

Response of Different Organic and Inorganic Sources of Nutrients on Growth and Yield of Wheat (*Triticum aestivum* L.)

Deepak Loura*, Suresh Kumar, Pawan Kumar, Sunil, Akshit and Amit Dhankar

Department of Agronomy, Chaudhary Charan Singh Haryana Agricultural University
Hisar-125004, Haryana, India

*Corresponding Author E-mail: deepakloura586@gmail.com

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ABSTRACT

A field experiment was conducted during Rabi season of 2018-2019 at the farm of Gurukul, Kurukshetra, research site of CCS Haryana agricultural university, Haryana, India. The experiment was laid out in randomized block design with three replications to evaluate the effect of different organic and inorganic sources of nutrients on wheat growth. The eight treatments were evaluated in RBD design viz., T₁: Farm Yard Manure @ 15 t/ha, T₂: Vermicompost @ 7.5 t/ha, T₃: Jivamrit soil application thrice @ 500 litres/ha, T₄: Jivamrit soil application twice @ 500 litres/ha + Jivamrit spray twice, T₅: T₄+ Ghanjivamrit ground casting twice, T₆: T₅+ Sapt Dhanya Ankur Ark spray, T₇: Recommended dose of fertilizers (RDF), T₈: Control. The results showed that highest growth parameters were recorded in T₇ at all the stages of crop. Among organic sources of nutrients T₂ recorded highest plant height (97 cm), maximum number of tillers/m² (346), highest leaf area index (3.5), highest dry matter accumulation (675 g/m²) followed by T₁ and other cow based nutrient sources. Highest grain yield and straw yield was obtained under RDF application in T₇ followed by T₂, T₁ and other cow based nutrient sources. From the present investigation, it can be inferred that combined use of organic and inorganic sources of nutrition gave the optimum productivity and organic nutrient sources can be a good alternative or supplement of synthetic fertilizer to produce optimum growth and yield for sustainable agriculture.

Keyword: Wheat, FYM, Vermicompost, Jivamrit, Ghanjeevamrit, Sapt Dhanya Ankur Ark, Sustainable.

INTRODUCTION

Wheat (*Triticum aestivum* L.) also known as “King of cereals” is a member of Poaceae (Graminae) family. At global and national level wheat ranks second most important food crop next to rice and at national level it contributes about 35 % to the national food basket. In India, is cultivated over an area of

30.78 m ha with the production of 98.51 m tones with the average national productivity of 3,200 kg/ha. In Haryana, wheat is grown over an area of 2558 lakh ha with a production of 11546.81 lakh tones and with average productivity of 4514 kg/ha, which is much higher than the national average (Anonymous, 2018).

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With advent of Green Revolution in 1960s in India, the production and productivity of wheat increased at a high level, which was achieved on the basis of the use of high yielding varieties, heavy doses of chemical fertilizers, pesticides, and heavy farm mechanization that led to unprecedented pressure on our natural resource base (Charyulu & Biswas, 2010). Continuous use of chemical fertilizers, agro-chemicals, and other practices were very exhaustive in nature, which results in removal of nutrients much higher than their replenishment and also depleted the physical, chemical, biological properties and ultimately hampers the soil fertility and productivity. The excessive use of chemicals over time has started posing problems to animal and human health due to the persistence of residues in food items. Besides, the chemical residues also harm the beneficial soil microbes and fauna (earthworms) resulting in the degradation of soil fertility (Meena et al. 2013), (Kumar & Bohra, 2006).

Consequently, in recent years farming practices have been changing and organic agriculture has emerged as a good alternative for sustainable agriculture. Declining factor productivity, worldwide energy crises and high increment in the price of synthetic fertilizers had led to the present focus on supplementation or replacement of inorganic fertilizers with low priced nutrition sources such as organic compost and manures (Prasad, 2005). The use of organic sources of nutrients in the form of manure, compost and in another form will be effective to further increase the crop yield on a sustained basis. In order to sustain agricultural productivity, a desirable level of soil organic matter needs to be maintained through repeated applications of organic amendment and proper management practices (Lodhi et al. 2006). Use of organic sources of nutrients for crop production can help in achieving long term sustainable agriculture productivity. Addition of organic matter through application of organic manures and compost improves soil physical, chemical and biological properties which contributes

higher productivity. Organic fertilization increases the organic carbon content in soil which was found to be more advantageous for improving growth and yield components of wheat.

Indian Agriculture has been cow-centric in ancient times. Emphasis is being given to developing sustainable desi cow-centric farming system models in the present times also. The cow-based organic nutrient formulations prepared from dung and urine of cow are being tried as nutrient sources by several workers as sources of nutrients for crops. Cow-based nutrient formulations like Jivamrit, Ghanjivamrit, and Beejamrit to increase the proliferation of soil micro-fauna and flora, which improves the soil fertility status. Encouraging results of Jivamrit has been reported by (Ugale, 2014) in Integrated Nutrient Management in the soybean-wheat cropping system. Other sources like Ghanjivamrit and Sapt Dhanya Ankur Ark are being used as nutrient sources for pure organic production of wheat. Association of beneficial micro-organism in Jivamrit and Ghanjivamrit transform the nutrients which are in non-available form into an available form when applied in the soil. The present study was conducted to investigate the effect of organic sources of nutrients on the wheat growth.

MATERIAL AND METHOD

The field experiment was conducted at the farm of Gurukul, Kurukshetra, Haryana, India during Rabi 2018-19. The experimental farm falls under the indo-gangetic alluvial tract and irrigated by tube well. The soil of experimental site was clay loam (fine sand 21.5 %, silt 42.8 % and clay 34.7 %) with pH 7.7 and electrical conductivity (EC) 0.36 dS/m in the top 15 cm of soil. The soil was low in organic carbon (0.29 %) and available nitrogen (126.4 kg/ha), medium in available phosphorus (16.2 kg/ha), high in available potassium (252.3 kg/ha) and low in zinc (1.5 kg/ha). The experimental design was randomized complete block with three replications. There are eight treatments as mentioned in Table-2. The source of nitrogen, phosphorus and potassium was organic and

inorganic, well-decomposed FYM and vermicompost as per treatment were incorporated in the soil before sowing. Recommended dose of fertilizers was applied by application of DAP, Urea and murate of potash (MOP) at the time of sowing and first

irrigation as per treatment. The irrigation and other crop management practices were followed as per recommended package and practices during the crop growth period. The wheat variety HD 2967 was sown on 14th November 2018 at a row spacing of 22.5 cm.

Table 1: Treatment description of different organic sources of nutrients

Treatment	Description of Treatments
T ₁	Farm Yard Manure @ 15 t/ha
T ₂	Vermicompost @ 7.5 t/ha
T ₃	Jivamrit soil application thrice @ 500 litres/ha(at pre-sowing irrigation, 1 st & 2 nd irrigation)
T ₄	Jivamrit soil application twice @ 500 litres/ha (at pre-sowing irrigation & 1 st irrigation) + Jivamrit spray twice at 50-60 DAS and 80-90 DAS @ 500 litres/ha
T ₅	T ₄ + Ghanjivamrit twice @ 150 kg/ha (Ground casting at 1 st & 2 nd irrigation)
T ₆	T ₅ + Sapt Dhanya Ankur Ark spray @ 1.75 kg/ha in 500-litres water/ha one week after 50% heading
T ₇	Recommended dose of fertilizers (RDF: N-120, P ₂ O ₅ -60, K ₂ O-60 kg/h)
T ₈	Control

RESULT AND DISCUSSION

This experiment was conducted to determine the effect of different organic sources of nutrition on wheat growth. The data in respect of periodical plant height (cm) of wheat was recorded at 30, 60, 90, 120 DAS and at harvest is presented in Table 1. Among the treatments the highest plant height (104 cm) was observed in T₇ (RDF) application at all the growth stages. It was significantly superior to other treatments at all the recorded observations. Minimum plant height of wheat was recorded in treatment T₈ (control). Among the organic nutrient sources, maximum plant height (97 cm) was recorded with treatment T₂ (vermicompost) at all the stages which was significantly superior to T₃, T₄, and T₈ at 30, 60 and 90 DAS. Differences in plant height under various nutrition sources may be due to different fertility levels provided under different treatment. There is less variation in plant height under various nutrition sources. This may be because of plant height being the genetic character, hence, affected less by external environment. The variation in plant height under different nutrient sources may be

due to variation in the availability of macro and micro nutrients released in the soil. Chemical fertilizers releases nutrients rapidly which are easily soluble in the soil solution and their instant availability to crop enhances plant growth. Organic sources of nutrients also supply macro as well as micronutrients and therefore, organic nutrients have a direct effect on growth, development, and productivity of a crop. These results are supported by (Edwards et al. 2004) and (Channabasanagowd et al. 2008).

Tillering is a vital component for grain production and is thereby an very important growth parameter of wheat growth improvement. Organic sources of nutrition modified the soil properties and provide better soil environment for crop growth which ultimately increases the effective number of tillers (Sarma et al. (2007), Gupta et al. (2006). Application of different organic and inorganic sources of nutrition significantly influenced the number of tillers per meter square. The data in respect of periodical number of tillers per meter square of wheat was recorded at 30, 60, 90, 120 DAS and at harvest is presented in

Table 2. Number of tillers per meter square increased with the advancement of crop age and reached the highest value at 90 DAS. The maximum numbers of tillers (400) were recorded in T₇. Among organic nutrient sources, T₂ produced maximum numbers of tillers (346) at all crop growth stages, which is significantly higher than T₁, T₃, T₄, T₅ and T₆. Lowest number of tillers (220) were observed under T₈ (control). The results are in conformity with (Dhillon, 1993) where a decrease in the number of tillers could be due to mortality of smaller and weaker tillers at later stages of growth. Higher number of tillers under RDF application might be due to adequate quantity and balanced proportion of plant nutrients supplied to the crop during vegetative period of crop resulting in creating favourable environment for growth of crop plants. These results corroborate the findings (Upashyay & Vishwakarma, 2014).

Area of green (photo-synthetically active) leaves was recorded at 30, 60 and 90 DAS and then leaf area index (LAI) was calculated. The data pertaining to LAI is presented in Table 3. The data depicted that the LAI increased with the advancement of crop stages reaching peak value at 90 DAS. At 90 DAS highest (4.5) LAI was calculated in T₇, which was significantly superior to all the different sources of nutrient, whereas the lowest (2.3) was recorded under control. Among organic sources, T₂ recorded highest LAI (3.5), which was statistically significant to all organic nutrient sources at 60 and 90 DAS and lowest was recorded under T₃ followed by T₄, T₅, and T₆ at all the observations. Similarly, different nutrient sources significantly influenced the dry matter accumulation at different growing days. The data pertaining to dry matter accumulation of wheat at various growth stages is presented in Table 3 (g/m²). Dry matter accumulation of wheat increased progressively with the advancement of crop age up to harvest, the maximum increase being recorded between 60 DAS and 90 DAS. The results revealed that the highest dry matter accumulation was recorded in T₇ from 30 DAS (58.7 g/m²) till harvest (981.3 g/m²), which

was significantly superior to all the treatments. Among the organic sources of nutrients T₂ recorded highest dry matter accumulation (789.8 g/m²), which was significantly superior to all the organic treatments and control. The possible reason for good growth under vermicompost application is due to the presence of various types of soil microorganisms that improve the growth of plant via hormones, vitamins and antibodies (Lourduraj, 2006). The plant growth in terms of LAI and dry matter weight were significantly lower in Jivamrit and Ghanjivamrit application and in control than RDF. This low growth in Organic treatments may be due to low availability of plant nutrient, which is necessary for the normal growth. This shows that organic sources have supplied the nitrogen to the crop plant slowly and their availability may also be less than the recommended dose of chemical fertilizer, which is readily available. These results corroborate the findings of (Kumar et al., 2004), and (Singh & Yadav, 2006).

The grain yield (kg/ha) and straw yield (kg/ha) of wheat is influenced significantly by different nutrient sources is given in Table 5. A perusal of the data revealed that highest grain yield was recorded with T₇ (4986 kg/ha), which was significantly higher than other sources of treatments, whereas, lowest grain yield was produced in control (2133 kg/ha). Among organic nutrient sources, T₂ recorded the highest grain yield (3646 kg/ha), which was statistically at par with T₁ (3426 kg/ha) and significantly superior over other treatments. Among cow based organic formulations highest grain yield was recorded under T₆ (3142 kg/ha). Highest straw yield was recorded in T₇ (7130 kg/ha) which was significantly higher than remaining all the nutrient sources, whereas lowest straw yield was reported in control. Among the organic treatments, T₂ recorded the highest straw yield (5250 kg/ha) followed by T₁ which was significantly superior over all the organic treatments. The possible reason for higher grain and straw yield in RDF is due to higher growth because of immediate availability of

nutrients in proper amount and available form as compared to slower release of nutrients from organic sources, mainly in the initial year of transition to organic farming (Liebhardt et al., 1989) and (MacRae et al., 1993). Among organic sources, vermicompost treated plots recorded the highest grain and straw yield

which might be due to more NPK content in vermicompost as compared to other organic sources which ultimately increased the growth, yield attributes and yield of wheat crop Hadis et al. (2018). These findings were in accordance with (Ghosh et al., 2004), and (Shishehbor et al., 2013).

Table-2: Effect of nutrient sources on plant height and leaf area index (LAI) of wheat

Nutrient sources	Plant height (cm)					Leaf area index (LAI)		
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest	30 DAS	60 DAS	90 DAS
T ₁	20.2	52.5	88.7	93.8	95.7	0.55	2.64	3.22
T ₂	20.7	53.4	91.4	95.6	97.4	0.57	2.73	3.52
T ₃	18.8	49.1	85.1	89.1	90.6	0.48	1.91	2.61
T ₄	18.9	49.6	85.6	89.7	91.2	0.50	2.07	2.75
T ₅	19.1	50.2	86.1	90.2	91.7	0.52	2.18	2.84
T ₆	19.3	50.7	86.5	90.9	92.5	0.53	2.27	2.98
T ₇	21.8	58.6	95.8	101.7	103.9	0.64	3.26	4.46
T ₈	18.2	47.3	82.2	86.2	87.8	0.42	1.76	2.28
SEm ±	0.46	1.3	2.0	2.2	2.2	0.01	0.05	0.07
CD (p =0.05)	1.4	3.9	6.08	6.6	6.7	0.03	0.15	0.20

Table 3: Effect of nutrient sources on No. of tillers of wheat

Nutrient sources	No. of tillers per m ²			
	30 DAS	60 DAS	90 DAS	120 DAS
T ₁	230.5	316.7	322.7	318.8
T ₂	236.2	344.5	350.9	345.7
T ₃	198.7	245.9	255.2	248.2
T ₄	206.9	261.3	267.1	264.2
T ₅	213.4	276.4	282.6	275.7
T ₆	220.6	292.6	299.5	295.1
T ₇	236.3	394.8	402.8	400.2
T ₈	188.2	217.5	230.6	220.4
SEm ±	4.8	6.7	6.9	5.8
CD (p = 0.05)	14.7	20.3	20.9	15.2

Table 4: Effect of nutrient sources on periodic dry matter accumulation and grain and straw yield of wheat

Nutrient sources	Dry matter accumulation g/m ²					Yield (kg/ha)	
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest	Grain yield (kg/ha)	Straw yield (kg/ha)
T ₁	51.6	229.7	417.40	621.90	746.3	3426	4910
T ₂	53.4	244.6	445.20	674.70	789.8	3646	5250
T ₃	48.3	194.5	342.90	502.50	605.6	2675	3718
T ₄	48.7	202.8	351.20	513.40	612.5	2785	3955
T ₅	49.1	211.3	363.88	531.30	634.9	3043	4443
T ₆	50.2	218.4	382.70	542.80	652.7	3142	4681
T ₇	58.7	284.4	523.80	796.10	981.3	4986	7130
T ₈	47.5	182.1	326.50	462.90	548.4	2133	3434
SEm ±	1.20	5.13	8.31	11.80	14.36	82.10	111.05
CD (p = 0.05)	3.65	15.55	25.21	35.79	43.55	249.01	336.83

CONCLUSION

Based on the results of the present study, it was observed that the application of Farm yard manure, vermicompost and other cow based nutrient formulations have low grain yield in the initial years of application due to transition phase of organic farming. Continued application of organic sources of nutrition improves the organic carbon content in the soil and soil properties which ultimately enhance the economic yield of crop. All the sources of nutrition showed significant effect on growth and productivity of wheat. From the present investigation, it can be inferred that combined use of organic and inorganic sources of nutrition gave the optimum productivity and maintain the soil health. Our findings indicated that, organic fertilizer can be a good alternative or supplement of synthetic fertilizer to produce optimum growth, yield and maintain soil health for sustainable agriculture.

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