Original Research Article……..

International Journal of Agricultural Invention

(online available at www.agriinventionjournal.com)

***International Journal of Agricultural Invention* 9(2): 178-184: December, 2024**

ISSN: 2456 – 1797 (P)

Effect of FYM and Vermicompost application on growth, yield and quality of Wheat (*Triticum aestivum* L.) crop

Sonu Kumar[1], *Varun Kumar[1], Kamalkant[2], Ranjeet Kumar[3], Ravikant Shakya[3], Mubeen[4], Aman Singh Chauhan[5]

[1]Department of Soil Science and Agriculture Chemistry, R. B. S. College, Bichpuri (Dr. Bhimrao Ambedkar University, Agra) U.P., India
[2]Department of Agronomy, Galgotias University, Greator Noida, U.P., India
[3]Department of Agronomy, R. B. S. College, Bichpuri (Dr. Bhimrao Ambedkar University, Agra) U.P., India
[4]Faculty of Agriculture, Mohammad Ali Jauhar University, Rampur, U.P., India
[5]Department of Soil Science, University of Allahabad, Prayagraj, U.P., India
***Corresponding email**: *varunrbs81@gmail.com*

ARTICLE INFO

Original Research Article
Received on November 05, 2024
Revised on November 08, 2024
Accepted on December 03, 2024
Published on December 07, 2024

Article Authors
Sonu Kumar, Varun Kumar, Kamalkant, Ranjeet Kumar, Ravikant Shakya, Mubeen, Aman Singh Chauhan

Corresponding Author Email
varunrbs81@gmail.com

PUBLICATION INFO

International Journal of Agricultural Invention (IJAI)
RNI: UPENG/2016/70091
ISSN: 2456-1797 (P)
Vol.: 9, **Issue:** 2, **Pages:** 178-184
Journal Homepage URL
http://agriinventionjournal.com/
DOI: 10.46492/IJAI/2024.9.2.27

ABSTRACT

A field experiment was conducted during rabi season 2021-22 at the Research Farm, Raja Balwant Singh College, Bichpuri, Agra, Uttar Pradesh. To study the "Effect of FYM and Vermicompost application on growth, yield and quality of Wheat (*Triticum aestivum* L.) crop" in alluvial soil of Agra region. The experiment having combination of eight treatments viz. T_1 - Absolute control, T_2 - N 120, P 60, K 40 kg ha-1 (100% RDF), T_3 - N 90, P 45, K 30 kg ha-1 (75% RDF), T_4 – N 60, P 30, K 20 kg ha-1 (50% RDF), T_5 – N 60, P 30, K 20 kg ha-1 (50% RDF) + FYM @ 2.5 t ha-1, T_6 - N 60, P 30, K 20 kg ha-1 (50% RDF) + FYM @ 2.5 t ha-1 + Vermicompost @ 1.5 t ha-1, T_7 – N 90, P 45, K 30 kg ha-1 (75% RDF) + FYM @ 2.5 t ha-1, T_8 – N 90, P 45, K 30 kg ha-1 (75% RDF) + FYM@ 2.5 t ha-1+ Vermicompost @ 1.5 t ha-1 with three replications in Randomized Block Design (RBD). The results of experiment showed that the higher grain 52.40 q ha-1and straw yield 79.79 q ha-1 obtained in T_8 with the application of 75% RDF + FYM @2.5 t ha-1 + Vermicompost @ 1.5 t ha-1. Maximum plant height, number of grains/ spike, test weight and protein content was recorded in treatment T_8 ((75% RDF) + FYM@ 2.5 t ha-1+ Vermicompost @ 1.5 t ha-1). The data exposed that maximum harvest index (39.63%) was observed in treatment T_8 ((75% RDF) + FYM@ 2.5 t ha-1 + Vermicompost @ 1.5 t ha-1). The soil properties in respect of pH, EC, organic carbon and available N, P & K were noticed with the treatment T_8 (75% NPK) + FYM@ 2.5 t ha-1 + Vermicompost @ 1.5 t ha-1). The T_8 treatment is the good option for farmer field in present scenario because it replaces 25% inorganic nutrients by organic source of nutrients which increase quality of grain.

KEYWORDS

FYM, Vermicompost, Chemical Fertilizers, Soil Properties, Productivity, Wheat, PBW-343, Alluvial Soil

HOW TO CITE THIS ARTICLE

Kumar, S., Kumar, V., Kamalkant, Kumar, R., Shakya, R., Mubeen, Chauhan, A. S. (2024) Effect of FYM and Vermicompost application on growth, yield and quality of Wheat (*Triticum aestivum* L.) crop, *International Journal of Agricultural Invention,* 9(2): 178-184. DOI: 10.46492/IJAI/2024.9.2.27

Wheat (*Triticum aestivum* L.) is one of the leading cereals in the world. It belongs to the family poaceae and it is the world's most widely cultivated cereal crop which ranks first followed by rice. Wheat accounts for 26% of world cereal production and 44% of total cereal consumption. Rapid economic and income growth, urbanization, and globalization are leading to dramatic dietary shifts, especially in Asia as consumers are increasing their consumption of wheat products. Wheat production needs to increase to meet the combined growing population and expanding demand by the middle of this century (Bhattacharya, 2007).

Measured either by cultivated area (211.06 million ha) or by the production (566.8 million t) achieved Known as "king of cereals". It is grown throughout the temperate, tropical and subtropical region in the world. In Wheat cultivation, enormous amount of chemical fertilizers is used to increase the production, this chemical fertilizer negatively affects soil environment as well as living beings. Continuous use of chemical fertilizers in modern intensive cropping not only adversely affects the crop yield but also deteriorates soil health to a great extent. Therefore, it is the necessary to use of eco-friendly and less expensive chemical fertilizers for sustaining wheat yield and soil health. Fertilizer use especially NPK plays an important role in increasing the yield of wheat but continuous use of micronutrient free NPK fertilizers in intensive cropping system with avoid of organic manures have resulted in the depleting micronutrients from soil reserves. Integration of organic manures with chemical fertilizers has been found to be quite reliable not only in increasing higher productivity but also in providing sustainability in crop production (Abhijit and Devi, 2004).

Nitrogen is major and primary element and play vital role in increasing productivity of wheat. It is an important constituent of chlorophyll, protoplasm, protein and nucleic acid and increasing the growth and development of all living tissues. Nitrogen also plays an important role in physiological process of plant. Phosphorus is a key element play an important role in energy transfer, biosynthesis of nucleic acid and membranes. It is essential constituent for nucleic acid and phytin and also called energy currency. Phosphorus promotes new cell formation and root development in plants. Potassium is an essential plant nutrient in photosynthesis, regulates the opening and closing of stomata as well as regulates CO_2 uptake. FYM is one of the more valuable organic fertilizers maintaining soil fertility in the system of alternative agriculture. Vermicompost is a kind of organic fertilizers and derived from composting organic waste by using various species of earthworms. Integrated Nutrient Management helps to render and sustain soil fertility, crop productivity and also improves soil health. It may also help to check the emerging deficiency of nutrient other than NPK. Nutrients are required for proper plant growth, as well as effective crop and soil management.

It also reduced the need for chemical fertilizers by taking advantages of non-chemical sources of nutrients such as the manures, composts and bio-fertilizers.

Materials and Methods

A field experiment was conducted at R. B. S. College, Agricultural Research Farm, Bichpuri, Agra for Rabi seasons of 2021-22. Agra district is located south - east of Delhi in the semi - arid or gray steppe soil region of south - western Uttar Pradesh. The intersect of 27.20 N latitude and 77.9° E longitude is about 21 Km south of Agra city. The soils of Agra region have developed on the alluvium of river Yamuna. Alkaline pH and severe salinity / sodicity problems are common throughout the district. The alluvium are divided into two sub groups (i) old (Pleistocene) alluvium known as Bangar and (ii) recent alluvium known as khaddar Bangar is rich in concretion and nodules of impure calcium carbonate of various sizes, while khaddar is free of lime nodules and is coarser in texture. The rocks immediately beneath the alluvium are tertiary in age. The climate of Agra is hot and dry.

The average annual rainfall of Agra district is about 675 mm, 90% rain is received during August and September through south monsoon rains, which start by the end of June and continue up to September. However, a few showers common occur during winter months also and sometimes fog and frost are sperimented. The average temperature in summer remains well above 40 °C. According to Koppen's classification of climate the geothermal climate of Agra district falls in wig type. Agra is an important millet and cereal - producing region. The main kharif (rainy season) crops of the district are jowar, bajra, maize, arhar, green gram, black gram and cowpea is also grown but acreage is small. In Rabi (winter season) crops, wheat, wheat, gram, mustard potato wheat and berseem fodder are common crops. In irrigated areas, the problems if soil salinity and brackish water are of common occurrence that reduces the crop growth.

Characteristics of the Experimental Soil

The experimental plot size was the 2×2 m^2 and each plot considers size of ridge 50 cm spacing.

Table 1. Effect of FYM and vermicompost on growth of wheat

Treatment	Plant hight at 30 DAS	Plant hight at 60 DAS	Plant hight at 90 Das	Plant height	Dry matter (at 30 days)	Dry matter (at 60 days)	Dry matter (at 90 days)	Dry matter (at harvest)	CGR 30	CGR 60	CGR 90	CGR 120
T_1	7.68	28.11	53.18	72.11	25.56	270.68	685.19	955.0	0.9	8.2	13.82	9.0
T_2	8.82.	41.21	79.50	93.35	35.02	317.81	773.28	1052.0	1.2	9.4	15.18	9.3
T_3	8.57	38.10	73.09	88.13	32.32	296.81	744.60	1010.6	1.1	8.8	14.93	8.9
T_4	8.02	34.22	65.96	81.42	27.02	283.79	708.05	987.4	0.9	8.5	14.14	9.3
T_5	8.41	35.96	68.88	85.81	30.24	290.69	723.01	914.0	1.0	8.7	14.41	6.4
T_6	9.01	43.08	82.24	95.65	37.36	331.94	787.74	1053.5	1.2	9.8	15.19	8.9
T_7	8.75	39.19	75.52	90.05	33.77	305.55	820.14	1032.8	1.1	9.1	17.15	7.1
T_8	9.11	46.11	84.58	96.92	40.05	343.89	815.80	1106.9	1.3	10.1	15.73	10.4
SEM±	0.175	0.611	1.003	0.740	0.585	0.62	15.79	29.28	0.0197	0.0289	0.52	1.463
CD at 5%	0.537	1.872	3.072	2.268	1.777	1.87	47.90	88.83	0.060	0.088	1.58	NS

Table 2. Effect of FYM and vermicompost on yield of wheat

Treatment	Biological Yield (q ha-1)	Grain Yield (q ha-1)	Straw Yield (q ha-1)	Harvest Index
T1	57.77	22.81	34.96	39.47
T2	114.82	45.63	69.19	39.73
T3	103.05	41.18	61.87	39.96
T4	80.58	31.95	48.63	39.66
T5	93.67	37.11	56.56	39.60
T6	123.83	49.06	74.77	39.60
T7	111.65	44.12	67.53	39.51
T8	132.19	52.40	79.79	39.63
SEM±	1.157	0.625	0.638	0.266
CD at 5%	3.543	1.915	1.953	N/A

The soil of the experimental field was sandy loam in texture with pH 8.40, and the electrical conductivity of the soil is 1.6. Available N_2 145.50 kg ha^{-1}, P_2O_5 17.0 kg ha-1, K_2O 185.5 kg ha-1 and organic matter 0.83%. The nutrient content of the organic manures tried viz., FYM and vermicompost were 0.50 N_2, 0.25 P_2O_5 and 0.50 K_2O and 12% Organic matter and vermicompost contain 1.80 N_2; 0.5 P_2O_5, 0.25 K_2O and 9.75% organic matter respectively. All the organic manures as per the treatments were applied and incorporated into the soil 3 to 5 days before sowing. The growth characters like plant height, number of tiller per plant and yield were recorded. The quality characters like NPK content in grain and straw were estimated. The mean data were analyzed statistically. Economics viz., benefit cost ratio was worked out taking into consideration the cost of cultivation and net.

Results and Discussion

The results of experiment have been presented in preceding chapter. Interpretations have been made in the view of the factors governing the manifestation of result and their corroboration light of results obtained by other scientist workers engaged in the relative field of research. Wheat is predominant, productive, remunerative as well as adoptive and recommended in the Northern and Central parts of India and Pakistan. Attempts have however, been made to compare the present results with the past finding from experiment carried out in this niche of wheat producing systems. As we all know that the plant growth and yield are the resultant of a number of environmental factor, edaphic factors as well as metabolic process taking place in the plant.

The environmental factors such as rainfall, temperature, relative humidity, wind velocity and sunshine hours are beyond the control of human being. However, it is possible to adjust and manage many edaphic almost the all agronomic factors. In preceding chapter while discussing results of the weather conditions have also been elaborated with a view to ensuring proper interpretation of results, which are fluctuating due to the weather aberrations. Wheat is most sensitive to temperature rather than rainfall. The discussion is presented in the following paragraphs. The weather conditions during crop growth have congenial and favourable.

The present investigation entitled "Effect of FYM and vermicompost application on growth, yield and quality of wheat (*Triticum aestivum* L. crop*"* was conducted in the Department of Soil Science and Agricultural Chemistry during the seasons of Rabi 2020-21 at Agricultural Farm, R. B. S. College, Bichpuri, Agra under field conditions. The results recorded on different aspects with respect to various treatments are presented and discussed in this chapter, important treatment effects provided some useful information have also been described.

Growth and Yield Attributing Characters

Progressive data on growth and development characters of wheat in terms of plant height, and plant stand accumulation in plants of row length and day 75% spike emergence and day to physiological maturity of the crop as affected by application of different level of FYM and vermicompost on wheat crop have been described that effect of different levels of FYM and vermicompost treatments on plant height (cm) at 30, 60, 90, and 120 DAS. The data on plant height regarding wheat crop have been analyzed. The finding are presented and discussed as below. It could be inferred from table that various 100% RDF, FYM and vermicompost treatment significantly influenced the plant height in comparison to control. Although, the treatment T_8, respectively showed significantly better results over T_1, T_4, T_5, T_3, and T_7 treatment in case of plant height of wheat crop whereas, the difference between T_2, and T_6, and T_7 was not found significant.

In general, it is also obvious from given data in table 1 that treatment T_8, performed significantly better over the rest of the 100% RDF, FYM and vermicompost treatments in case of plant height throughout the research investigation (fig 1). The superiority of the treatments may be arranged as $T_8 > T_6 > T_2 > T_7 > T_3 > T_5 > T_4 > T_1$ in case of plant height. The maximum available nitrogen at 0-15 cm soil depth recorded in T_8 which was 299.37 kg/ha and was at par with T_3 (298.68 kg/ha) and minimum nitrogen at 0-15 was recorded in control (T_1) which was 282.45 kg/ha. The enhancement in available nitrogen was increased 5.65 % over control. The application of vermicompost increase nitrogen content.

The similar findings are in line with (Pandey *et al*., 2007 and Patel *et al*., 2005). The maximum available phosphorous content was recorded in 50% RDF + 50% N through vermicompost (T_6) which was significantly higher over the treatments T_1 (control), T_2 (50% RDF + 50% N through FYM), T_5 (25% RDF + 75% N through vermicompost) and T_8 (50% FYM + 50% N through vermicompost) and at par with T_3 (50% + 50% N through vermicompost) T_4 (75% RDF + 25% N through vermicompost) T_7 (75% RDF + 25% N through vermicompost). The treatments T_8 have been 15.89 kg/ha of available phosphorous content which was higher over control.

Vermicompost and FYM are capable to reduce phosphorus fixation in soil. The results are in agreements by (Kumawat and Kumawat, 2009; Naikwade *et al*., 2012). Effect integrated of vermicompost, FYM and chemical fertilizers enhanced available K content in soil. The result further showed that maximum available K content was recorded in treatment T_6 (50% RDF + 50% N through vermicompost) which was significantly higher over treatments T_1 (control), T_2 (25% RDF + 75% N through vermicompost), T_5 (25% RDF +75% N through vermicompost) and T_8. The use of 1:1 ratio of chemical fertilizers combined with FYM or vermicompost found better in respect of available K in soil. This may be due to organic acid produced during decomposition of organic manures reduces the K-fixation in soil. These findings are in agreement with those of (Hussain *et al*., 2002 and Naikwade *et al*., 2012).

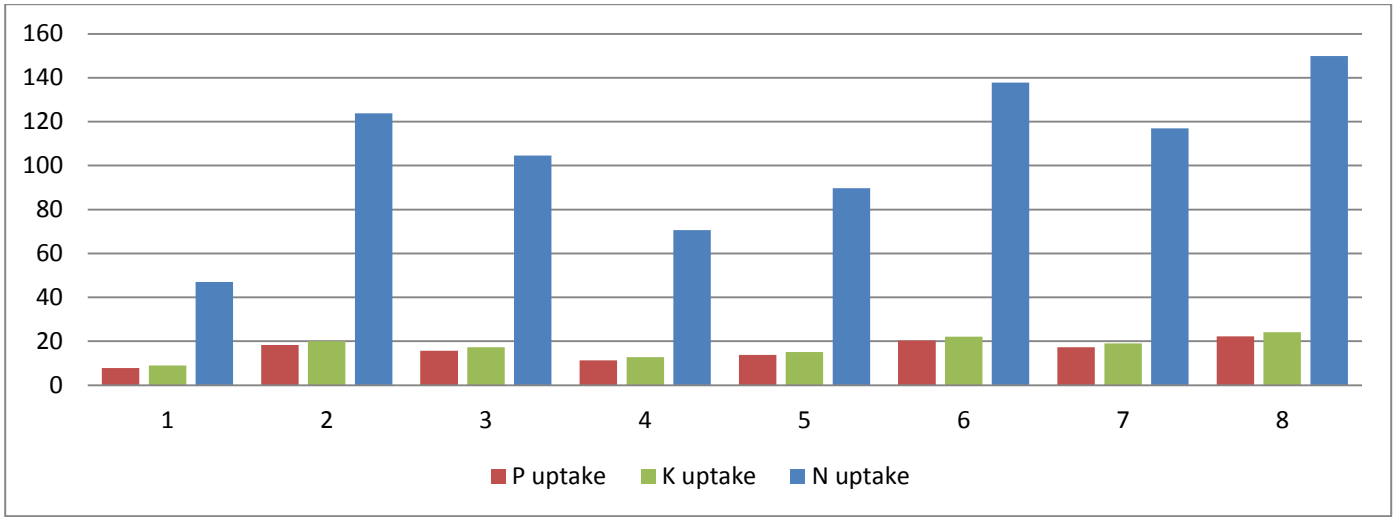

Fig 1. Effect of FYM and Vermicompost application on nutrient uptake

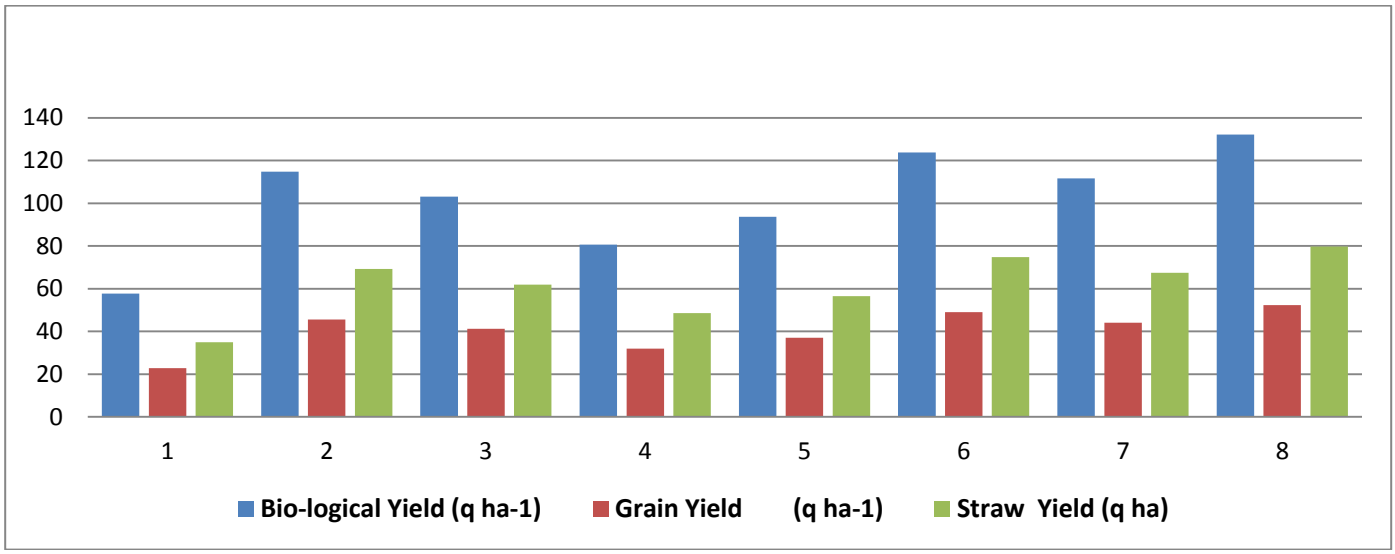

Fig 2. Effect of FYM and Vermicompst on yield of wheat

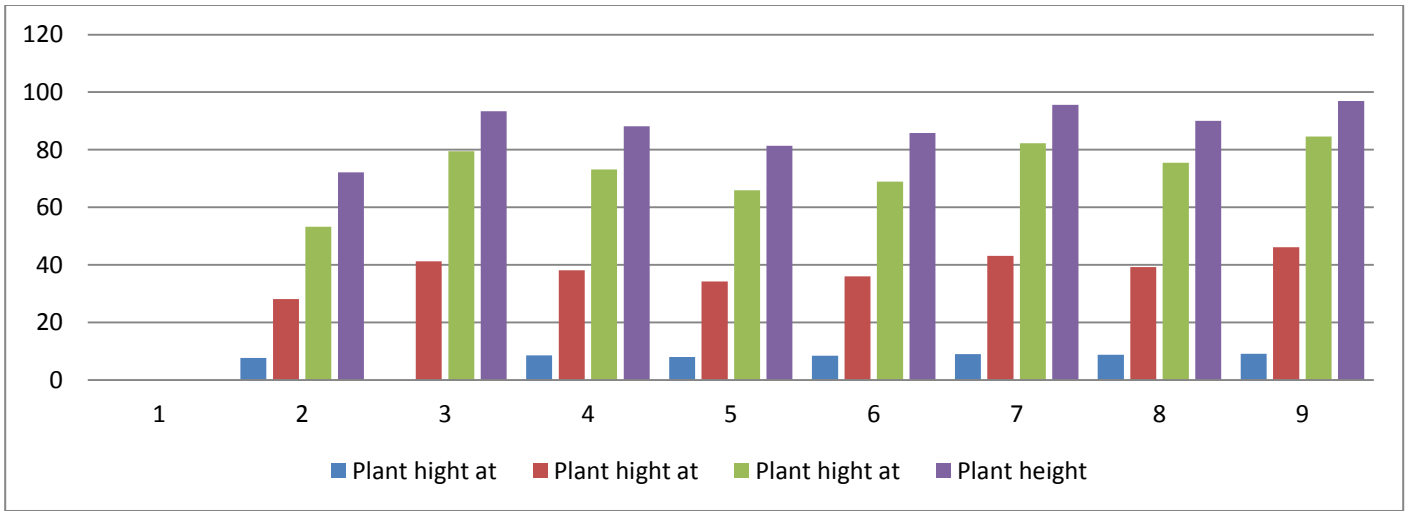

Fig 3. Effect of FYM and Vermicompost application on plant height of wheat

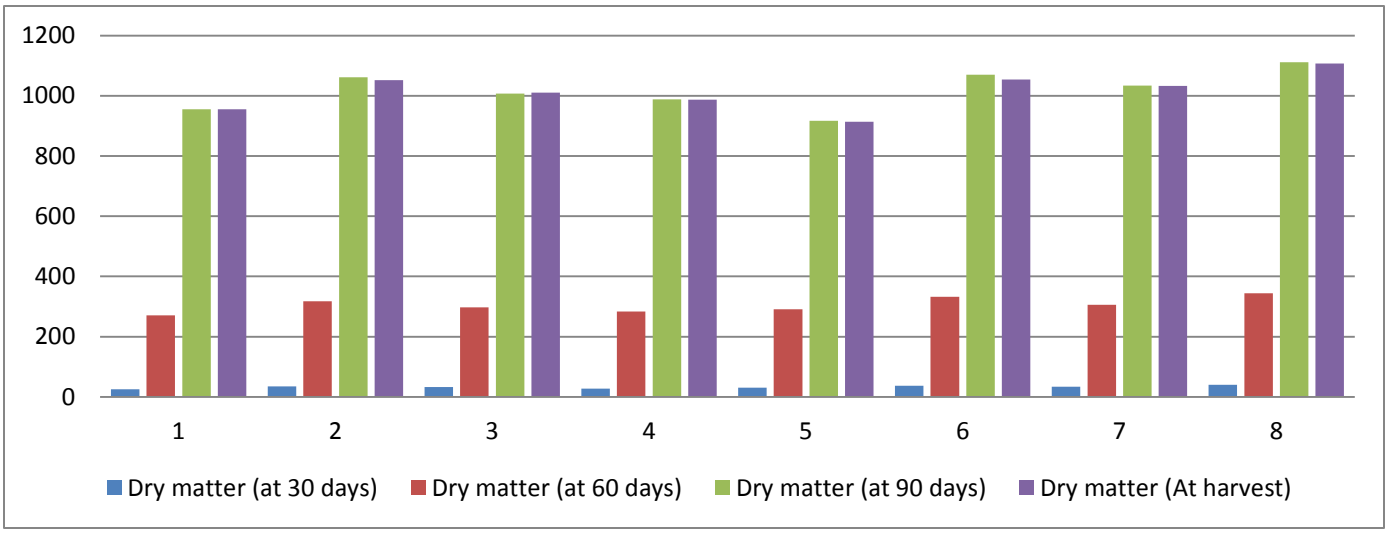

Fig 4. Effect of FYM and Vermicompost Application on dry matter of wheat

Conclusion

On the basis of experimental study, it was concluded that integrated use of chemical fertilizers in combination with farm yard manure and vermicompost found better in respect to growth, yield attributing characters and yields of wheat crop. However, the treatment T_8 (75% RDF + FYM@ 2.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1}) chemical fertilizers with farm yard manure vermicompost proved better in respect to grain yield of wheat. The integrated use of chemical fertilizers either with FYM or vermicompost enhanced the soil fertility status in respect of pH, EC, organic carbon, available nitrogen, phosphorus and potassium in the soil. The maximum improvement in soil fertility was noticed where vermicompost was applied with chemical fertilizers. Therefore, the treatment T_8 (75% RDF + FYM@ 2.5 t ha-1 + vermicompost @ 1.5 t ha-1) through vermicompost proved better for production of wheat crop and may be recommended to the farmers.

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