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Evaluating the Effect of Different Compost Types on Wheat Seedling Growth

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Abstract. Compost production is considered an economical and environmentally friendly means to reduce solid waste. The use of compost in crop production practices, enhances crop growth, improves soil nutrient profile and reduces the environmental pollution caused by the extensive use of mineral fertilizers. This study was planned to check the effect of various compost types on wheat seedling growth. The experiment was laid under CRD in a factorial arrangement. The pots were filled with 500 g sand and six types of compost were added in pots at 25:75 of compost and sand, respectively. The results showed significant differences among the compost treatments for the shoot length, root length, shoot fresh weight, shoot dry weight, root fresh weight and root dry weight. The maximum shoot length (20.66 cm) was observed under T4 (anaerobic composting) of cow manure : wheat straw (3:1). The maximum root fresh weight, (3.76 g) and shoot dry weight (2.27 g) was recorded under T1 (anaerobic composting of cow manure : wheat straw (1:3)). The maximum root length (4.6 cm), root fresh weight (2.37 g) and root dry weight (1.25 g) was recorded under T2 (anaerobic composting of cow manure : wheat straw (1:1). Our results showed that the growth of wheat seedling was more on the compost produced under anaerobic conditions compared to the compost under aerobic conditions. We conclude that the application of compost has potential to fulfill the nutritional demand of wheat plants, enhance the wheat growth and reduce the environmental pollution caused by the extensive use of inorganic fertilizer.

Keywords: composting, wheat growth, seedling growth, root length, environmental pollution

Introduction

Sustainable agricultural production is an immense need now a days to reduce environmental pollution due to which is due to improper agricultural practices and enhanced use of inorganic fertilizers. The challenge for sustainable agriculture production is the most important in developing countries like Pakistan. Mineral fertilizers is the most essential for the nutrition of plants but they are the main source of environmental pollution, especially the mineral phosphorus (P) and mineral nitrogen (N) fertilizers. High application of the mineral nitrogen fertilizers enhances the NO^{3-} ions in soil and also in the plant edible parts (Rady, 2011). The mineral phosphorus fertilizers contain the Cd^{2+} ion which is the heavy metal that significantly influences agricultural productivity (McLaughlin *et al*., 2000). Thus enhanced application of fertilizers containing mineral P results in Cd^{2+} contamination which is absorbed by roots and transferred to the plant parts (Semida *et al*., 2015). Furthermore, farmers in Pakistan suffering from a reduction in soil fertility and enhanced soil salinity, so these soils of arid and semi-arid regions need effective solutions. The main reasons for the reduction in soil fertility the extensive cropping, high rate of evaporation, low irrigation, poor water management and low rainfall (Rady *et al*., 2011).

Attention is needed on an urgent basis to use different types of organic matter composts for the partial substitution of inorganic fertilizers. These practices were recommended under both normal, drought and salinity conditions in the semiarid and arid regions as a potential source of nutrients (Smith *et al*., 2015; Ojo *et al*., 2014) because Pakistani soils have low mineralization and organic matter (Okusami *et al*., 1997) due to low rainfall and high alkalinity. The beneficial impact of these practices results in enhanced productivity, balanced plant nutrition and soil sustainability and fertility were reported (Dotaniya *et al*., 2016; Kumar and Chopra, 2016; Moyin-Jesu, 2015; Semida *et al*., 2015; Rady, 2011). Furthermore, the application of green manures and FYM also showed a positive impact on the soil properties (Suja and Sreekumar, 2014). The potential use of these plant residues in composting after

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mixing with some potential mineral or organic compounds, like farm yard manure, potassium humate and agricultural sulfur produced high-quality organic compost. The composting process is the most beneficial as it enhances soil fertility and fulfills the need for N and P after adding in soil.

Plant residues like green leaves, straw and stoves, are used as raw materials for the production of compost. Traditionally the farmers get rid of this raw material by burning it in the open field. The compost is the organic amendments that were achieved through composting. But the compost has many positive impacts on the soil and plant production, *e.g*. improves soil health (Sadegh-Zadeh *et al*., 2018) minimizes soil salinity (Youssif *et al*., 2018), improves drought tolerance (Eboibi *et al*., 2021) and increase the plant growth and yield (Aiqing *et al*., 2021). The application of compost is considered the best strategy to improve soil structure (Mahmoud *et al*., 2020) water holding capacity (Diacono *et al*., 2011) nutrient availability (Yupeng *et al*., 2018) seedling growth and grain yield in wheat (Hafez *et al*., 2020).

Wheat is the most important cereal crop and is used as a staple food in Pakistan. It is the source of various proteins carbohydrates and fibre ash etc., Despite its importance and its yield is lower in Pakistan compared to other top-growing countries. The lower yield in this crop is due to the non-availability of mineral nutrients required by the crop plants to complete their life cycle and give good production. Thus, the cultivation of wheat crops under the soil application of compost has the potential to enhance the crop yield and soil fertility and add mineral nutrients to the soil (Ojo *et al*. 2014). This practice increased crop growth and yield and healthy food for humans. It will also minimize the extensive use of mineral fertilizer, production cost and environmental pollution and indirectly enhance the farmer's income. This study was planned to find the effect of various composts produced under organic and inorganic composting on wheat growth at the seedling stage.

Materials and Method

This experiment was performed to check the growth and performance of wheat variety Akbar-19 by the application of compost. This experiment was laid under CRD with six treatments in three replications (Table 1). The experiment was performed in the posts filled with 1 Kg of soil and compost. The pots are filled by mixing 75 % soil and 25% compost obtained from different composting material. The compost was obtained from the previous experiment (Fatima *et al*., 2023). All the recommended agronomic practices were followed from sowing to harvest. The data was recorded 30 days after the germination for days to emergence (DTE), seedling length (SL, cm), root length (RL, cm), shoot fresh weight (SFW, g), shoot dry weight (SDW, g), root fresh weight (RFW, g) and root dry weight (RDW, g). The collected data was subjected to the analysis of variance following the procedure outlined by Steel *et al*. (1997) and the treatment means were compared using Tukey's HSD test by using Statistics 8.1 software.

Results and Discussion

The compost produced under different composting treatments and conditions was applied to check the growth and performance of wheat. The results showed significant differences for root length, shoot fresh weight, shoot dry weight and root fresh weight, while the shoot length and root dry weight differed non-significantly among the composting treatments (Table 2).

In the case of shoot length, the maximum shoot length (20.66 cm) was observed under the application of compost produced from the anaerobic composting of cow manure : wheat straw (3:1) which followed by 17.8 cm recorded under the application of compost produced from the anaerobic composting of cow manure : wheat straw (1:3). The lowest shoot length (16.56 cm) was observed under the application of compost produced from the aerobic composting of cow manure : wheat straw (3:1) (Fig. 1a). Nadjet *et al*. (2014) also observed

Table 1. List of treatments

Treat-ments	
T1	Aerobically produced compost having 3:1 of cow manure and wheat straw,
T2	Aerobically produced compost having 1:1 of cow manure and wheat straw
T3	Aerobically produced compost having 1:3 of cow manure and wheat straw
T4	Anaerobically produced compost having 3:1 of cow manure and wheat straw,
T5	Anaerobically produced compost having 1:1 of cow manure and wheat straw
T6	Anaerobically produced compost having 1:3 of cow manure and wheat straw

Table 2. Mean sum of squares for the shoot length (SL), root length (RL), shoot fresh weight (SFW), shoot dry weight (SDW), root fresh weight (RFW) and root dry weight (RDW) of wheat grown under different types of compost

Source	DF	SL	RL	SFW	SDW	RFW	RDW
Treatments	5	8.19^{NS}	8.29**	1.06*	0.96**	0.65**	0.07^{NS}
Error	48	15.74	1.53	0.35	0.06	0.11	0.05
Total	53						

where: DF = degree of freedom; * = significant at $P \leq 0.05$; ** = highly significant at $P \leq 0.01$ and the NS = non-significant at $P > 0.05$

that the application of compost increased plant growth and improved the seedling and plant length. The maximum shoot fresh weight (3.76 g) and shoot dry weight (2.27 g) were recorded under the application of compost produced from the anaerobic composting of cow manure : wheat straw (1:3), followed by 3.25 g and 1.51 g of shoot fresh and dry weight recorded under the application of compost produced from the anaerobic composting of cow manure : wheat straw (1:1). The lowest shoot fresh weight (2.99 g) and shoot dry weight (1.36 g) was recorded under the aerobic composting of cow manure : wheat straw (3:1) (Fig. 1b and 1c). Nadjet *et al*. (2014) found that the compost results in increased wheat growth and development and better yield, plant fresh and dry weight, number of seeds, weight of seeds, number of spikes and their weights than the control.

The maximum root length (4.6 cm), root fresh weight (2.37 g) and root dry weight (1.25 g) was recorded under the application of compost produced from the anaerobic composting of cow manure : wheat straw

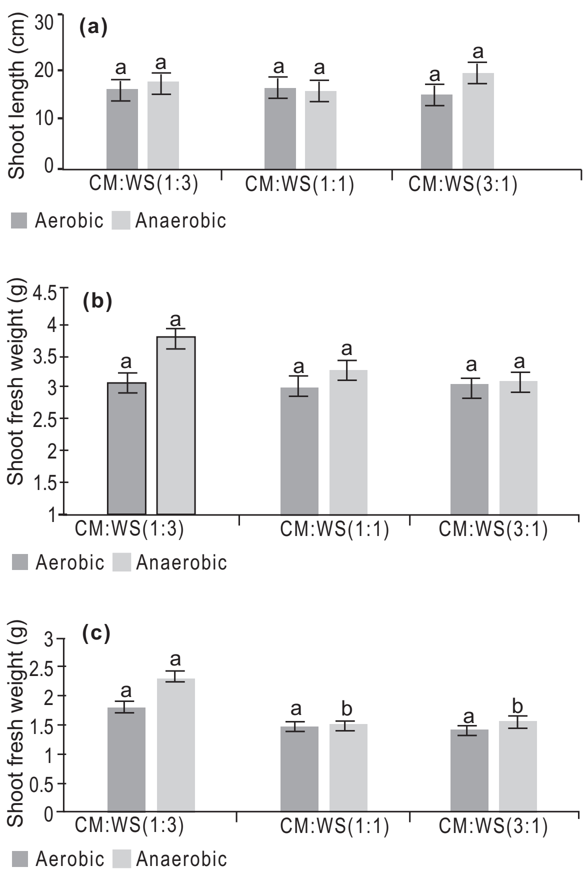

Fig. 1. Performance of wheat genotypes for **(a)** shoot length, **(b)** shoot fresh weight and **(c)** shoot dry weight under application of different types of compost.

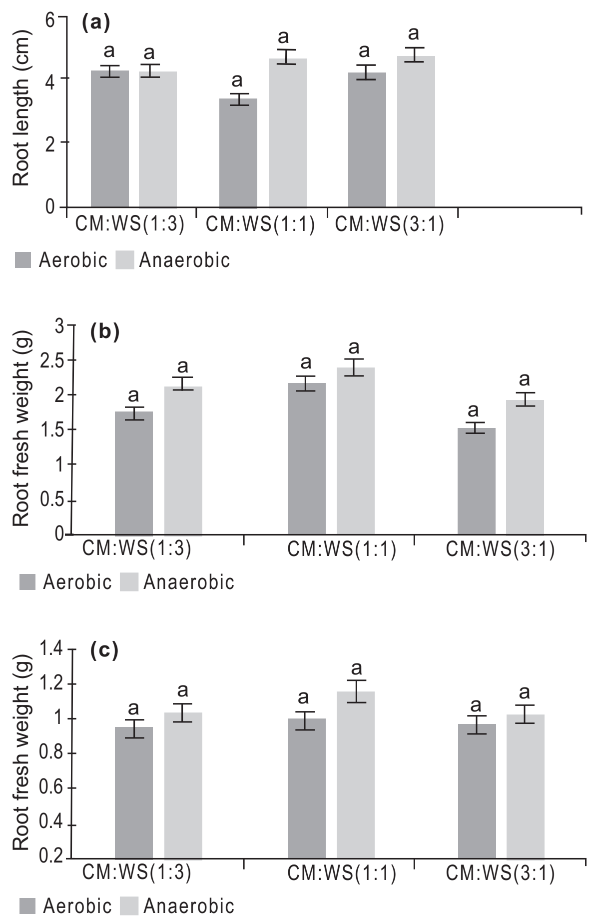

Fig. 2. Performance of wheat genotypes for **(a)** root length, **(b)** root fresh weight and **(c)** root dry weight under application of different types of compost.

(1:1). The minimum root length (3.36 cm) was recorded under the application of compost produced from the aerobic composting of cow manure : wheat straw (1:1). The lowest root fresh weight (1.52 g) and root dry weight (0.99 g) was recorded under the application of compost produced from the anaerobic composting of cow manure : wheat straw (3:1) (Fig. 2a, 2b, 2c, respectively). The application of compost improved the physical and biochemical properties of soil. It also enhances the soil structure, good soil structure enhances the water and gas transfer in the soil, seed germination, root growth and reduces soil erosion (Gao *et al*., 2010). Compost can enhance the growth of plant, root development and thus enhance nutrient uptake from the soil (Walker and Bernel, 2008). The compost has many positive impacts on the soil and plant production, *e.g*. improves soil health (Sadegh-Zadeh *et al*., 2018) minimizes soil salinity (Youssif *et al*., 2018) improves drought tolerance (Eboibi *et al*., 2021) and increase the plant growth and yield (Aiqing *et al*., 2021). These results suggest that the compost application effectively improved the wheat growth, which may lead to better seeding stand and wheat yield.

Conclusion

This study showed that the effect of applied compost on the growth of wheat plants varies on the type of compost. The compost produced under anaerobic composting conditions showed enhanced seedling growth, root and shoot length compared to the compost produced under anaerobic conditions. This study showed that the utilization of compost instead of inorganic fertilizers may improve the wheat growth and result in better seedling stand which ultimately enhances the grain yield per unit area.

Conflict of Interest. The authors declare that they have no conflict of interest.

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