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Influence of organic farming packages on growth, yield attributes and yield of wheat (*Triticum aestivum* L.)

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Abstract
A field experiment was carried out at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during *Rabi* season of 2016-17 to study the response of Organic farming packages on growth, yield and quality of wheat. The experiment consisting of 9 treatments *viz*, T_1 (0% Control), T_2 (50% RDF), T_3 (100% RDF), T_4 (50% RDF + 50% Vermicompost), T_5 (50% RDF + 50% FYM), T_6 (50% RDF+25% poultry manure) T_7 (75% RDF+ 25% Vermicompost), T_8 (75% RDF+ 25% FYM), T_9 (75% RDF + 25% poultry manure). The experiment was conducted in Randomized Block Design (R.B.D.) with three replications on silt loam soil with low in organic carbon (0.34%), nitrogen (161.43kg ha^{-1}) and medium in phosphorus (14.71kg ha^{-1}) and potassium (240.33kg ha^{-1}). The growth characters like plant height, number of tillers, dry matter accumulation, leaf area index were significantly higher with the application of 75% recommended dose of fertilizer (RDF) through inorganic sources + 25% N through poultry manure (T_9) being at par with T_8, T_7, T_6, T_4, and T_3.The yield components like number of effective tillers, length of spike, number of grains $spike^{-1}$ were maximum with the application of 75% recommended dose of fertilizer (RDF) through inorganic sources + 25% N through poultry manure (T_9) being at par with T_8, T_7, T_6, T_4, and T_3. Grain yield (kg ha^{-1}) and straw yield (kg ha^{-1}) were maximum with the application of 75% recommended dose of fertilizer (RDF) through inorganic sources + 25% N through poultry manure (T_9) being at par with T_8, T_7, T_6, T_4 and T_3. Harvest index and 1000 grain weight (g) were not influenced significantly due to nutrient management practices. Thus, it may be concluded that Organic farming practice of 75% recommended dose of fertilizer (RDF) clubbed with 25% poultry manure proved as the most suitable practice to get more yield and benefit.

Keywords: Wheat (*Triticum aestivum* L.), organic farming, growth, yield attribites, yield

Introduction
Wheat (*Triticum aestivum* L.) is a staple food of the world and belongs to family Poaceae (*Gramineae*). It is most important staple food of about two billion people (36% of the World population). About 55% of the world population depends on wheat for intake of about 20% of food calories. Wheat is self-pollinated crop and it has been described as the 'king of cereals'. It is the world's most widely cultivated food crop and is primarily grown in temperate regions and also at higher altitude under tropical climatic areas in winter season. Wheat is the single most important cereal crop that has been considered as integral component of the food security system of the several nations. It is grown in the world with an area of 221.60 million hectare, production 728.3 million tonnes with productivity of 3.3 tonnes per hectare (USDA, 2015).

In India, it is grown in an area of 30.47 million hectare and production is 95.85 million tonnes with average productivity of 3.15 tonnes per hectare. Uttar Pradesh having first rank in respect to both area (9.95 million hectare) and production (30.24 million tonnes) with a productivity of 3.10 tonnes per hectare in 2015 (FAS/USDA 2015).

Poor productivity in the state like Uttar Pradesh is mainly due to different atmospheric, edaphic and agronomic factors such as insufficient fertilizer application, delayed sowing, improper selection of varieties, inadequate seed rate, plant population and irrigation etc. The seed and nutrients are among the monetary input and their optimum time of use may save the money along with higher crop production and profit per unit area per rupee investment.

Although increased level of production can be achieved by increased use of fertilizers, but continuous use of chemical fertilizer alone may lead to some detrimental effect on physio-chemical properties of soil and may not be so remunerative unless the fertility of soil is maintained at sustainable level by application of organic manure.

Organic manure are considered to be an integral component of sustained system, as they improve soil fertility and physical properties such as soil structure, aeration, porosity, infiltration rate and water retaining capacity and decrease soil crusting, bulk density, water and wind erosion. Organic matter in soil improves the physical condition of soil far better performance of micro-organism and physical status of soil as well (Kumar and Tripathi, 1990) [6].

Balanced fertilizers through organic and inorganic sources improve the soil health as well as boost the productivity of wheat. Organic matter is the substrate for a large number of soil living beneficial organisms which are essential to keep the plant healthy and help in maintaining the productivity of soil. All India Co-ordinate Research Project on microbial development reported that organic manure can be enriched by *Aspergillus awamori*. Application of 5 tonnes of same enriched compost under rice – wheat sequence gave adequate phosphate, comparable to the application of 40 kg rock phosphate. Enriched FYM improves the nutrient availability and increases wheat yield. Organic matter in soil increases the water holding capacity, cation exchange capacity as well as improves the soil structure for better performance of microorganisms. The soil enriched with organic matter has been found to respond better to the application of nitrogenous fertilizers (Subbiah and Bajaj, 1968) [17]

Materials and Methods

The experiment was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar, Kumarganj, Faizabad (U.P.). Geographically experimental site is situated at 26^0 47′ N latitude, 82^0 12 ′E longitude and altitude of 113 meters above mean sea level in Indo-gangetic regions of eastern Uttar Pradesh. The soil of experimental field was alkaline in reaction (8.12 pH), low in organic carbon (0.34%) available nitrogen (161.43 kg ha^{-1}) while medium in available phosphorus (14.71 kg ha^{-1}) potassium (240.33 kg ha^{-1}). The average weekly maximum and minimum temperatures during the crop growth period ranged from 37.8 ^{0}C to 18.0 ^{0}C and 18.8 ^{0}C to 4.9 ^{0}C respectively. The relative humidity ranged between 18.2% to 88.2%, wind speed between 1.1 to 4.7 km $hrs.^{-1}$ Total evaporation ranged from 2.4 to 8.7 mm while bright sunshine between 1.0 to 9.5 hours. The total rainfall received during the crop period was 17.5 mm. The experiment consists of 9 treatments T_1 (0% Control), T_2 (50% RDF), T_3 (100% RDF), T_4 (50% RDF + 50% Vermicompost), T_5 (50% RDF + 50% FYM), T_6 (50% RDF+25% poultry manure) T_7 (75% RDF+ 25% Vermicompost), T_8 (75% RDF+ 25% FYM), T_9 (75% RDF + 25% poultry manure) which were laid out in Randomized Block Design with three replications. The crop was fertilized as per the treatment. The recommended dose of nitrogen, phosphorus and potassium @ 150 kg, 60 kg and 40 kg ha^{-1} was applied respectively. Urea, DAP, MOP, FYM, vermicompost and poultry manure were used as the source of nitrogen, phosphorus and potassium as per treatment. The crop was harvested at proper stage of maturity as determined by visual observations. Half meter length on either end of each plot and 2 border rows from each side as border were first removed from the field to avoid error. The crop in net plot was harvested for calculation of yield data. Produce was tied in bundles and weighted for biomass yield. Threshing of produce of each net plot was done by using pull man's thresher. The observations were recorded as per the procedure described below. For this purpose 5 plant were selected randomly in each net plot and were tagged with a level for recording various observation on growth and yield parameters at 30, 60, 90 days after sowing and at harvest.

Result and Discussion

Growth Characters

Plant Height (cm)

The plant height was recorded at 30, 60, 90 DAS and at harvest. The relevant data pertaining to plant height recorded at various growth stages are presented in Table 4.1.

At 30 DAS plant height was not significantly affected due to any treatments, where as at 60, 90 DAS and at harvest, various treatments influenced the plant height significantly. Among the inorganic sources 100% RDF was significantly superior over rest of inorganic sources. Among the integrated approach of nutrient application maximum plant height was noted when 75% RDF was clubbed with 25% poultry manure. Further, among the organic sources poultry manure recorded maximum value (23.81, 51.53, 85.70, 98, 56) as compare to vermicompost (23.69, 50.29, 84.10, 96.72) and farm yard manure (23.46, 49.82, 83, 95.45).

Further, scanning of table reveals that maximum plant height was observed with the treatment T_9 (75% RDF + 25% poultry manure) recorded maximum plant height, which was at par with T_8 (75% RDF + 25% FYM), T_7 (75% RDF + 25% Vermi-compost), T_6 (50% RDF + 50% poultry manure), T_3 (100% RDF) and significantly superior over rest of the treatments tested during the investigation.

A significant increase in plant height was recorded during investigation and it was mainly due to more availability of nitrogen to the plants (Table1). Higher nitrogen level results higher nitrogen uptake, which ultimately results into increased protein synthesis, cell division and cell enlargement which express morphologically an increase in height of plant. Similar findings were reported by Chopra *et al*. (2016) [2].

Number of tillers meter^{-2}

The data on number of tillers recorded at 30, 60, 90 DAS and at harvest and are given in Table-2. At 30 DAS tillers was not significantly affected due to any treatments. Whereas at 60, 90 DAS and at harvest, various treatments influenced the tillers significantly. Among the inorganic sources 100% RDF was significantly superior over rest of inorganic sources. Among the integrated approach of nutrient application maximum number of tillers was noted when 75% RDF was clubbed with 25% poultry manure. Further, among the organic sources poultry manure recorded maximum value (176.47, 448.60, 515.89, and 490.10) as compare to vermicompost (175.62, 442.40, 508.76, and 483.32) and farm yard manure (173.91, 430.50, 495.08 and 470.32).

The number of tillers increased rapidly up to 60 DAS and reached maximum at 90 DAS (515.89) and there after started declining. At 30 DAS the number of tillers per meter^{-2} row length was recorded higher with treatment T_9 (75% RDF + 25% poultry manure) followed by T_7 (75% RDF + 25% Vermi-compost) and it was significantly superior over rest of the treatments. The treatment T_9 (75% RDF + 25% poultry manure) recorded maximum tillers per meter^{-2} row length, which was at par with T_8 (75% RDF + 25% FYM), T_7 (75% RDF + 25% Vermi-compost), T_6 (50% RDF + 50% poultry manure), T_3 (100% RDF) and significantly superior over rest of the treatments.

The higher number of tillers associated with increase in nutrient level at later stages might be due to enhanced cell expansion and various metabolic processes in the presence of abundant supply of nutrients which resulted into increased tillering. Similar results were reported by Abbas *et al*. (2012) [1].

Dry matter accumulation (meter^{-2})

Analogous to growth characters, the dry matter production increased at successive growth stages of the crop. Among various growth stages the highest value of dry matter was recorded at harvest stage. The rate of increase in dry matter was observed more between 30 to 60 DAS followed by 60 to 90 DAS and 90 DAS to harvest stage, respectively.

Dry matter accumulation increased progressively at all in growth stages. Among the inorganic sources 100% RDF was significantly superior over rest of inorganic sources. Among the integrated approach of nutrient application maximum dry matter accumulation was noted when 75% RDF was clubbed with 25% poultry manure. Further, among the organic sources poultry manure recorded maximum value (112.82, 379.13, 589.75, and 842.50) as compare to vermicompost (112.27, 374.40, 582.40 and 832) and farm yard manure (111.18, 364.05, 566.30, and 809).

Maximum dry matter accumulation was recorded with T_9 (75% RDF + 25% poultry manure) which was at par with T_8 (75% RDF + 25% FYM), T_7 (75%RDF + 25% Vermi-compost), T_6 (50% RDF + 50% poultry manure), T_3 (100% RDF) at 30, 60, 90 DAS and at harvest include T_5 (50% RDF + 50% Vermi-compost) at 90 DAS and except T_6 (50% RDF + 50% poultry manure) at harvest. The lowest dry matter accumulation was recorded with T_1 (0% Control) at different growth stages.

Maximum dry matter accumulation recorded with nutrient combination of 75% RDF + 25% poultry manure. This might be attributed due to more synthesis of food material in plants. Similar findings were reported by Ebrahim *et al*. (2008).

Leaf area index

Leaf area index recoded at 30, 60 and 90 DAS are summarized in Table 4.4 and depicted in Fig. 6. It is evident from the data that LAI increased with the advancement of crop growth up to 90 DAS. Among the inorganic sources 100% RDF was significantly superior over rest of inorganic sources. Among the integrated approach of nutrient application maximum leaf area index was noted when 75% RDF was clubbed with 25% poultry manure. Further, among the organic sources poultry manure recorded maximum value (1.50, 4.72, 4.75) as compare to vermicompost (1.47, 4.65, 4.70) and farm yard manure (1.45, 4.42, 4.47).

At 30 DAS the leaf area index was not significantly affected by any of the treatments. At 60 and 90 DAS the maximum leaf area index was recorded with T_9 (75% RDF + 25% poultry manure) which remained at par with, T_8 (75% RDF + 25% FYM), T_7 (75%RDF + 25% Vermi-compost), T_6 (50% RDF + 50% Poultry manure), T_4 (50% RDF + 50% Vermi-compost) and T_3 (100% RDF), respectively.

The leaf area index increased very slowly at the initial stage (30 DAS) and ushered in a period of rapid expansion possibly because of increase light absorption and high photosynthetic activities. As leaf area increases, light absorption and rate of dry matter production increase till the foliage become sufficiently dense to cause mutual shading, resulting in reduced photosynthetic activity of lower leaves.

Leaf area index influenced non-significantly due to various treatments at 30 DAS. At 60 and 90 DAS leaf area index influenced significantly due to various treatments (Table 4.4). Leaf area index increased rapidly from 30 to 90 days after sowing. Significant increase in leaf area index was noted when 75% RDF was clubbed with 25% poultry manure. It could be due to more growth and development of leaves due to adequate nutrient supply. The nitrogen is very essential for chlorophyll synthesis in leaves, which helps in more photosynthesis and production of dry matter resulting increase in leaf area. Channabasanagowda *et al.* (2008) also reported similar results.

Yield contributing characters

Number effective tiller (m^{-2})

The effect of various treatments on yield attributes was recorded at harvest and the relevant data are presented in Table 2. It is evident from the data that number of effective tiller meter^2 row length in wheat was affected significantly due to various treatments. Among the inorganic sources 100% RDF was significantly superior over rest of inorganic sources. Among the integrated approach of nutrient application maximum number of effective tiller was noted when 75% RDF was clubbed with 25% poultry manure. Further, among the organic sources poultry manure recorded maximum value (416.58) as compare to vermicompost (410.82) and farm yard manure (399.77).

The highest number of effective tillers m^2 row length (416.58) was recorded under T_9 (75% RDF + 25% poultry manure). Lowest number of effective tiller m^{-2} row length (283.60) was recorded under T_1 (0% Control) during the course of experimentation. Perusal of data presented in Table-2. clearly reveal that the maximum number of effective tiller meter^{-2} row length was observed with T_9 (75% RDF + 25% poultry manure) which was at par with T_8 (75% RDF + 25% FYM), T_7 (75%RDF + 25% Vermi-compost), T_6 (50% RDF + 50% poultry manure), T_3 (100% RDF), and significantly superior over rest of the treatments.

Length of spike (cm)

The data presented in Table 2. Clearly reveals that the spike length was affected by various treatments. Among the inorganic sources 100% RDF was significantly superior over rest of inorganic sources. Among the integrated approach of nutrient application maximum length of spike was noted when 75% RDF was clubbed with 25% poultry manure. Further among the organic sources poultry manure recorded maximum value (10.20) as compare to vermicompost (10.00) and farm yard manure (9.80).

Perusal of data presented in Table-2. clearly indicates that the maximum spike length was observed with T_9 (75% RDF + 25% poultry manure) which was statistically at par with T_8 (75% RDF + 25% FYM), T_7 (75%RDF + 25% Vermi-compost), T_6 (50% RDF + 50% poultry manure), T_3 (100% RDF) and was significantly more than rest of the treatments. Minimum spike length (8.30) was observed with T_1 (0% Control).

Number of grains spike^{-1}

The data on number of grains spike^{-1} is presented in Table- 2. It indicates that the number of grains spike^{-1} was significantly affected by various treatments. Among the inorganic sources

100% RDF was significantly superior over rest of inorganic sources, among the integrated approach of nutrient application maximum grain/spike was noted when 75% RDF was clubbed with 25% poultry manure. Further, among the organic sources poultry manure recorded maximum value (51.00) as compare to vermicompost (50.20) and farm yard manure (48.40).
Further, scanning of table reveals that maximum number of grains was observed with T_9 (75% RDF + 25% poultry manure) which was statistically at par with T_8 (75% RDF + 25% FYM), T_7 (75%RDF + 25% Vermi-compost), T_6 (50% RDF + 50% poultry manure), T_4 (50% RDF + 50% Vermi-compost), T_3 (100% RDF). Minimum number of grains per spike was recorded in T_1 (0% Control).

Yield

Grain yield (q ha^{-1})

The data pertaining to grain yield is presented in Table 5. It is evident from the data that grain yield influenced significantly by different treatments. Among the integrated approach of nutrient application maximum grain yield was noted when 75% RDF was integrated with 25% poultry manure. Further among the organic sources poultry manure recorded maximum value (35.80) as compare to vermicompost (35.20) and farm yard manure (33.90).
Perusal of data presented in Table-2 clearly reveals that the maximum grain yield 35.80 q ha^{-1} was observed with treatment T_9 (75% RDF + 25% poultry manure) fallowed by T7 (75%% RDF + 25% vermicompost) which was statistically at par with T_8 (75% RDF + 25% FYM), T_3 (100% RDF) and significantly superior over rest of the treatments. The minimum grain yield 19.10 q ha^{-1} was recorded with T_1 (0% Control).
The grain yield significantly increased where 75% RDF + 25% poultry manure was given (Table 4.6.). This might be due to more ear length, number of grains ear^{-1}, grain weight ear^{-1} and 1000 grain weight. Similar findings were reported by Talashikar *et al.* (1999).

Straw yield (q ha^{-1})

The data pertaining to straw yield is presented in Table 2. It is evident from the data that the straw yield was affected significantly due to nutrient management practices. Among the inorganic sources 100% RDF was significantly superior over rest of inorganic sources,
Among the integrated approach of nutrient application maximum straw yield was noted with T_9 combination of (75% RDF 25% + poultry manure). Further, among the organic sources poultry manure recorded maximum value (48.45) as compare to vermicompost (48.00) and farm yard manure (47.00).
Further, perusal of Table:-5 reveals that maximum straw yield 48.45 q ha^{-1} was observed with T_9 (75% RDF + 25% poultry manure) fallowed by T7 (75% RDF + 25% Vermi-compost) which was statistically at par with T_8 (75% RDF + 25% FYM), T_6 (50% RDF + 25% poultry manure), T_4 (50% RDF + 50% Vermi-compost), T_3 (100% RDF) and significantly superior over rest of the treatments. The minimum straw yield 30.20 q ha^{-1} was observed with T_1 (0% Control).
Straw yield was influenced significantly only due to application of 75% RDF + 25% poultry manure (Table 4.6.). This may be probably due to higher shoots and increased rate of dry matter accumulation**.** Rajender *et al.* (1997) also reported similar results.

Harvest index (%)

Harvest index indicates the relationship between economical yield and biological yield as influenced by different Organic sources. Among the inorganic sources 100% RDF was significantly superior over rest of inorganic sources. Among the integrated approach of nutrient application maximum harvest index was noted when 75% RDF was clubbed with 25% poultry manure. Further, among the organic sources poultry manure recorded maximum value (42.49) as compare to vermicompost (42.31) and farm yard manure (41.90).
The data pertaining to harvest index were recorded and presented in Table 5. Harvest index was found the maximum harvest index (%) observed with T_9 (75% RDF + 25% Poultry manure) fallowed by T_7 (75% RDF + 25% Vermi-compost), T_8 (75% RDF + 25% FYM) and minimum was T_1 (0% Control).
Harvest index of wheat was not affected significantly due to different treatments Similar results were given by Singh (1998).

Table 1: Effect of different treatments combinations on Plant height, Tillers, Dry matter accumulation and Leaf area index

S. No	Treatments	Plant height (cm)				Tillers (m^{-2})				Dry matter accumulation (g m^{-2})				Leaf area index			
		30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
1	0% Control	22.26	40.89	60.60	69.69	165.04	305.40	351.21	333.21	105.51	221.85	345.10	493.00	1.25	3.30	3.33	1.25
2	50% RDF	22.47	43.71	65.80	75.67	166.58	340.80	391.92	372.32	106.49	279.00	434.00	620.00	1.35	3.75	3.80	1.35
3	100% RDF	23.23	48.41	82.52	94.88	172.21	421.60	484.84	460.60	110.09	353.25	549.50	785.00	1.44	4.35	4.40	1.44
4	50% RDF + 50% Vermi-compost	22.61	46.06	78.20	89.93	167.60	382.90	440.34	418.32	107.15	329.18	512.05	731.50	1.40	4.20	4.25	1.40
5	50% RDF + 50% FYM	22.49	45.12	73.40	84.41	166.75	375.50	431.83	410.23	106.60	313.20	487.20	696.00	1.38	4.10	4.15	1.38
6	50% RDF + 50% Poultry manure	22.98	47.47	80.30	92.35	170.33	405.70	466.56	443.23	108.89	340.65	529.90	757.00	1.42	4.30	4.35	1.42
7	75% RDF + 25% Vermi-compost	23.69	50.29	84.10	96.72	175.62	442.40	508.76	483.32	112.27	374.40	582.40	832.00	1.47	4.65	4.70	1.47
8	75% RDF + 25% FYM	23.46	49.82	83	95.45	173.91	430.50	495.08	470.32	111.18	364.05	566.30	809.00	1.45	4.42	4.47	1.45
9	75% RDF + 25% Poultry manure	23.81	51.53	85.70	98.56	176.47	448.60	515.89	490.10	112.82	379.13	589.75	842.50	1.50	4.72	4.75	1.50
S.Em±		1.052	1.586	3.224	4.090	6.752	16.631	19.364	18.625	3.523	14.481	23.597	25.882	0.059	0.187	0.168	0.059
	C.D.at 5%	NS	4.755	9.666	12.263	NS	49.860	58.054	55.839	NS	43.413	70.744	77.593	NS	0.561	0.503	NS

Table 2: Effect of different treatments combinations on Effective tiller, Length of spike, grains per spike, test weight, grain, yield, straw yield and harvest index

S.N	Treatments	Effective tillers/m^2	L. of spike (cm.)	Grains spike^{-1}	Test Wt. (g)	Grain Yield q ha^{-1}	Straw Yield q ha^{-1}	Harvest index (%)
1	0% Control	283.60	8.30	38.00	33.30	19.10	30.20	38.74
2	50% RDF	316.48	8.60	43.00	33.60	24.30	37.70	39.19
3	100% RDF	391.51	9.60	47.80	35.30	32.50	46.00	41.40
4	50% RDF + 50% Vermi-compost	355.57	9.00	46.40	34.70	29.40	43.75	40.19
5	50% RDF + 50% FYM	348.70	8.90	45.20	34.10	27.80	41.80	39.94
6	50% RDF + 50% Poultry manure	376.74	9.30	47.30	35.00	30.90	44.80	40.82
7	75% RDF + 25% Vermi-compost	410.82	10.00	50.20	35.80	35.20	48.00	42.31
8	75% RDF + 25% FYM	399.77	9.80	48.40	35.60	33.90	47.00	41.90
9	75% RDF + 25% Poultry manure	416.58	10.20	51.00	36.00	35.80	48.45	42.49
S.Em±		19.021	0.376	1.570	1.705	1.393	1.715	1.719
	C.D.at 5%	57.026	1.128	4.707	5.112	4.176	5.140	5.155

Conclusion

On the basis of results it may be concluded that for obtaining optimum growth and yield attributes as well as yield from wheat crop 75% RDF should be integrated with 25% N through poultry manure.

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