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Impact of Organic and Chemical Fertilizers on Growth and Yield of Wheat(Triticumaestivum L.)

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ABSTRACT

A field experiment was carried out at the outdoor nursery of Department of Environmental Science, School of Earth Sciences, Solapur University, Solapur to study the effects of organic and chemical fertilizers on the growth and yield of Wheat crop.The organic fertilizers were used as soil supplement in the plots of size 2 m x 1 m. Five treatments were given viz. VC- @ 1 kg (@ 0.5 kg/sq. m), NADEP compost-@ 2 kg (@ 1 kg/sq. m), Pit compost-@ 1.25 kg (@ 0.625 kg/sq. m), NPK (recommended dose of fertilizers) and soil (control) in triplicates with a Randomized Block Design (RBD). A total of 20 plants were selected randomly for the assessment of growth and yield of wheat (Triticumaestivum L.). It has been observed that all the growth parameters showed higher performance with straight chemical fertilizers treatment then followed by vermicompost treatment.

KEYWORDS | Vermicompost, organic fertilizers, wheat, growth performance, chemical fertilizer

Introduction

Wheat is one of the major cereal crops with unique protein and is provides provide more nourishment for the humans than any other sources. It also contain carbohydrates, minerals, vitamins and fats [1, 2]. Composting and vermicomposting are suitable methods for solid waste management practices, resulting in good soil conditioner for better improvement of growth and yield of crop and therefore utilised as nutrient source to crop system [3]. Vermicomposting is simple a biological process in which certain species of earthworms are used to convert organic biodegradable solid wastes into a nutrient-rich end product and applied in agriculture as a soil conditioner for crop improvement. The nutrient rich end product is very effective natural fertilizer with no environmental hazards [4].Yousefi andSadeghi(2014) conducted a field experiment to study effect of vermicompost and urea chemical fertilizers on the yield and yield components of wheat (*Triticumaestivum*) in the field condition. The results observed that the combined application of urea fertilizer andvermicompost had significant effects on grain yield. Addition of vermicompost increased growth characteristics of wheat but combination of urea fertilizer with vermicompost were improved the performance and yield components of wheat [5]. Rakesh Joshi et al (2013) conducted a field experiment to study the effects of vermicompost as soil supplement to enhance the growth, yield and quality of *Triticumaestivum L*. The study observed that most of the growth, yield and quality parameters were found to be maximum in NPK treatment. [6]. Noreen and Noreen (2014) stated that the combined use of farmyard manure, chemical fertilizer and biofertilizer has beneficial effect on crop plants. The use of organic fertilizers are beneficial for the crop growth and they do not pollute the environment while on the other hand the use of chemical fertilizers pollutes our environment and kill the beneficial soil microorganisms [7]. The main objective of this study was to access the effect of organic and chemical fertilizers on growth and yield of wheat and compare the growth and yield of wheat using different fertilizer treatments.

Methodology

The main objectives of the field experiment was to compare the growth and yield of wheat using organic and chemical fertilizer treatments. All the treatments were given in triplicates in a complete randomized block design. Agricultural solid waste with cattle dung (ASW)was used for preparation of vermicompost (VC) and NADEP compost. Municipal solid waste (MSW) was used for preparing pit compost. Nutrient status of prepared organic fertilizers and initial soil was analysed at the laboratory of Department of Environmental Science, School of Earth Sciences, Solapur University, Solapur and confirmed in Nikhil laboratory, Sangali. The method of composting process was followed as described byChavan et al (2015) [8].The five treatments were taken as compost from vermicomposting (T_1), NADEP method of composting (T_2), pit composting method (T_3), chemical fertilizers was applied in the proportion 120:60:40 Kg of NPK/ha according to recommended dose of fertilizers (RDF) as T_4 and the control (T_5). Application of vermicompost, NADEP compost at the rate of @ 1 kg (@ 0.5 kg/sq. m) and @ 2 kg (@ 1 kg/sq. m) per plot were used to the plots having size 2m x 1m. A common dose of pit compost was used at rate @ 1.25 kg (@ 0.625 kg/sq. m) as per usual practice of farmers. Straight chemical fertilizers (Urea-52.08gm + Single super phosphate-75gm + Murate of potash-13.28 gm) combinally used in plot size 2 m x 1 m.Experimental details and cultivation practice for Wheat crop were as given bellow.

Binomial name -Triticumaestivum L.
Varity - Local

Experiment - Field experiment.

Design - Randomized block design.

Plot size - 2m x 1m

Replications - Three

Crop population per plot -1000

Treatment details and recommended dose of fertilizers (RDF)

T_1 - VC prepared from ASW @ 5 t/h, [6]

T_2 - NADEP compost prepared from ASW @ 10 t/ha, [9]

T_3 - Pit compost prepared from MSW @ 6.25 t/ha, [10]

T_4 - Chemical fertilizer- 120:60:40-N: P: K Kg/ha, [11]

T_5 - Control

Quantity of fertilizers used according to RDF in plot size 2m X 1m.

T_1 - @ 1 kg (@ 0.5 kg/sq. m), [6]

T_2 - @ 2 kg (@ 1 kg/sq. m), [9]

T_3 - @ 1.25 kg (@ 0.625 kg/sq. m), [10]

T_4 - According to RDF (Urea-52.08gm + single super phosphate - 75gm + murate of potash - 13.28 gm), [11]

T_5 - Soil without fertilizer.

The initial soil samples were collected randomly from 0 to 15 cm depth in different plots of the field and well mixed, dried, sieved to pass through 2mm screen and taken to laboratory for soil analysis. Prepared organic fertilizers were also taken for chemical analysis. Soil pH was estimated using digital pH meter. Moisture content was estimated by drying the sample in oven. Organic matter was estimated by titratration method using ferrous ammonium sulphate. Nitrogen was determined using Kjeldahls assembly. The amount of phosphorus was analysed by spectrophotometer method. The potassium was analysed by flame photometer.

Result and Discussion

Soil testing is important method and used for determining the nutrient need of the plant before the crop is planted.Table 1 shows the results of the chemical analysis of the soil studied. The value of pH of soil was 08.11 and has moisture content 8.07%. The value of organic matter was 1.00. The N, P and K values of soil were 0.29%, 0.25% and 0.11% observed respectively. The all values of nutrients found from prepared organic fertilizers are represented in table 1.

Table 1. Soil and organic fertilizers characteristics.

Parameters	Soil	T1	T2	T3
pH	08.11	8.01	7.70	7.20
Moisture (%)	8.07	30.24	18.40	05.47
Org. matter (%)	1.00	16.55	11.82	11.32
N (%)	0.29	1.25	0.99	0.75
P (%)	0.25	1.50	1.09	0.11
K (%)	0.11	1.05	1.90	0.81

T_1 indicate vermicompost, T_2 indicate NADEP compostand T_3 indicate pit compost

At the age of 90 days, 20 wheat plants from each plot were randomly taken for morphological data such as average plant height without spike (cm), average length of spike without awns/plant (cm/spike), average number of seeds/spike/plant and average dry weight of seeds/plant (gm/spike) and were measured. Also dry weights/plant were estimated after 30 and 60 days. Dry weight of 100 seeds and total yield of wheat/plot (kg/plot) were also estimated after 90 days. The results obtained on various growth and yield parameters were recorded after 30, 60 and 90 days. Total 20 plant samples were selected randomly from each treatment (20 from each plot) for the assessment of morphological characters of wheat plant. The results on growth parameters and yield of Wheat treated with different fertilizer treatments are presented in Table no. 2 and 3.

Table no.2 Effect of fertilizers treatment on dry weight of the wheat crop after 90 day.

Treatments	Average height of plant without spike (cm)	Average length of spike without awns (cm/spike/plant)	Average number of seeds/spike/plant	Average dry weight of grains/spike/plant (gm)	Dry weight of 100 seeds (gm)	Yield / plot (Kg/plot)
T_1	50.64	6.32 (±1.26)	18.40 (±4.27)	0.975 (±0.11)	5.05	0.86
T_2	51.47	6.10 (±0.47)	17.25 (±6.60)	0.766 (±0.29)	4.78	0.75
T_3	48.5	6.12 (±0.37)	16.25 (±4.57)	0.847 (±0.18)	4.08	0.58
T_4	58.2	6.46 (±1.19)	21.00 (±7.25)	1.00 (±0.26)	5.80	0.91
T_5	47.5	5.46 (±1.37)	20.00 (±6.97)	0.745 (±0.15)	3.24	0.59

T_1 indicate vermicompost, T_2 indicate NADEP compost, T_3 indicate pit compost T_4 indicate chemical fertilizers and T_5 indicate control

Height of plant without spike/plant (cm/plant):

Average plant height (cm) in the treatments T_1, T_2, T_3, T_4 and T_5 were found to be 50.64cm, 51.47cm, 84.5cm, 58.2 and 47.5 respectively. Maximum height per plant was found in the plants treated with (58.2cm) in T_4treatment followed by (51.47cm) T_2 treatment. It was lowest in (47.5cm) T_5treatment which is nearest to (48.5cm) T_3 treatment.

Length of spike without awns (cm/spike/plant):

Average length of spike without awns (cm/spike/plant) in the treatments T_1, T_2, T_3, T_4 and T_5 were found to be 6.32cm, 6.10cm, 6.12cm, 6.46cm and 5.46cm respectively. Average length of spike without awns (cm/spike/plant) was maximum in T_4 (6.46cm) treatment while it was minimum in T_5 (5.46cm) treatment.

Number of seeds/spike:

A significant increase was observed in average number of seeds/spike/plant in treatmentupto 18.40 in T_1, 17.25 in T_2, 16.25 in T_3, 21.00 in T_4 as compared to control (20.00) as T_5 treatment. Average number of seeds/spike/plant of wheat was maximum in (21.00) T_4 treatment, followed by (20.00) T_5 treatment and lower in (18.40) T_1 treatment and minimum in T_3 treatment.

Dry weight of grains /plant:

Average weight of grains/spike/plant was more in (1.00 gm) T_4 treatment than control and other remaining fertilizer treatments. It was 1.00 gmT_1, 0.766 gm in T_2, 0.847 gm in T_3, and 0.745 gm in T_5 respectively. There was no difference in treatments T_2 and treatment T_5 in average grain weight of wheat crop.

Dry weight of 100 seeds (gm):

A significant increase was observed in 100 grains weight in fertilizer treatments. It was 5.05 gm in T_1, 4.78 gm in T_2, 4.08 gm in T_3, 5.81 gm in T_4 as compared to control (3.24gm) and is shown in table no.2. The maximum dry weight of 100 seeds (5.80gm) of treatment T_4 was observed The minimum dry weight of 100 seeds (3.24gm) of control treatment T_5 was obtained.

Yield / plot (Kg/plot):

The yield/plot of wheat in soil (control) came out to be 0.59 Kg while it came out to be 0.91 Kg, 0.58 Kg, 0.75 Kg and 0.76 Kg in treatments T_4, T_3, T_2, T_1 respectively. Maximum yield was observed in control treatment T_5 as compared to treatmentT_3. At the time of harvesting (after 90 days) maximum grain yield/plot was highest (0.91 Kg/plot) in plots received with (T_4)chemical fertilizers application followed in order by T_1 (vermicompost), T_2 (NADEP compost), T_5 (control), and T_3 (pit compost).

Table 3.Effect of fertilizers treatment on dry weight of the wheat crop after 30 and 60 day

Treatments	Average dry weight/plant (gm/plant) after 30 days	Average dry weight/plant (gm/plant) after 60 days
T-1	0.359 (±0.13)	1.50 (±0.72)
T-2	0.166 (±0.15)	1.43 (±0.35)
T-3	0.179 (±0.17)	1.03 (±0.53)
T-4	0.328 (±0.04)	1.19 (±045)
T-5	0.278 (±0.09)	1.20 (±0.57)

T_1 indicate vermicompost, T_2 indicate NADEP compost, T_3 indicate pit compost T_4 indicate chemical fertilizers and T_5 indicate control

The data presented in Table no. 3 indicated that maximum av-

erage dry weight/plant (0.359gm/plant) and lowest dry weight (0.166 gm/plant) were obtained after 30 days in treatment T_1 and T_2 respectively. While maximum average dry weight/plant (1.50gm/plant) and lowest dry weight (1.03 gm/plant) were obtained after 60 days in treatment T_1 and T_3 respectively.

Conclusion

This study have clearly indicated that all the growth parameters of wheat (***Triticumaestivum L.***)crop have higher performance with straight chemical fertilizers treatment then followed by vermicompost and other remaining fertilizer treatments.

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