

Original Research Article

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Impact of Organic and Inorganic Amendments on Yield and Growth of Wheat (*Triticum aestivum* L.)

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ABSTRACT

Keywords

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Effect of organic and inorganic amendments on growth and yield of wheat were studied in alluvial soil in experiment farm of Lovely Professional University 2017-18. The experiment was laid out in Randomized complete block design with eight treatments were set and each replace three times. Totally eight treatments in which one control and one 75% RDF alone and five treatment consist combination of organic and inorganic amendments and one treatments is combination of organic manures. Growth parameters were recorded at 30, 60 and 90 DAS and yield parameters are were recorded at the time of harvest. Plant height, leaf area per plant, number of grains per spike and grain yield of wheat was recorded. Result indicates that the application of 50%RDF+0.4t sewage sludge ha⁻¹+0.25t bone meal ha⁻¹ showed significant positive impact on plant height, leaf area per plant, number of grains per spike and grain yield of wheat.

Introduction

Wheat considered as the highest cultivated crop all around the world. It is good source of protein and provides a large fraction of the total food supply. Wheat is mainly grown in Punjab and some other states of India, but now cultivated worldwide. Total production of wheat all around world 2016-17 years was 724 million tons and rice was (494.4 million tons). The wheat considered grown under larger area than any other commercial food. Wheat has

higher protein content than other major cereals crops, corn or rice. Wheat is a Rabi season crop of Central Zone and North Western Plain zone of India. Wheat grains are comparatively better source of protein consumed in India. Wheat fulfills the 10-20% requirement of protein in India. The productivity of the wheat crop and the protein content could be increased by the use of different fertilizers. The imbalanced and heavy use of chemical fertilizer are two most important factors has led to think about the use of vermicompost,

poultry manure, sewage sludge, bone meal, FYM, etc. in growing areas for sustainable production system. To achieve the potential of production and sustainability of crop, higher uses of vermicompost, poultry manure and their scientific management is very important. It must be stressed that the value of FYM, poultry manure, cattle slurry and vermicompost in soil improve the nutrient content, while helping in the improvement of water holding capacity and soil structure of soil. The seed produced under organic system has to be used for organic crop production. For the sake of continuing world energy crisis and spiraling price of chemical fertilizer, the use of organic manure as a renewable source of plant nutrients is assuming importance. In this endeavor proper blend of organic manure and inorganic fertilizer is important not only for increasing yield but also for sustaining soil health (Kumar *et al.*, 2013). Vermicompost is rich in microbial populations and diversity, particularly fungi, bacteria, and actinomycetes (Edwards, 1988, Tomati, 1995) and also best result is obtained by the vermicompost at the growth of plants. The continuously use of chemical fertilizers effect on the human health and such as ground water, surface water polluted by the nitrate leaching (Pimentel, 1996).

Andhikari and Mishra (2002) showed that the mixed applications of vermicompost and urea can be reduced by 50% amount of urea in the field conditions. And, also the yield was 12% higher than by the use of vermicompost and urea. Wheat is important cereal crop and require a good supply of nutrients especially nitrogen for its growth (Mandal *et al.*, 1992) and yield (Kirrilov and Pavlov, 1989) and also the best combination of organic and inorganic fertilizer for the growth and yield of wheat. Mainly application of organic and chemical fertilizers to improve the soil fertility, soil physical and chemical properties and increase yield (Ezekiel, 2010).

Organic manure increases the accumulation of the soil organic carbon (SOC), quality and quantity of various classes of organic compounds. Research on SOC following crops residue has been mainly focused on changes of bulk organic carbon. It is seen that the integrated use of concentrate organic materials and inorganic fertilizers has received considerable attention, in the past with a hope of meeting the farmer's economic need. It may also help to check the emerging deficiency of nutrients other than N, P and K that brings economy and efficiency in fertilizers. The necessary nutrient management favorably affects the physical, chemical and biological environment of soil.

Materials and Methods

Location of experimental site

The experiment was conducted at the experimental Farm of the Department of Agriculture, Lovely Professional University, Jalandhar, Punjab (India) during 2017-18. The latitude 31° 22'31.81'N and 75°23'03.02 E longitude with altitude of 252 m above sea level, which falls under the central plain zone of Agra climate zone of Punjab. The soil was sandy loam with pH 7.6. The available N, P and K content of soil were 246, 16.51 and 265 kg ha⁻¹, respectively with organic carbon 0.38 (%) and Electrical conductivity 0.36 (dSm⁻¹).

Experimental detail

The experiment was laid out in Randomized complete block design with eight treatments were set and each replicate three times. Totally eight treatments in which one control, one treatment consist 75% RDF and five treatments consist combination of inorganic fertilizers, organic manures and one treatment is the combination of organic manures. Table 1 shows the detail of treatments.

Agronomic practices

Wheat variety HD 2967 was used in this research work. In addition to this, half dose of nitrogen and full dose of phosphorus and potassium were also applied as per treatment through urea, SSP and muriate of potash, respectively. The remaining half dose of nitrogen was applied at the time of earthing up. Wheat was sown by line sowing method at sowing depth 3-6 cm in the November, 2017. The 100% RDF contained 120 kg N, 60 kg phosphorous, 40 kg Potassium per hectare and 75% RDF contained 90 kg N, 45 kg phosphorous and 30 kg potassium per hectare and 50% RDF contained 60 kg N, 30 kg phosphorous and 20 kg potassium per hectare and 25% RDF contained 30 kg N, 15 kg phosphorous and 10 kg potassium per hectare.

Data collection

The growth attributes (plant height and leaf area index) were taken at 90 DAS and yield attributes (Number of grains per spike and grain yield) were taken at harvesting.

Statistical analysis

Data were analyzed by Duncan's Multiple Range Tests (DMRT) for separation of means with a probability $p < 0.05$. Difference between mean values was evaluated by Analysis of Variance (ANOVA) using the software SPSS 16.

Results and Discussion

Growth attributes

Plant height

Plant height ranged from 54.22 to 67.67 cm at 90 DAS. The highest value (67.67 cm) of plant height was recorded in T₃ (50%RDF+0.4t sewage sludge ha⁻¹+0.25t bone

meal ha⁻¹) followed by T₁ (75%RDF) i.e. 66.30 cm while the lowest value (54.22 cm) was recorded in T₀ (control). As compared to T₀, T₃ showed 24.81% increase in plant height at 90 DAS. The reason of the highest plant height in this treatment is that the combination of RDF, sewage sludge and bone meal is having good amount of nitrogen and easily provided to plants which helps in good plant height. Same results were reported by Thakur *et al.* (2017).

Leaf area per plant

Leaf area per plant ranged from 196.62 to 227.34 cm² at 90 DAS. The highest value (227.34 cm²) of leaf area per plant was recorded in T₃ (50%RDF+0.4t sewage sludge ha⁻¹+0.25t bone meal ha⁻¹) followed by T₁ (75%RDF) i.e. 222.86 cm² while the lowest value (196.62 cm²) was recorded in T₀ (control). As compared to T₀, T₃ showed 15.62% increase in leaf area per plant at 90 DAS. The RDF, sewage sludge and bone helps to increase these characters of wheat. Our results are in accordance with the result of Pietz *et al.*, (1982) (Table 2).

Yield attributes

Number of grains per spike

Number of grains per spike ranged from 46.42 to 72.02. The highest value (72.02) of number of grains per spike was recorded in T₃ (50%RDF+0.4t sewage sludge ha⁻¹+0.25t bone meal ha⁻¹) followed by T₁ (75%RDF) i.e. 70.32 while the lowest value (46.42) was recorded in T₀ (control). As compared to T₀, T₃ showed 25.8% increase in number of grains per spike. Number of grains per spike is highest in T₃ (50%RDF+0.4t sewage sludge ha⁻¹+0.25t bone meal ha⁻¹). This may be due to higher organic matter content in sewage sludge (Table 3).

Table.1 Treatment detail

T ₀	Control
T ₁	75% RDF
T ₂	50% RDF+6t FYM ha ⁻¹ +1t Poultry Manure ha ⁻¹
T ₃	50% RDF+0.4t Sewage Sludge ha ⁻¹ +0.25t Bone Meal ha ⁻¹
T ₄	50% RDF+6t FYM ha ⁻¹ +1.5t Vermicompost ha ⁻¹
T ₅	25% RDF+6t FYM ha ⁻¹ +1.5t Vermicompost ha ⁻¹ +25% Bone meal
T ₆	25% RDF+1.5t Vermicompost ha ⁻¹ +0.4t Sewage Sludge ha ⁻¹ +1t Poultry Manure ha ⁻¹
T ₇	6t FYM ha ⁻¹ +1t Poultry Manure ha ⁻¹ +0.4t Sewage Sludge ha ⁻¹ +0.25t Bone Meal ha ⁻¹

RDF= recommended dose of NPK

Table.2 Effect of different organic and inorganic amendments on Plant height (cm) and leaf area per plant (cm²)

Treatments	Plant height (cm) at 90 DAS	Leaf area per plant(cm ²) at 90 DAS
T ₀	54.22 ^c ± 1.36	196.62 ^c ± 3.45
T ₁	66.30 ^{ab} ± 1.67	222.86 ^{ab} ± 3.91
T ₂	63.84 ^{abc} ± 1.60	220.22 ^{ab} ± 3.86
T ₃	67.67 ^a ± 1.70	227.34 ^a ± 3.98
T ₄	62.59 ^{bc} ± 1.57	215.95 ^{abc} ± 3.78
T ₅	60.79 ^{cd} ± 1.53	211.03 ^{bcd} ± 3.70
T ₆	58.95 ^{cde} ± 1.48	206.85 ^{cde} ± 3.62
T ₇	56.76 ^{de} ± 1.43	202.28 ^{de} ± 3.55

The mean followed by different letters are significantly different at p<0.05, according to DMRT (Dum can's Multiple Range Test) for separation of means.

Note- T₀-control, T₁-75% RDF, T₂-50% RDF+6t FYM ha⁻¹+1t poultry manure ha⁻¹, T₃-50% RDF+0.4t sewage sludge ha⁻¹+0.25t bone meal ha⁻¹, T₄-50% RDF+6t FYM ha⁻¹+1.5t vermicompost ha⁻¹, T₅-25% RDF+6t FYM ha⁻¹+1.5t vermicompost ha⁻¹+0.25t bone meal ha⁻¹, T₆-25% RDF+1.5t vermicompost ha⁻¹+0.4t sewage sludge ha⁻¹+1t poultry manure ha⁻¹, T₇-6t FYM ha⁻¹+1t poultry manure ha⁻¹+0.4t sewage sludge ha⁻¹+0.25t bone meal ha⁻¹

Table.3 Effect of different organic and inorganic amendments on Number of grains per spike and Grain yield

Treatments	Number of grains per spike	Grain yield (t ha ⁻¹)
T ₀	46.42 ^f ± 0.68	3.62 ^f ± 0.08
T ₁	70.32 ^{ab} ± 1.03	5.62 ^b ± 0.12
T ₂	67.61 ^b ± .99	5.33 ^{bc} ± 0.11
T ₃	72.02 ^a ± 1.05	6.0 ^a ± 0.12
T ₄	64.06 ^c ± .94	5.04 ^c ± 0.1
T ₅	61.19 ^d ± .89	4.70 ^d ± 0.1
T ₆	57.16 ^e ± .83	4.54 ^d ± 0.09
T ₇	55.23 ^e ± .80	4.13 ^e ± 0.08

The mean followed by different letters are significantly different at p<0.05, according to DMRT (Dum can's Multiple Range Test) for separation of means.

Note- T₀-control, T₁-75% RDF, T₂-50% RDF+6t FYM ha⁻¹+1t poultry manure ha⁻¹, T₃-50% RDF+0.4t sewage sludge ha⁻¹+0.25t bone meal ha⁻¹, T₄-50% RDF+6t FYM ha⁻¹+1.5t vermicompost ha⁻¹, T₅-25% RDF+6t FYM ha⁻¹+1.5t vermicompost ha⁻¹+0.25t bone meal ha⁻¹, T₆-25% RDF+1.5t vermicompost ha⁻¹+0.4t sewage sludge ha⁻¹+1t poultry manure ha⁻¹, T₇-6t FYM ha⁻¹+1t poultry manure ha⁻¹+0.4t sewage sludge ha⁻¹+0.25t bone meal ha⁻¹

Sewage sludge can improve physical, chemical and biological properties of soil. It helps to reduce soil erosion and improves the soil quality as a plant growth medium. The fertilizer effect enables a reduction in cost for nitrogen and phosphorus mineral fertilizers and may improve crop yield on sludge treated fields.

Hence, number of grains per spike was highest. The findings of present investigation are nearly similar with the findings of Abedi *et al.*, (2010).

Grain yield

Grain yield ($t\ ha^{-1}$) varied from 3.62 to 6.0 $t\ ha^{-1}$. The highest value (6.0 $t\ ha^{-1}$) of Grain yield ($t\ ha^{-1}$) was recorded in T₃ (50%RDF+0.4t sewage sludge ha^{-1} +0.25t bone meal ha^{-1}) followed by T₁ (75%RDF) i.e. 5.62 $t\ ha^{-1}$. The lowest value (3.62 $t\ ha^{-1}$) was recorded in T₀ (control). As compared to T₀, T₃ showed 12.86% increase in Grain yield ($t\ ha^{-1}$).

Grain yield ($t\ ha^{-1}$) value is high in T₃ which contain 50% RDF, 4t sewage sludge ha^{-1} and 0.25t bone meal ha^{-1} . We know that the RDF when we apply to soil, it give result to plant very quickly. Because the RDF dissolve in soil very fast and RDF give good result during early period of crop and remaining organic manure that taken some time to decompose in soil and that's why the sewage sludge and bone meal decompose after some time and crop taken benefit after flowering and good fruit set and give good grain yield. And this result is nearly similar with the result of Khan *et al.*, (2007).

Based on the present study it was concluded that the combination of RDF, sewage sludge and bone meal helps to improve the growth and yield characters of wheat which plays an important role in the sustainable agriculture.

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