in soil quality improvement, which should be investigated under field conditions.

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