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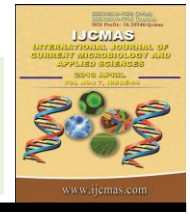

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Evaluation of Quality Compost Prepared from Paddy Straw and Distillery Effluent for Effect on Growth of Wheat (*Triticum aestivum*)

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A B S T R A C T

The main objective of present investigation was to study the effect of quality compost prepared from paddy straw and distillery effluent on the growth of wheat crop. Three best composts 1, 2and 3weretaken for the growth of wheat crop and different treatments were made by amending soil with different concentrations of compost and recommended dose of fertilizers. Different parameters like root, shoot weight and length, N, P, K uptake by wheat at 90 days of sowing and total N, P, K of soil after harvesting were studied. The maximum root and shoot length were 15.92 and 36.20 cm respectively in T9. The same effect was seen with root and shoot weight, it was also maximum in T9 i.e. The dry matter yield and N (41.75), P (51.24), K (35.87) mg/plant uptake of wheat was maximum in T9 with the application of 100% RDF along with compost prepared with 30% distillery effluent and microbial consortia (compost 2). The total N (0.038%), P (532 mg/Kg) was maximum in T9 while K (0.344%) of soil after harvesting of crop was maximum in T13.

Introduction

Paddy straw is a major agricultural waste in rice producing countries including India (Reinhard *et al.*, 2001). Paddy straw is a major agricultural waste in rice producing countries. About 95 million tons of rice residues are produced in the Indo-Gangetic plains, which is about 39% of total crop residues generated (Sidhu *et al.*, 2003). Distillery effluent is an industrial dark brown organic material having extremely high biological oxygen demand (BOD), chemical oxygen demand (COD), inorganic solids and having acidic pH (Shin *et al.*, 1992, Biradar, 2005, Saha *et al.*, 2005, Srivastava *et al.*, 2012). It is considered as one of the serious pollution causing factor of countries (Uppal, 2004).

In last few decades there are so many reports of increasing paddy straw and distillery effluent. The intervention of the National Green Tribunal (NGT) has directed the farmers of Haryana and Punjab not to burn the paddy straw (Gill, 2017). There is increase in particulate matter of air due to burning of paddy straw, thus resulting in posing a great environmental threat (Uppal, 2004). Also soil health along with organic matter is decreasing day by day due to application of chemical fertilizers and overproduction of crops with no left residue behind. Paddy straw is an agricultural residue generated in rice fields and distillery effluent is an industrial waste, produced by molasses-based distilleries (Sidhu *et al.*, 2003).

Composting can be an alternative to recycle such organic wastes along with winery and distillery effluent since it convert them into organic manures which can be used in agricultural practices (Bustamante *et al.*, 2007; 2008). Composting is a process of transforming biologically or biochemically, the organic materials into amorphous humus like substances (under optimum temperature, moisture and aeration conditions) that can be handled, stored and applied to land without harmful environmental impacts (Gallardo-Larva and Nogades, 1987). Also composting or addition of compost may enhance soil organic matter content, thus soil fertility besides bioremediation, and thus it is believed to be one of the most cost-effective methods for soil health improvement (Chen *et al.*, 2017). There are so many diverse strategies for soil bioremediation through composting which are direct composting in field, compost addition, and incorporation of bulking agent, bio-augmentation and application of surfactants. Researchers mostly apply a single or a combination of these strategies to achieve their goals. Organic wastes from agricultural and industrial practices are often selected as the initial composting materials to reduce the costs during soil bioremediation. Also use of these organic wastes for soil remediation is also beneficial in minimizing time and money in their treatment and storage. Organic matter used for composting is helpful in improving soil quality and fertility (Pedra *et al.*, 2007).

If paddy straw having high C/N ratio is mixed with low C/N ratio industrial waste and co-composted, the resulting compost, if use as organic manure, reduce the environmental pollution, substitute chemical fertilizers and maintain the soil health (Bustamante *et al.*, 2010). Since it transforms wastes into organic manures, which can be used in agricultural soil to improve growth of various crops. These organic wastes component of compost are typically rich in organic matter having high levels of nitrogen (N) and phosphorus (P) which are required for growth of plant (Eghball and Gilley, 1999; Parkinson *et al.*, 2004).

So keeping in view the harmful impacts of paddy straw and distillery effluents to the environment and day by day decreasing soil quality due to application of chemical fertilizers, the present study was carried out with the idea of application of compost prepared from paddy straw and distillery effluent like organic waste in soil to enhance the crop quality, thus evaluation of its effects on growth of wheat crop.

Materials and Methods

Compostable material

Rice straw was collected from farmer's fields of village Gujjar Bara, Dist. Narnond (Haryana) India. The distillery effluent (treated) was collected from Associated Distilleries Ltd. Hisar. The cattle dung was collected from Animal Science Department, COBS&H, CCS HAU, Hisar.

Compost selection

Compost was prepared from paddy straw, distillery effluent treated in different concentrations and cattle dung along with microbial consortium and it was analysed for various quality parameters like C/N ratio, CO_2 evolution, water soluble carbon, humic substances, and wheat germination index under laboratory conditions.

Based upon different quality parameters following three best composts were selected:

Compost 1. (Paddy straw + 20% Distillery Effluent + 10% Cattle dung + microbial consortia)

Compost 2. (Paddy straw + 30% Distillery Effluent + 10% Cattle dung + microbial consortia)

Compost 3. (Paddy straw + 40% Distillery Effluent + 10% Cattle dung + microbial consortia)

All three selected composts were dark brown in colour and having neutral pH.

Effect of quality compost on growth of wheat

As there was no phytotoxicity seen in laboratory conditions and it was further evaluated for effect on growth of wheat under pot house conditions. Soil for pot house experiment was collected from field of Balsmand, Hisar and it was analysed for presence of N, P, K and total organic carbon.

After analysing soil and different parameters of compost, the quality compost was checked for its influence on growth of wheat crop under pot house experiment.

Compost was amended @ 5 ton/hectare in the upper layer of soil (0-15 cm) in pots. For this experiment wheat seeds (var. WH 711) used were obtained from CCS HAU, Hisar farm.

Distinct treatments were designed by changing amount of RDF (recommended dose of fertilizer which is 120 kg N, 60 kg P, 60 kg K and 25 kg Zn per hectare for wheat).

One control was taken without any RDF and three quality composts were applied to pots with different combinations of recommended dose of fertilizers i.e. 0%, 50%, 75% and 100% respectively.

The following different parameters of wheat crop were observed

Quantitative parameters

Root weight and length were measured.
Shoot weight and length were also observed.

Qualitative parameters

Total N, P, K uptake by wheat crop after 90 days of sowing was calculated.

Total N, P, K level of soil was also observed after crop harvest.

Total Nitrogen content was determined by Kjeldahl's method (Bremner and Mulvaney, 1982). The total phosphorus was estimated by the method of John (1970).

Total Potassium was calculated on flame photometer by direct feeding given by Jackson, 1973.

Results and Discussion

Initial chemical analysis of soil

The initial analysis of soil was done for pot experiment. The soil was sandy with0.15 % organic carbon and total N, P and K was 0.016%, 260 mg/Kg and 0.25 % respectively.

Effect of quality compost on plant health and soil health

The table 1 shows the effect of three quality compost on wheat root, shoot length under pot house conditions. Root length (15.92 cm) was highest in treatment T9 having compost 2 (@5t/ha) + (100% RDF) and was lowest (2.21 cm) in T1 (control) having only soil. Shoot length was maximum (36.20 cm) in the same treatments and was lowest (16.13 cm) in control without any fertilizer (Fig. 1).

Following treatments were designed

Treatment No.	Treatment
T1	Soil(0% RDF)
T2	Soil+ Compost 1 (@ 5t/ha)+ 0% RDF
T3	Soil+ Compost 1 (@ 5t/ha) + 50% RDF
T4	Soil+ Compost 1 (@ 5t/ha)+ 75% RDF
T5	Soil+ Compost 1 (@ 5t/ha) + 100% RDF
T6	Soil+ Compost 2 (@ 5t/ha)+ 0% RDF
T7	Soil+ Compost 2 (@ 5t/ha) + 50% RDF
T8	Soil+ Compost 2 (@ 5t/ha) + 75% RDF
T9	Soil+ Compost 2 (@ 5t/ha) + 100% RDF
T10	Soil+ Compost 3 (@ 5t/ha)+ 0% RDF
T11	Soil+ Compost 3 (@ 5t/ha)+ 50% RDF
T12	Soil+ Compost 3 (@ 5t/ha) + 75% RDF
T13	Soil+ Compost 3 (@ 5t/ha) + 100% RDF

Table.1 Effect of compost on length of wheat (Var-WH 711) at 90 days after sowing

Sr. No.	Treatments	Root length (cm)	Shoot length (cm)	Total length (cm)
T1.	0% RDF (Control)	**2.20**	**16.13**	**18.33**
T2.	Compost 1 (@ 5t/ha)+ 0% RDF	9.13	30.75	39.88
T3.	Compost 1 (@ 5t/ha) + 50% RDF	13.26	32.06	45.32
T4.	Compost 1 (@ 5t/ha)+ 75% RDF	13.94	33.16	47.10
T5.	Compost 1 (@ 5t/ha) + 100% RDF	14.81	34.30	49.11
T6.	Compost 2 (@ 5t/ha)+ 0% RDF	13.35	31.21	44.56
T7.	Compost 2 (@ 5t/ha) + 50% RDF	14.60	32.43	47.03
T8.	Compost 2 (@ 5t/ha) + 75% RDF	15.02	35.31	51.33
T9.	Compost 2 (@ 5t/ha) + 100% RDF	**15.92**	**36.20**	**52.12**
T10.	Compost 3 (@ 5t/ha)+ 0% RDF	12.26	30.90	43.16
T11.	Compost 3 (@ 5t/ha)+ 50% RDF	13.10	32.50	45.60
T12.	Compost 3 (@ 5t/ha) + 75% RDF	15.33	34.30	49.63
T13.	Compost 3 (@ 5t/ha) + 100% RDF	14.66	36.05	50.71
C. D. at 5% level of significance		0.14	0.06	0.08

Table.2 Effect of quality compost on root and shoot dry weight of wheat (Var- WH 711) at 90 days after sowings

Sr. No.	Treatments	Root dry weight (mg / pot)	Shoot dry weight (mg / pot)	Total dry weight (mg / pot)
T1.	0% RDF (Control)	**96**	**212**	**308**
T2.	Compost 1 (@ 5t/ha)+ 0% RDF	264	838	1102
T3.	Compost 1 (@ 5t/ha) + 50% RDF	338	1046	1384
T4.	Compost 1 (@ 5t/ha)+ 75% RDF	388	1062	1450
T5.	Compost 1 (@ 5t/ha) + 100% RDF	410	1074	1484
T6.	Compost 2 (@ 5t/ha)+ 0% RDF	280	972	1252
T7.	Compost 2 (@ 5t/ha) + 50% RDF	296	1038	1334
T8.	Compost 2 (@ 5t/ha) + 75% RDF	442	1386	1828
T9.	Compost 2 (@ 5t/ha) + 100% RDF	499	1399	1898
T10.	Compost 3 (@ 5t/ha)+ 0% RDF	339	867	1206
T11.	Compost 3 (@ 5t/ha)+ 50% RDF	394	892	1286
T12.	Compost 3 (@ 5t/ha) + 75% RDF	442	1186	1628
T13.	Compost 3 (@ 5t/ha) + 100% RDF	**466**	**1204**	**1670**
C. D. at 5% level of significance		7.85	23.96	21.67

Table.3 Total N, P, K level of soil after crop harvest

Sr. No.	Treatments	Total N (%)	Total P(mg/Kg)	Total K (%)
T1.	0% RDF	0.016	260	0.248
T2.	Compost 1 (@ 5t/ha)+ 0% RDF	0.024	423	0.288
T3.	Compost 1 (@ 5t/ha) + 50% RDF	0.028	430	0.309
T4.	Compost 1 (@ 5t/ha)+ 75% RDF	0.034	506	0.317
T5.	Compost 1 (@ 5t/ha) + 100% RDF	0.035	510	0.326
T6.	Compost 2 (@ 5t/ha)+ 0% RDF	0.029	460	0.300
T7.	Compost 2 (@ 5t/ha) + 50% RDF	0.031	490	0.316
T8.	Compost 2 (@ 5t/ha) + 75% RDF	0.035	525	0.318
T9.	Compost 2 (@ 5t/ha) + 100% RDF	**0.041**	**532**	**0.320**
T10.	Compost 3 (@ 5t/ha)+ 0% RDF	0.030	464	0.293
T11.	Compost 3 (@ 5t/ha)+ 50% RDF	0.034	492	0.326
T12.	Compost 3 (@ 5t/ha) + 75% RDF	0.039	517	0.342
T13.	Compost 3 (@ 5t/ha) + 100% RDF	**0.038**	**523**	**0.344**
C. D. at 5% level of significance		N.S.	17.167	0.071

Fig.1 Effect of quality compost on growth of wheat (Var- WH 711) at 90 days after sowing

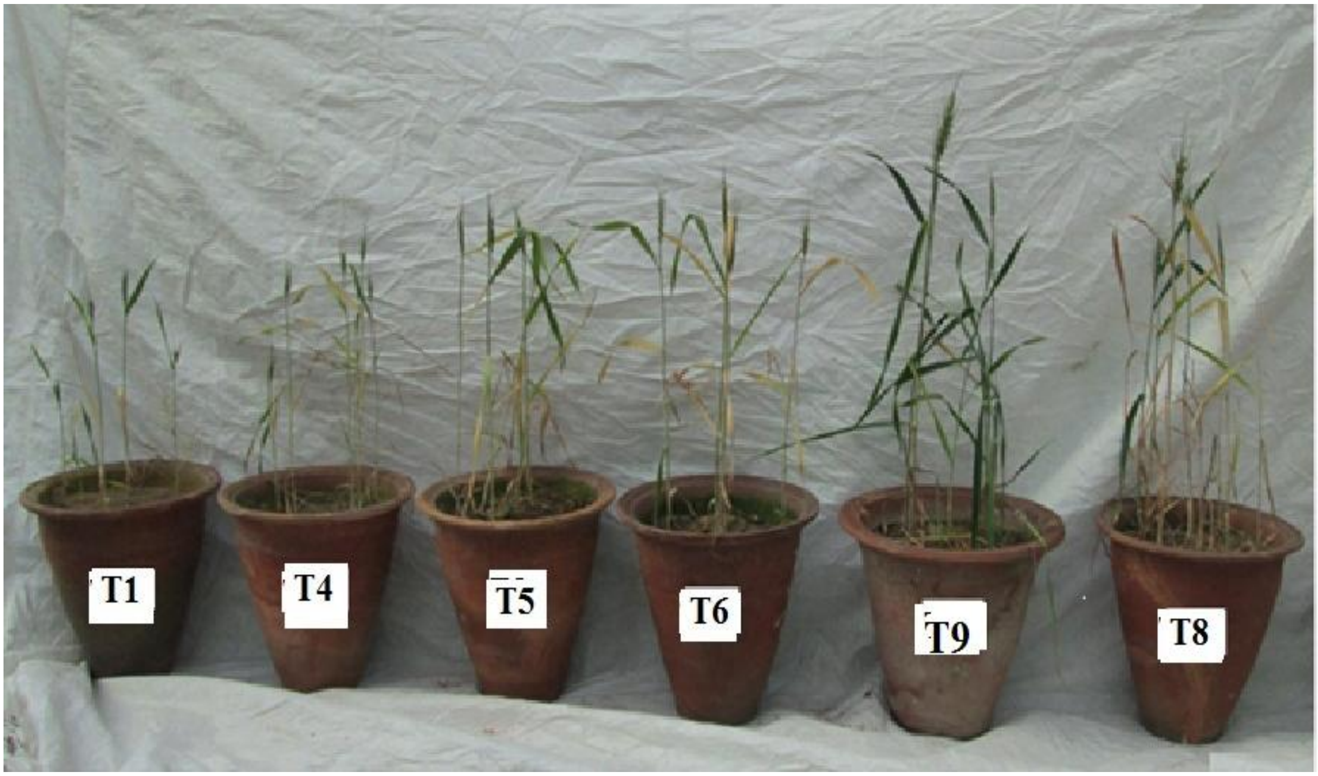


Fig.2 N uptake by wheat plants (WH-711) after crop harvest

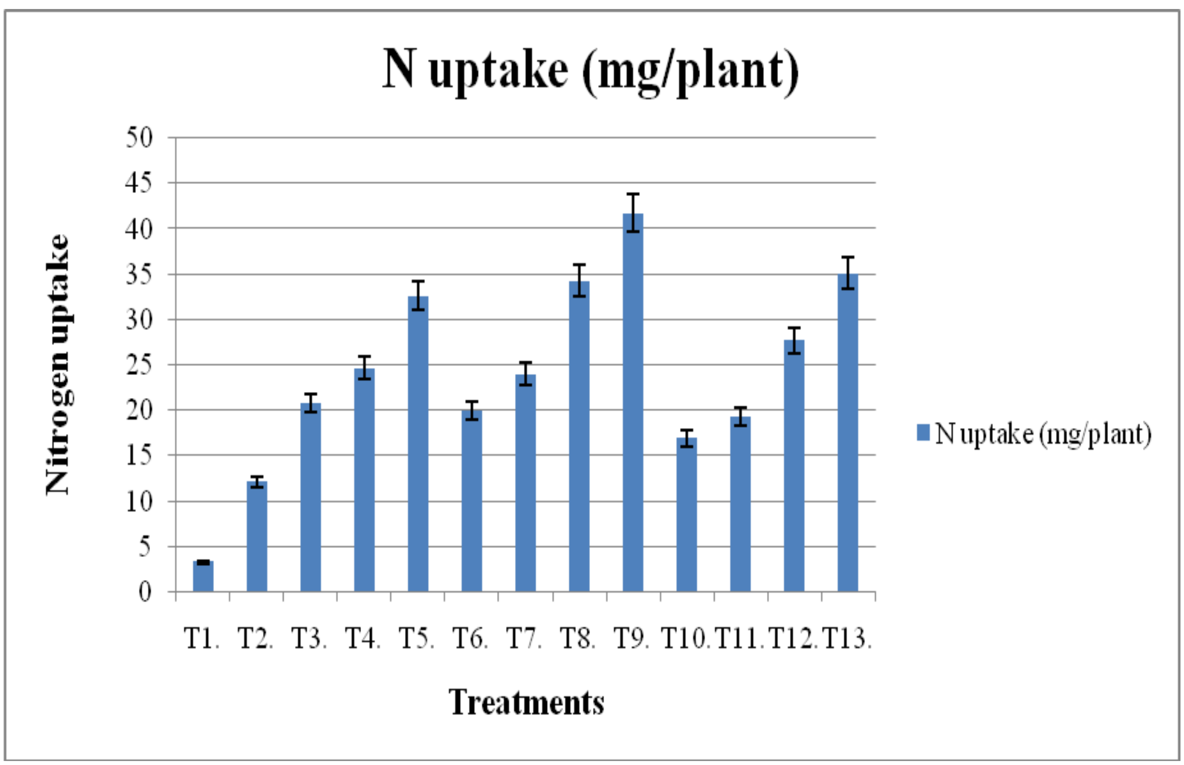


Fig.3 P uptake by wheat plants (WH-711) after crop harvest

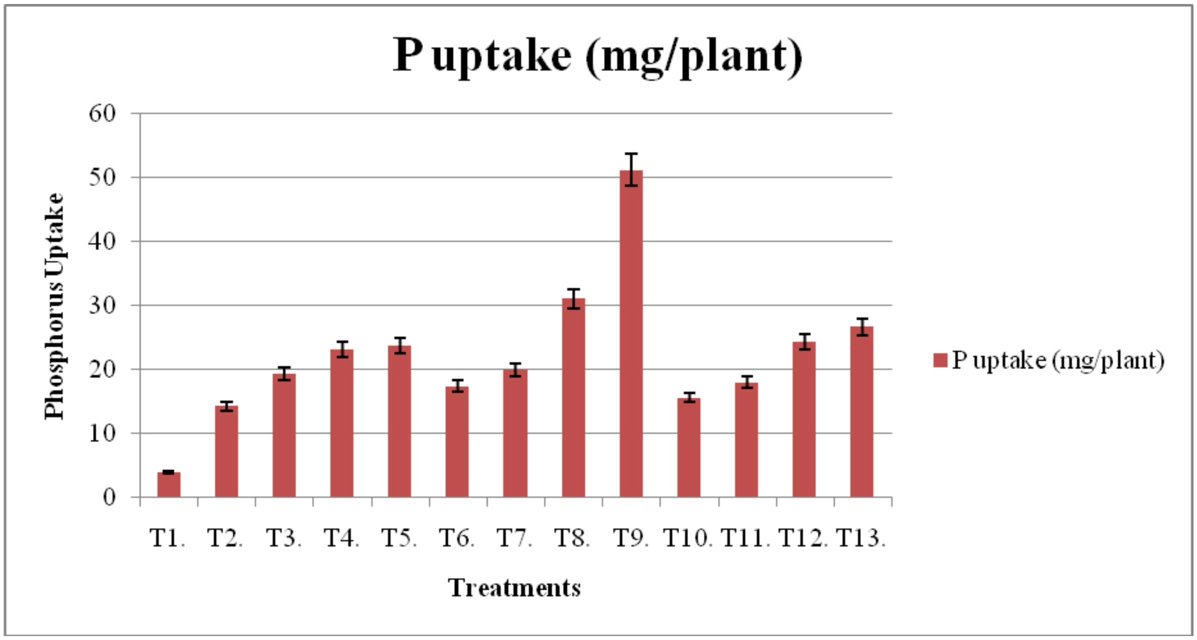
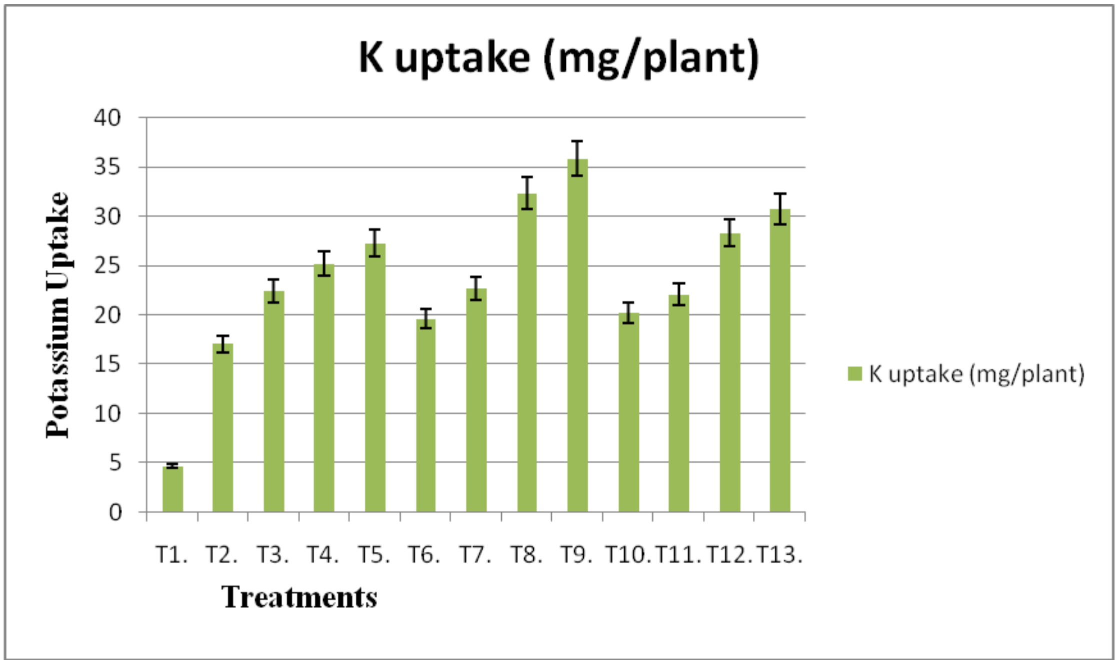


Fig.4 K uptake by wheat plants (WH-711) after crop harvest



Root and shoot dry weight of wheat plants were also observed after 90 days of sowing. Root dry weight was maximum (499 mg/ pot) in treatment T9 having compost 2 + 100% RDF. The shoot dry weight and total dry weight were also maximum in the treatment T9; it was 1399 and 1898 mg/pot respectively (Table 2). The both were minimum in the treatment T1 (control) and was 96 and 212 mg per pot of root and shoot respectively.

Nutrient (N, P, K) uptake in plants after 90 days of sowing are presented in Figure 2, 3 and 4 respectively. Highest N, P and K uptake was 41.75, 51.24 and 35.87 mg/plant respectively in treatment T9 having compost 2 + 100% RDF.

Soil was analyzed for total N, P and K after harvest of wheat crop. Total P and K increased significantly over control, while increase in total N was not significant. Total N and P was maximum in treatment T9having compost 2 (@5 t/ha) + 100% RDF, While total K (%) was maximum in treatment T13 having compost 3 @ 5t/ha) + 100% RDF (Table 3).

The impact of paddy straw and distillery effluent compost on plant growth parameters in wheat (var. WH-711) was evaluated under pot house conditions at 0% RDF (control) and it was compared with treatment having compost @5 t/ha + 0, 50, 75 and 100 % RDF respectively and it was found that the application of compost@5t/ha resulted into more uptake of N, P and K by wheat plants. Various plant growth parameters *viz*., root length, shoot length, plant weight were also significantly affected by compost application alone or in combination with inorganic fertilizers. The evaluation of rhizospheric soil after crop harvest also showed the improvement in soil organic N, P and K contents. Showing thereby that the application of 5t/ha compost in sandy soil will improve the crop quality and soil health. These results were in agreement with finding of Siddiqui *et al.*, (2008), as the plant growth parameters were significantly higher when paddy straw compost was tested on green bean under pothouse. The paddy straw compost fortified with *Trichoderma harzianum* reduced the disease intensity of root rot in green bean and also promoted plant height, fresh and dry weight. Tahir *et al.*, (2006) also revealed that organic compost enriched with 25% recommended dose of fertilizer and inoculated with PGPR was more effective in improving growth and yield of tomato as compared to full dose of N fertilizer.

In an another study carried out by Sadaf *et al.*, (2017), the total carbon and mineral nitrogen content of wheat crop were increased 21 and 106% higher respectively when compare with control by application of biochar and chemical fertilizers(CF). Co-application of biochars and CF treatments increased the biological yield of wheat crop with highest increment in nutrient biochars farmyard manure or poultry manure (29 or 26%), than structural biochars wood chips and kitchen waste (15 and 13%), respectively.

To sustain the soil fertility, the integrated use of inorganic fertilizer with organic manure is the need of the day. These studies indicate that paddy straw and distillery effluent can be co-composted and converted into a product, which can benefit plant growth and soil health. The findings of above study should be evaluated at the field conditions before this technology is transmitted to the farmers.

Application of compost prepared by paddy straw and30% distillery effluent along with cattle dung and microbial consortium and 100% recommended dose of fertilizer @ 5t/ha, resulted into improved wheat yield and crop quality like more uptake of nutrients like N, P and K. Also there was improvement in soil health as there was increment in soil nutrients. Total N, P and K was up to0.038%,532mg/Kg and 0.344% respectively in comparison to initial soil N, P and K 0.016%, 260 mg/Kg and 0.25 % respectively.

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