Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(1): 260-265
Received: 14-11-2017
Accepted: 16-12-2017

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Influences of organic and inorganic fertilizers on productivity and soil fertility of wheat (*Triticum aestivum* L.) in *Typic Ustochrept* soil of Uttar Pradesh

Vineet Singh, NS Rana, BP Dhyani, Ravindra Kumar, Vivek, RK Naresh and Arun Kumar

Abstract
A study was conducted to assess fertilizer effect on wheat yield and soil fertility with the following treatments; T_1- Control, T_2- 100 % NPK, T_3-75 % NPK + FYM, T_4- 75 % NPK + FYM + PSB+ Azotobactor, T_5- 100 % NPK + Zn, T_6- 100 % NPK + Zn+ Mn, T_7-100 % NPK + Zn + Mn + Fe, T_8-75 % NPK + FYM+ PSB+ Azotobactor + Zn + Fe + Mn, T_9-125 % NPK, T_{10}- 125% NPK + Zn, T_{11}- 125 % NPK + Zn+ Mn, T_{12}-125% NPK + Zn + Mn + Fe, T_{13}-100% NPK + FYM+ PSB+ Azotobactor + Zn + Fe + Mn and T_{14}-50% N +100%PK + FYM+ PSB+ Azotobactor + Zn + Fe + Mn + LCC based N top dressing. Treatments differed significantly in influencing soil fertility and grain and straw yields of wheat crop. The study indicated that addition of 100% NPK + FYM + PSB + Azotobactor+ Zn + Fe + Mn recorded significantly higher value of growth and yield attributes in terms of plant height (cm), dry matter accumulation (g m^{-1}), number of effective tillers (m^{-2}) and yield attributes character grains spike^{-1},1000-grain weight (g), harvest index (%), grain yield (58.40 q ha^{-1}) and straw yield (83.9 q ha^{-1}) followed by 125% NPK + Zn+ Mn grain yield (57.9 q ha^{-1}) and straw (82.9 q ha^{-1}).The content of organic carbon increase with the combined application of organic and inorganic with biofertilizer. Integration of 100% NPK + FYM + Azotobactor + Zn + Mn + Fe was found more productivity and remvaerative with the higher residual soil fertility status after wheat crop. Based on the study, 100% NPK + FYM + Azotobactor + Zn+ Mn+ Fe could be recommended for attaining maximum wheat crop productivity and sustainability of soil under semi-arid and sub-tropical sandy loam.

Keywords: FYM, biofertilizers, yield attributes, organic Carbon

Introduction
Wheat (*Triticum aestivum* L.), the second most important food crop of the world in terms of area, production and nutrition, meets 20 per cent of the total food, 19 per cent of calories and 20 per cent of protein requirements of the global population besides being a major source of dietary fibre in human nutrition since decades. It was grown in diverse environments across the globe over an area of 277 million hectares producing 654 million metric tons of grains with an average productivity of 3 tons ha^{-1}. In India, wheat occupied an area of 31.0 million hectare and produced of 88.9 million tons of grains with productivity of 2872 kg ha^{-1} during 2015-16 (Anonymous, 2016). Amongst food-grains, it shared about 21 % of area and 34 % production of the country. Soil productivity has gone down, and now time has come to supplement these chemical fertilizers with organics to sustain the fertility and productivity of the soils Behera *et al*. (2009) [4].

Soil is the largest and the most active terrestrial pool of the carbon (C) cycle (Janzen, 2004) [11]. Soil organic matter (SOM) can be defined as the accumulated decaying debris of biota living on or in the soil. It is heterogeneous, encompassing everything from the most recent root exudates to old aged persistent humified material (Amundson, 2001) [1]. SOM holds about 1500 Pg C to a depth of 1m as the major pool of terrestrial C to regulate its biogeochemical processes. In terms of the C storage capacity, the soil system triples and quadruples those of the atmosphere and all living terrestrial plants and marine life forms (especially corals), respectively (Silva *et al*., 2008; Naresh *et al*., 2017) [1, 18]. However, intensive agricultural activities have had a detrimental effect on soil such as rapid mineralization of soil organic carbon (SOC). This has resulted in transformation of the excess C into soil air increasing CO_2 levels in the atmosphere while depleting the soil C stock. In particular, arable agriculture leads to depletion of soil C with the harvesting of a large proportion of photo synthetically-fixed C, while returning less plant litter. Such activity is expected to expedite biological decay of OM by disrupting soil aggregates and mixing fresh litter into the soil. Consequently, it should help intensify erosion to displace C-rich surface soil (Janzen, 2006) [12]. Organic inputs play a vital role in managing the soil C pool by replenishing the SOC stock depleted via harmful agricultural practices. Moreover, restoration and rejuvenation of agro-ecosystems should substantially improve the SOC pool, thereby compensating for C loss through mineralization. In addition, bioenergy-based products have considerable ecological benefits by improving soil and water quality and increasing the net economic return to an agrarian society.

Integrated nutrient management (INM) is a viable option as it utilizes available organic and inorganic nutrients to build ecologically sound and economically viable farming systems. In wheat production, micronutrients play a vital role in the yield improvement Zn, Mn, Fe, B, Cu and Mo are known to be the most important micronutrients for higher plants Micronutrients occupy a major portion as they are essential for increasing the growth and yield attributes of plant. Their importance increases due to their role in plant nutrition and increasing the soil productivity. Thus, judicious combination of organics, bio-fertilizers and chemical fertilizers helps to maintain soil productivity to alleviate the problem has become the need of the hour to address multifarious issues. Organic manures supports soil biological activities besides improving soil structure, water holding capacity and other physico-chemical properties of soil Devi *et al*. (2013) [6]. An increase in availability of micronutrients like Zn, Cu, Fe and Mn and OM- bound fractions of micronutrients with the addition of organic and mineral fertilization have been advocated by Herencia *et al.* (2008) [9]. Keeping this in view, an attempt was made to evaluate influence of organic and inorganic sources on productivity and soil fertility of wheat (*Triticum aestivum* L.) in *Typic Ustochrept* soil of Uttar Pradesh.

Materials and method

The field experiment was conducted during the *rabi* season of 2015-16 at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, (29^0 13' N, 77^0 68' 43 E, 237 m above mean sea level) Meerut, India. Climate was semi arid sub tropical with extremes of hot weather in summer and cold in winter season. There is gradual decrease in mean daily temperature from October reaching as low as 2-4 ^{0}C in January and further a gradual increase is registered from February reaching as high as 43-45 ^{0}C in May. The rains are predominantly caused by south-west monsoon which sets in the last week of June, reaches its peak in July-August and withdraws by the end of September. The area receives 862 mm of rains annually on an average, of which 90% is confined to rainy season (July-September). Soil of experimental field was sandy loam with pH of 8.3, electric conductivity (EC) 1.7dSm^{-1}, low in organic C (0.41%), available N (174.8 kg ha^{-1}), medium in available P (13.7 kg ha^{-1}) and K (245 kg ha^{-1}). A range of mean weekly maximum temperature varied from 16.5°C to 40.2°C, and the mean weekly minimum temperature ranged from 4.6°C to 22.7°C during 2015-16. The total of 22.4 mm rainfall was received during crop season 2015-16.

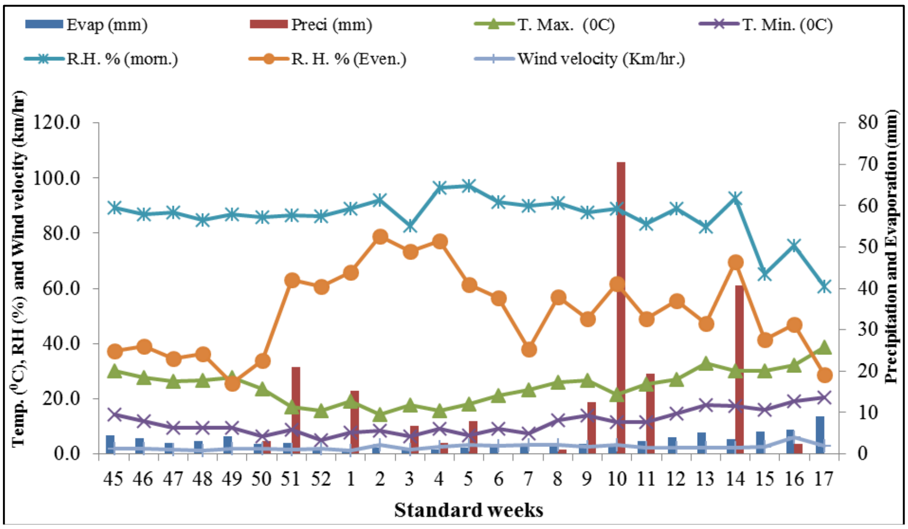

Fig 1: Weekly meteorological data during crop period (November 2015 - April 2016).

The experiment was laid out in RBD (Randomized Block design) with three replication. Studies were conducted with fourteen treatments viz., T_1- Control, T_2- 100 % NPK, T_3-75 % NPK + FYM, T_4- 75 % NPK + FYM + PSB+ Azotobactor, T_5- 100 % NPK + Zn, T_6- 100 % NPK + Zn+ Mn, T_7-100 % NPK + Zn + Mn + Fe, T_8-75 % NPK + FYM+ PSB+ Azotobactor + Zn + Fe + Mn, T_9-125 % NPK, T_{10}- 125% NPK + Zn, T_{11}- 125 % NPK + Zn+ Mn, T_{12}-125% NPK + Zn + Mn + Fe, T_{13}-100% NPK + FYM+ PSB+ Azotobactor + Zn + Fe + Mn and T_{14}-50% N +100%PK + FYM+ PSB+ Azotobactor + Zn + Fe + Mn + LCC based N top dressing. Wheat crop was sown with the row spacing of 22.5 cm. five irrigations (60 mm irrigation in each) were applied at five critical phenological stages. In regards to fertilizer application of the crop, 150 kg N, 75 kg P_2O_5 and 60 kg K_2O were applied as recommended dose. Out of which, 1/2 N and full dose of P_2O_5 and K_2O were applied as basal at the time of sowing by broadcasting method. The remaining 1/2 dose of N was applied in two equal splits at CRI and late tillering stages. Organic manure, FYM, and bio fertilizer Azotobactor and PSB were used as per treatment. Variety of wheat is DBW 17 was sown on 28 November, 2015. Five spike selected randomly were threshed manually, grains were counted and data presented as grains per spike. The sample of 1000-grains collected from each plot, weighed and presented as gram. Total bundle weight was recorded from each plot at the time of harvesting. The crop was threshed and grain were weighed and presented as quintal per hectare. Meteorological data, *viz.*, rainfall, relative humidity, maximum and minimum temperature, were recorded from Agro-meteorological observatory, Meerut. Data on yield attributes, grain, biological yield, and harvest index were recorded at crop maturity. Standard procedures were used for chemical analysis of soil and plant sample. The data were analyzed by using the 'Analysis of Variance Technique' as per the procedures described by Gomez and Gomes (1984) [7]. The treatment means were compared at 5% level of significance.

Table 1: Physico-chemical properties of the soil of the experimental field.

S. No.	Soil Properties	Content	S.No.	Soil Properties	Content	S.No.	Soil Properties	Content
1.	Sand (%)	64.2	5.	EC(dSm^{-1})	0.48	9.	Available K (kg/ha^{-1})	245
2.	Silt (%)	18.5	6.	Organic carbon (%)	0.41	10.	Available Fe (mg kg^{-1})	3.3
3.	Clay (%)	17.3	7.	Available N (kg ha^{-1})	174.8	11.	Available Zn (mg kg^{-1})	0.82
4.	pH (1:2)	8.3	8.	Available P (kg/ha^{-1})	13.7	12.	Available Mn (mg kg^{-1})	3.85

Results and discussion

Growth and yield attributes

Applications of organic with inorganic sources of fertilizer at any level were found to improve the growth and yield attributing character (Table 2) in comparison to control. Nutrient had significant effect on plant height during the year of investigation. Application of different nutrient management practices influenced the plant height significantly over the control. The application of 125% NPK + Zn + Mn + Fe recorded the maximum plant height which was at par with 100% NPK + FYM + PSB+ Azotobactor + Zn + Fe + Mn. The control plots resulted significant reduction in plant height compared to other treatments at harvest. Such a higher plant height in 100% NPK with organic manures and bio-fertilizers can be associated with sufficient nutrient supply at the active growth stage. Similar results of increased plant height were also reported by Kumar and Ahlawat (2004) [14], Tulsa Ram and Mir (2006) [29], Thakral *et al.* (2003) [27]. Dry matter production in crop is a function of current photosynthesis. Balanced nutrition helps in achieving higher dry matter accumulation through enhanced canopy cover which ultimately increased higher amount of assimilated through higher rate of current photosynthesis. Total plant stand, plant height, number of effective tillers characters will ultimately affect dry matter accumulation by crop. Nutrient management treatments had significant effect on dry matter accumulation. Further, perusal of the data revealed that dry matter accumulation (g m^{-1}) decreased significantly with nutrient doses from 100% NPK with all other nutrient inputs (FYM + Bio fertilizers + micronutrient) to control. At harvest, 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe with all other nutrient inputs crop accumulated more dry matter than other nutrient options. Highest dry matter accumulation was recorded in 125% NPK + Zn + Mn + Fe which was statistically at par with 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe at harvest during 2015.16. Minimum dry matter accumulation was recorded in control plots. The application of organic and inorganic sources of nutrients with 100% NPK also produced better growth parameters viz., plant height, number of effective tillers and finally dry matter. Similar results were also reported by Jakhar *et al.* (2006) [10], Sepat *et al.* (2010) [22]. The number of tillers (m^{-2}) increased up to at 60 DAS and started declining their after at 90 DAS and at harvest. The highest number effective tillers at 90 DAS were recorded in 125% NPK + Zn + Mn + Fe which was statistically at par with 100% NPK alongwith FYM, biofertilizers, Zn, Mn and Fe at harvest during 2015.16. Lowest numbers of tillers were recorded in control plots. Such a higher number of effective tillers in these treatments can be linked with optimum supply of essential nutrients at active tillering stage. Similar results were also reported by Singh and Agarwal (2001) [25] and Jat *et al.* (2013) [13].

Yield

The yield of a crop depends upon the source sink relationship and is the cumulative expression of various growth parameters and yield attributing components viz; grains/spike, 1000- grain weight. Maximum of number of grain/spike and 1000- grain weight was recorded in 125% NPK + Zn + Mn + Fe which was found statistically at par with 100% NPK + FYM+ PSB+ Azotobactor+Zn + Fe + Mn. The effect of 100% NPK + FYM+ PSB+ Azotobactor+Zn + Fe + Mn being statistically at par with 125% NPK + Zn + Mn + Fe and was superior to control in respect of yield attributing characters. More yield attributes were found in the treatment where organic and inorganic sources of plant nutrients were applied over control. Higher level of nutrients improved the fertility level of soil and creates congenial condition for better growth and development thus improved the yield attributes. These results are in conformity with those reported by Sen *et al.* (2003) [21], Singh *et al.* (2007) [26] and Barthwal *et al*. (2013) [3]. Application of nutrient management treatments significantly increased the grain, straw and biological yield of wheat during the years of experimentation. The grain, straw and biological yields were recorded significantly higher in the treatments 125% NPK + Zn + Mn + Fe which was 58.70, 84.10 and 142.8 q ha^{-1} which was at par with 100% NPK + FYM+ PSB+ Azotobactor+Zn + Fe + Mn. The magnitude of increase being highest of 30.4 q ha^{-1} or 107% with 125% NPK with Zn + Mn and Fe and 20.9 q ha^{-1} or 73.8% with 100% NPK. Crop grown with 25% substitution of nitrogen through FYM or FYM and biofertilizers gave 2.8 and 4.0% higher yield than that grown with 100% NPK. The crop receiving 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe remaining at par with treatments having 125% NPK with micronutrients proved significantly better than 100% NPK. All the other treatments where 100% NPK was supplemented with micronutrients resulted in significant increase in grain yield over 100% NPK being 5.8% with Zn, 8.7% with Zn + Mn and 9.7% with Zn + Mn + Fe. Further enhancement of NPK to 125% alone or with micronutrients produced significant effect over respective combinations with 100% NPK. Basal application of NPK along with biofertilziers and micro-nutrients coupled with LCC based nitrogen top dressing led to significant increase in yield being 3.8 q ha^{-1} (7.7%) over 100 NPK but remained significantly lower than the yield obtained with 100% NPK, FYM + biofertilizers + micronutrients (58.4 q ha^{-1}). The magnitude of increase in straw yield was highest of 43.6 q ha^{-1} or 107.6% with 125% NPK + Zn + Mn and Fe, and 31.8 q ha^{-1} or 78.7% with 100% NPK in comparison to control. Crop fertilized with 125% NPK with Zn + Mn and Fe recorded highest biological yield (142.8 q ha^{-1}). The crop receiving 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe remaining at par with treatments having 125% NPK with micronutrients proved significantly better than 100% NPK. The magnitude of increase was highest of 74.0 q ha^{-1} or 107.5% with 125% NPK + Zn + Mn and Fe and 52.7 q ha^{-1} or 76.5% with 100% NPK over control. The harvest index was not influenced significantly by the application of nutrient management treatments during of study. Highest harvest index was found in 125% NPK + Zn + Mn + Fe followed by 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe and lowest in control plot. The beneficial effect of organic manures on grain, straw, biological yields and yield attributing characters might be assigned to the fact that after proper decomposition and mineralization, these manures supplemented plant nutrients to the plants and also had solublising effect on fixed forms of nutrients in soil. Similar findings were also reported by Mubarak and Singh, (2011) [17]. The combination use of organic manures and chemical fertilizers enhanced the inherent capacity of soil as reported by Pandey *et al.* (2009) [19], Verma, *et al.* (2010) [31] and Meena *et al.* (2012) [16].

Protein content and organic carbon

Application of 125% NPK + Zn + Mn + Fe has proven the best with 10.40 % Protein it was statistically at par with 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe. The results indicate that integrated nutrient application through chemical fertilizer, FYM and bio- fertilizer improve the protein content in grain over control. Nitrogen is most important factor which determines protein constituent of grain. It is essential for vegetative and reproductive stages. Nitrogen not only affects wheat productivity but also has a synergistic effect on quality of grain. Nitrogen is important constituent of protein, enzyme and chlorophyll and is involved in all processes associated with protoplasm, enzymatic reaction and photosynthesis. Organic carbon in soil varied significantly among different nutrient treatment. Maximum carbon content was recorded in 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe (0.53) was statistically at par with 125% NPK + Zn + Mn + Fe and 50% N +100%PK + FYM+ PSB+ Azotobacter+Zn + Fe + Mn + LCC based N top dressing (0.50 and 0.48) and significantly higher to control. Studies conducted by various workers have established the fact of maintenance of soil fertility in terms of improved organic content and available nutrients in soil by application of organic manures in combination with chemical fertilizers in different ratio Singh *et al.* (2008) [24] and Verma *et al.* (2009) [30].

Profitability

Net return was observed highest in treatment 125% NPK + Zn + Mn + Fe closely followed by 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe. The lowest net return was observed in control plots. Similar result was also reported by Ram and Mir, (2006) [29]. The result on current studies showed that cost of cultivation was marginally higher when the nutrients were applied in combination. Due to higher grain and straw yields, the net income was also higher with use of organic and inorganic fertilizers over 100% NPK. Similar result was also reported by Bhaduri & Gautam (2012) [5] and Lone *et al.* (2011) [15].

Conclusion

The highest growth characters recorded with treatment 125% NPK + Zn + Mn + Fe was statistically similar to the treatment of 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe and significantly higher than 100% NPK and control. Although application of 125% NPK + Zn + Mn + Fe yielded more among all the nutrient management options but it was found at par with 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe in grain, straw an biological yield, protein content and net return. In view the buildup of Soil organic carbon in soil, application of 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe was found best among all nutrient management options. Keeping in view the sustainability of soil health 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe proved better. Thus 100% NPK along with FYM, biofertilizers, Zn, Mn and Fe may be suggested for good performance of wheat crop and sustainability of soil health and crop yield in future.

Acknowledgement

This study has been executed at the Crop research centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India under the Department of Agronomy during 2015-16. I would like to thank the Department of Agronomy for offering me the necessary facilities during this period.

Table 2: Plant height, dry matter accumulation, effective tillers, No. of grains/spike and 1000- grain weight as influenced by different nutrient options.

Treatment	Plant height at harvest (cm)	Dry matter accumulation (g) m^{-1} at harvest	Effective tillers m^{-1} 90 DAS	No. grains $Spike^{-1}$	1000 -grain weight (g)
T_1- Control	61.5	678.0	205	22.1	28.7
T_2-100 % NPK	75.2	1007.4	267	31.4	36.3
T_3-75 % NPK + FYM	75.9	1010.8	270	32.4	36.6
T_4-75 % NPK + FYM + PSB+ Azotobactor	76.4	1012.1	273	33.0	36.9
T_5-100 % NPK + Zn	77.2	1014.4	277	33.4	37.2
T_6-100 % NPK + Zn+ Mn	78.6	1017.4	285	34.6	38.2
T_7-100 % NPK + Zn + Mn + Fe	80.2	1021.2	290	34.8	38.5
T_8-75 % NPK + FYM+ PSB+ Azotobactor+Zn + Fe + Mn	78.3	1013.0	281	33.5	37.8
T_9-125 % NPK	84.5	1077.1	317	34.8	38.8
T_{10}-125% NPK + Zn	84.8	1078.4	320	35.2	39.1
T_{11}-125 % NPK + Zn+ Mn	85.1	1079.3	324	36.1	39.4
T_{12}-125% NPK + Zn + Mn + Fe	86.6	1081.5	330	36.9	40.1
T_{13}-100% NPK + FYM+ PSB+ Azotobactor+Zn + Fe + Mn	85.3	1080.2	327	36.2	39.7
T_{14}-50% N +100%PK + FYM+ PSB+ Azotobactor+Zn + Fe + Mn + LCC based N top dressing	77.5	1018.7	280	33.1	37.5
CD (P= 0.05)	7.2	52.1	20.7	1.2	0.8

Table 3: Grain, straw and biological yield, harvest index, protein content, net return and organic carbon as influenced by different nutrient options.

Treatment	Grain Yield (q ha^{-1})	Straw Yield (q ha^{-1})	Biological Yield (q ha^{-1})	Harvest Index (%)	Protein content (%)	Net returns (Rs ha^{-1})	Organic carbon (%)
T_1- Control	28.3	40.5	68.8	41.1	9.6	24740	0.39
T_2-100 % NPK	49.2	72.3	121.5	40.4	9.7	66385	0.41
T_3-75 % NPK + FYM	50.6	73.9	124.5	40.6	9.8	69143	0.45
T_4-75 % NPK + FYM + PSB+ Azotobacter	51.2	74.8	126.0	40.6	9.8	70123	0.48
T_5-100 % NPK + Zn	52.1	75.2	127.3	40.9	9.8	71080	0.40
T_6-100 % NPK + Zn+ Mn	53.5	77.5	131.0	40.8	10.0	72900	0.42
T_7-100 % NPK + Zn + Mn + Fe	54.0	79.0	133.0	40.6	10.0	73175	0.44
T_8-75 % NPK + FYM+ PSB+ Azotobacter +Zn + Fe + Mn	53.3	77.3	130.6	40.8	10.0	70628	0.49
T_9-125 % NPK	53.2	79.2	132.4	40.1	10.1	74374	0.46
T_{10}-125% NPK + Zn	56.3	81.5	137.8	40.8	10.1	79079	0.47
T_{11}-125 % NPK + Zn+ Mn	57.9	82.9	140.8	41.1	10.2	80168	0.48
T_{12}-125% NPK + Zn + Mn + Fe	58.7	84.1	142.8	41.1	10.4	81349	0.50
T_{13}-100% NPK + FYM+ PSB+Azotobacter +Zn + Fe + Mn	58.4	83.9	142.3	41.0	10.2	80170	0.53
T_{14}-50% N +100%PK + FYM+ PSB+ Azotobacter+Zn + Fe + Mn + LCC based N top dressing	53.0	76.8	129.8	40.8	10.0	71260	0.48
CD (P= 0.05)	2.6	4.5	9.2	NS	0.6	-	0.05

References

1. Amundson R. The carbon budget in soils. Annu. Rev. Earth Planet. Sci. 2001; 29:535-562.
2. Anonymous. Annual Report 2015-16, Department of Agriculture, Cooperation & Farmers' Welfare, Ministry of Agriculture & Farmers Welfare, Government of India. Krishi Bhawan, New Delhi, 2016.
3. Barthwal A, Bhardwaj AK, Chaturvedi S, Pandiaraj T. Site specific NPK recommendation in wheat (*Triticum aestivum*) for sustained crop and soil productivity in mollisols of Tarai region. Indian J Agron. 2013; 58(2):208-214.
4. Behera SK, Singh D. Effect of 31 years of continuous cropping and fertilizer use on soil properties and uptake of micronutrient by maize (*Zea mays* L.)-Wheat (*Triticum astivum* L.) system. J Agri. Sci. 2009; 79:264-270.
5. Bhaduri D, Gautam P. Balanced use of fertilizers and FYM to enhance nutrient recovery and productivity of wheat (*Tritiucm aestivum* CV UP-2382) in a mollisol of Uttrakhand. Intl. Journal of Agric. Biotech, 2012; 5(4):435-439.
6. Devi KN, Singh MS, Singh NG, Athokpam HS. Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum* L.). J Crop Weed. 2013; 7(2):23-27.
7. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research - An International Rice Research Institute Book, A Wiley Inter science, John Wiley and Sons Inc., New York, USA, 1984.
8. Hasan MA, Kamal AM. Effect of fertilizer on grain yield and *m* grain protein content of wheat. J. Nat. Sci. Council Sri Lanka. 1998; 26(1):1-8.
9. Herencia JF, Ruiz JC, Melero MS, Villaverde J, Maqueda C. Effects of micronutrients on wheat ICAR, New Delhi 359. Intl. Res. J. Appl. Basic. Sci. 2008; 3(1):219-223.
10. Jakhar Parveen, Singh Jagdev, Nanwal RK. Growth analysis of wheat (*Triticum aestivum* L.) as influenced by planting methods, bio-fertilizers and nitrogen levels. Haryana J. Agron. 2006; 22(1):77-78.
11. Janzen HH. Carbon cycling in earth systems- a soil science perspective. Agric. Ecosyst. Environ. 2004; 104:399-417.
12. Janzen HH. The soil carbon dilemma: Shall we hoard it or use it? Soil Biol. Biochem. 2006; 38:419-424.
13. Jat G, Majumdar SP, Jat NK, Majundar SP. Potassium and zinc fertilization of wheat (*Triticum aestvum*) in Western arid zone of India. Indian J Agron, 2013; 58(1):67-71.
14. Kumar V, Ahlawat IPS. Carry over effect of bioferilizers and nitrogen applied to wheat *(Triticum aestivum*) and direct applied N in maze *(Zea mays)* in wheat maize cropping systems. Indian J Agron. 2004; 49(4):233-236.
15. Lone AA, Mahdi SS, Bhat MI, Bhat RA, Faisul-ur-Rasool, Singh OP. Productivity and phosphorus use efficiency of wheat (*Triticum aestivum* L.) as influenced phosphorus under subtropical conditions of U.P. Environ Eco, 2011; 29(3A):1321-1325.
16. Meena BL, Phogat BS, Jat SL, Singh AK, Sharma HB. Effects of planting and integrated nutrient management systems on root phenology and grain yield of wheat. Etennded Summaries: 3rd International Agronomy Congress, Nov. 26-30, New Delhi, India, 2012.
17. Mubarak T, Singh KN. Nutrient management and productivity of wheat (*Triticum aestivum*) based cropping system in temperate zone. Indian J Agron, 2011; 56(3):176-181.
18. Naresh RK, Gupta RK, Minhas PS, Rathore RS, Dwivedi Ashish, Kumar Mukesh *et al*. Toward Optimal Soil Organic Carbon Sequestration with effects of Agricultural Management Practices and Climate Change in Upland Soils of Subtropical India: A Review. Int. J. Chem. Stu. 2017; 5(2):433-442.
19. Pandey SN, Sinha BN. Function of mineral nutrition in plant. *Plant physiology* Edn. 4th, 2009, 120-139.
20. Rehman S, Shad KK, Muhammad F, Rehman A, Khan AZ,

Amanullah Rehman A *et al*. Phenology, leaf area index and grain yield of rain fed wheat influenced by organic and Inorganic fertilizer. Pak. J Bot. 2010; 42(5):3671-3685.

21. Sen A, Pandey MD, Sharma SN, Singh RK, Kumar A, Shukla P *et al*. Surface seeding of wheat as affected by seed rate and nitrogen level. Indian J Agri Sci. 2003; 73(9):509-511.
22. Sepat RN, Rai RK, Dhar S. Planting systems and integrated nutrient management for enhanced wheat (*Triticum aestivum*) productivity. Indian J Agron. 2010; 55(2):114-118.
23. Silva LCR, Sternberg L, Haridasan M, Hoffmann WA, Miralles-Wilhelm F, Franco AC. Expansion of gallery forests into central Brazilian savannas. Glob. Change Biol. 2008; 14:2108-2118.
24. Singh F, Kumar R, Pal S. Integrated nutrient management in rice-wheat cropping system for sustainable productivity. J Indian soc Soil sci. 2008; 56(2):205-208.
25. Singh R, Agarwal SK. Growth and yield of wheat as influenced by levels of FYM and nitrogen. Indian J Agron. 2001; 46(3):462-467.
26. Singh RK, Singh SK, Singh LB. Integrated nitrogen management in wheat (*Triticum aestivum*). Indian J Agron, 2007; 52(2):124-126.
27. Thakaral SK, Kadian US, Kumar S. Effect of different organic and inorganic fertilizer levels on yield and yield attributes of wheat. Haryana, J Agron. 2003; 19(1):60-62.
28. Tisdale SL, Nelson WL, Beaton JD, Havlin JL. Soil fertility and fertilizer. Prevtice-Hall of India Pvt. Ltd., New Delhi, 1995.
29. Tulasa Ram, Mir SS. Effect of integrated nutrient management on yield and yield attributing characters of wheat (*Triticum aestivum*). Indian J Agron. 2006; 51(3):189-192.
30. Verma G, Mathur AK. Effect of integrated nutrient management on active pools of soil organic matter under maize-wheat system of a Typic Haplustept. J Indian Soc. Soil Sci. 2009; 57(3):317-322.
31. Verma G, Mathur AK, Bhandari SC, Kanthaliya PC. Long term effect of integrated nutrient management on properties of a typic haplustept under maize-wheat cropping system. J Indian Soc. Soil Sci. 2010; 58(3):299-302.