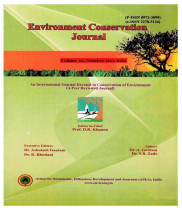
Environment Conservation Journal 23 (1&2): 107-113, 2022

Journal homepage: https://www.environcj.in/

Environment Conservation Journal

ISSN 0972-3099 (Print) 2278-5124 (Online)



Response of different methods of sowing and organic manures on growth and yield of Wheat (*Triticum aestivum* L.)

Bandi Gnana Prakash ✉
Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh, India.

Joy Dawson
Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh, India.

Thomas Abraham
Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh, India.

M. R. Meshram
Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh, India.

ARTICLE INFO

Received : 09 September 2021
Revised : 30 November 2021
Accepted : 13 December 2021

Published online: 31 January 2022

Key Words:
Agronomic
Manure
Organic farming
Sowing
Wheat

ABSTRACT

To study the retaliation performances of various methodologies of sowing by accompanying organic manures on growth, yield, and all other yield attributes of wheat (*Triticum aestivum* L.) crop. A field experiment was executed during the *Rabi* season of 2020-21 at the crop research farm of SHUATS, Prayagraj.The experiment was laid out in the most commonly encountered Randomized Block Design (RBD) with three replications of each treatment for all traits. Given this experiment three methods of sowing, *i.e.* M1 (Broadcasting), M2 (Line sowing), M3 (System of Wheat Intensification) as well as three organic manures *i.e.* O1 (Farmyard manure 12 t/ha), O2 (Poultry manure 5 t/ha), O3 (Vermicompost 4 t/ha) and two liquid manures Panchagavya 3% and Jeevamrutha 500 l/ha. And the liquid manures were foliar sprayed at 15, 30, and 45 days after sowing (DAS). Results were revealed that the maximum number of tillers (10.53), Dry weight (18.00 g/plant), Effective tillers (10.43), Spike length (11.73 cm), and Grains per spike (58.38) were found to be significantly higher with the application of treatment SWI + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500/h FS as compared to the other treatments. Maximum values were ensured with Plant height (78.30 cm), test weight (36.73 g), Grain yield (3.16 t/ha), Straw yield (4.48 t/ha), and harvest index (41.39 %). Hence with the current experiment's outputs, this study concluded that Line sowing + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS were produced more grains and productivity as compared to other organic treatment combinations.

Introduction

Wheat (*Triticum aestivum* L.) is one of the entire world's greatest crops that excels all other cereals both in area and production, called as "king of cereals". It's a highly nutritious cereal foodstuff and its organic compound yield per acre far exceeds that of animal products. Wheat grain rich in food value containing 12% protein, 1.72% fat, 69.60% carbohydrate, and 27.20% minerals (BARI, 2016). Wheat occupied a dominant position in the Indian food security system and it was consumed as one of the major staple food around a minimum of 43 countries. Global wheat is cultivated in an area of about 220 million hectares with a record production of 763.06 million tonnes of grain. In India wheat is the second most important cereal crop next to the rice and key crop of the revolution era. India stands second among wheat-producing countries in area and production. In India, the wheat cultivated area

Corresponding author E-mail: *gnanabandi@gmail.com*
https://doi.org/10.36953/ECJ.021845-2157

rose to 30.54 million hectares from 29.04 million hectares with a net gain of 5% in area APEDA (2019). The Broadcasting method produced the foremost effective spacing. While different methods of sowing methods are adopted by farmers for wheat cultivation. In which as compared to traditional drill planting, broadcast seedling would force 10-20 yet one more seed, it's simple, faster, and easier than traditional row spacing methodology. Line sowing is being practiced with proper row spacing and is an advisable sowing method because of its uniform plant population per unit area. As seeds are planted at an even depth and covered with soil, high germination and uniform stands are expected. Wheat intensification may be a new concept and goes with the systematic rice intensification (SRI) principle. Just in the case of SWI, all agronomic principles of SWI are put into practice and integrated with a package of practices of wheat crop. The technology has a high potentiality to provide a high wheat yield per drop of water as well per kg of agriculture inputs (Dhar *et al*., 2016). Adaptation of this technology can increase the productivity of wheat over two times (Uphoof *et al*., 2011). The role of foliar application or seed soaking of panchagavya in the production of many plantation crops had been well documented in India. These organic formulations contain all the trace elements and some essential plant growth hormones. Natural plant growth regulators (e.g. Auxin, Gibberellin, and cytokinin) present in these liquid organic formulations give a major boost to crop yields by accelerating the plant metabolic function. Presence of macro (N, P, K, and Ca) and micro (Zn, Fe, Cu, and Mn) nutrients besides total reducing sugar (glucose) in liquid manure (Papen *et al*., 2002; Swaminathan *et al*., 2007). Organic manures in agriculture add up a much-needed organic and mineral touch on the soil. The organic matter added is an imperative component of soil, and plays a vital role in the maintenance and improvement of soil fertility and productivity. The rise in eco-friendly production of wheat is often made possible by wider spread adaption of improved technologies of which fertilizer management, particularly that the nitrogen and organic manure can play a key role. It must be stressed that the worth of FYM, Vermicompost, Poultry manure, and manures in soil improvement is because of their nutrient content. To overcome the problem of nutrient deficiency and help nature rather than destroy it. Organic sources of nutrients are the best option to maintain the health of soil, plant, and animal and provide equal opportunity for all living existence to live and use from their beneficial activities, like nitrogen fixation, phosphorus solubilization, recycling of animal's waste, etc. Hence, the present study was undertaken. This, those two-factor sowing methods and organic manure interrelate providing important insight to the study combination effect on wheat production. Keeping these in view, an experiment was planned to study the Response of methods of sowing and organic manures on the growth and yield of wheat.

Hence, the present investigation was carried out to study the agronomic evaluation of wheat (*Triticum aestivum* L.) under a certified organic production system.

Material and Methods

A field experiment was conducted during the *Rabi* season of 2020-21 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) which is located at 25 degrees 24'41.27" N latitude, 81 degrees 50'56" E longitude, and 98 m altitude above the sea level. During this season soil (sandy loam), tested at a certified organic farm, SMOF. [SMOF was developed under the National Project on Organic Farming (NPOF) by the Department of Agronomy, the 2 hectares area has been certified by Lacon Quality Certification (P) Ltd, (Accreditation by Ministry of Commerce, Govt. of India). Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj. Having nearly neutral in soil reaction (pH 7.0), organic carbon (0.375 %), available nitrogen (168.75 kg/ha), available phosphorus (17.4 kg/ha) and available potassium (231.7 kg/ha). The climate of the region is semi-arid subtropical. In this experiment, a total of nine treatments has been developed and were tested. Treatment comprised of T_1- Broadcasting + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS, T_2- Line sowing + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS, T_3- SWI + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS, T_4- Broadcasting + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS, T_5- Line sowing + Poultry manure (5 t/ha) +

Panchagavya 3% FS + Jeevamrutha 500 l/ha FS, T_6- SWI + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS, T_7- Broadcasting + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS, T_8- Line sowing + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS, T_9- SWI + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS. Nine treatments were replicated thrice in Randomized Complete Block Design. Organic Manures were applied in advance to the sowing day and whereas the liquid foliar sprays were applied in different time intervals as 15, 30, and 45 days after sowing (DAS).

Chemical analysis of soil

Composite soil samples are collected before the layout of the experiment to determine the initial soil properties. The soil samples are collected from 0-15 cm depth and were dried under shade, powdered with wooden pestle and mortar, passed through a 2 mm sieve, and were analyzed for organic carbon by rapid titration method by Nelson (1975). Soil texture by Bouyoucos Hydrometer Method (Gee and Baudev, 1986). Available nitrogen was estimated by alkaline permanganate method by Subbiah and Asija (1956), available phosphorus by (Olsen *et al.,* 1954) and available potash was determined by Flame photometric method, Jackson (1973), available potassium was determined by using the flame photometer normal ammonium acetate solution and estimating by using flame photometer (ELICO Model) as outlined.

Statistical analysis

The data recorded were different characteristics were subjected to statistical analysis by adopting Fishers the method of analysis of variance (ANOVA) as described by Gomez and Gomez (2010). Critical difference (CD) values were calculated the 'F' test was found significantly at 5% level.

Results and Discussion

Response on plant height (cm)

Observations recorded in respective to the plant height of wheat were represented in Table 1 there was an increase in crop age and plant height was progressively noticed with the advancement during the experimentation period. The analysis on plant height was significantly higher in all the different growth intervals with the different methods of sowing and organic manures. At harvest, maximum plant height (78.30 cm) was recorded with the application of Line sowing + FYM (12 t/ha) + Panchagavya 3% FS + jeevamrutha 500 l/ha FS which was significantly superior over all the treatments and statistically at par with treatment of Line sowing + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (77.80 cm) and Line sowing + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (76.76 cm). This may be due to the application of poultry manure leading to the availability of nutrients necessary for the good growth of the plant. These results are consistent with what was achieved by Abbas *et al*. (2012) and Rasul *et al*. (2015). Chandrashekar *et al.* (2000) reported that application of poultry manure at 10 t/ha with recommended rates of fertilizers produced taller plants (187.5 cm) as compared to control.

Response on No. of tillers per plant of wheat

The obtained results in response to the tillers per hill were depicted in Table 1 and there were tillers progressively increased with the advancement of the crop during the crop growth period. At harvest maximum number of tillers per plant (10.53) was recorded with the application of SWI + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS which is significantly superior over all the treatments and statistically at par with treatment of SWI + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (10.26) and SWI + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (10.23). Several tillers were influenced significantly by different spacings and planting methods. SWI technique decreases the competition between the plant for light, water, space, and nutrients hence there is an increased number of tillers. There is an increase in the number of tillers in wheat crops due to the influence of different organic fertilizer combinations (Singh *et al*., 2011).

Response on Dry weight (g/plant)

Recorded observations relative to the dry weight were given in Table 1 and there was dry weight had given consecutively increased performance from 20 DAS to till harvest. At harvest, maximum dry weight (18.00 g/plant) was recorded with application of SWI+ Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS

Table 1: Response of wheat by different methods of sowing and organic manures

Treatments	Growth attributes of wheat at Harvest		
	Plant height (cm)	No. of Tillers/plant	Dry weight (g)
T_1- Broadcasting + FYM 12 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	72.57	5.43	16.94
T_2- Line sowing + FYM 12 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	77.8	7.41	17.01
T_3- SWI + FYM 12 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	72.9	10.26	17.59
T_4- Broadcasting + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	74.43	5.7	16.04
T_5-Line sowing + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	78.3	7.47	16.71
T_6- SWI + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	73.7	10.53	18.00
T_7- Broadcasting + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	70.26	5.58	15.14
T_8- Line sowing + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	76.76	7.23	16.02
T_9- SWI + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	71.93	10.23	17.05
SEm (±)	1.24	0.13	0.35
CD (5%)	3.68	0.41	1.05

Table 2: Yield attributes of wheat by different methods of sowing and organic manures

Treatment	No. of Effective tillers	Spike length (cm)	No of grains per spike	Test weight (g)
T_1- Broadcasting + FYM 12 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	5.26	10.44	47.11	29.23
T_2- Line sowing + FYM 12 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	7.27	10.75	48.56	35.13
T_3- SWI + FYM 12 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	10.16	11.35	54.76	30.43
T_4- Broadcasting + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	5.53	10.43	45.7	29
T_5-Line sowing + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	7.36	10.94	49.97	36.73
T_6- SWI + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	10.43	11.73	58.38	31.1
T_7- Broadcasting + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	5.48	10.21	41.82	27.6
T_8- Line sowing + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	7.13	10.63	47.96	31.5
T_9- SWI + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	10.13	11.00	52.28	29.93
SEm(±)	0.13	0.29	1.46	0.69
C.D (P=0.05)	0.39	0.88	4.34	2.05

which were significantly superior over all other treatments except with application of SWI + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (17.59 g/plant), SWI + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (17.05 g/plant), Line sowing + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (17.01 g/plant) were statistically on par. The cause of the rapid increase of Dry matter at crop harvest or ripening stage was possibly due to the emergence of the number of new tillers per plant and more fertile spike per plant (Alam, 2012).

The response over yield attributes of wheat

Observations regarding yield attributes are given in Table 2. Maximum number of effective tillers per plant (10.43) was recorded with application of SWI + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS which was significantly superior over all other treatments except with the application of SWI + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (10.16) and SWI + VC (4 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l /ha FS (10.13) were statistically at par with SWI + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS.

Table 3: Yield of wheat by different methods of sowing and organic manures

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)
T_1- Broadcasting + FYM 12 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	2.28	3.55	39.05
T_2- Line sowing + FYM 12 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	2.99	4.31	40.80
T_3- SWI + FYM 12 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	2.75	3.95	41.03
T_4- Broadcasting + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	2.2	3.44	38.95
T_5-Line sowing + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	3.16	4.48	41.39
T_6- SWI + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	2.66	3.92	40.45
T_7- Broadcasting + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	2.12	3.37	38.61
T_8- Line sowing + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	2.51	3.78	39.91
T_9- SWI + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrutha 500 L/ha	2.37	3.63	39.52
SEm(±)	0.05	0.05	0.42
C.D (P=0.05)	0.17	0.17	1.26

Spike length (11.73 cm) was recorded maximum with the application of SWI + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS which were significantly superior over all other treatments except with the application of SWI + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (11.35 cm), SWI + VC (4 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (11.00 cm) and Line sowing + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (10.94 cm) were statistically at par with SWI + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS. The maximum number of grains per spike (58.38) was recorded with the application of SWI + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS which was significantly superior over all other treatments except with the application of SWI + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (54.76) was found. Maximum test weight (36.73 g) was recorded with the application of Line sowing + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS which were significantly superior over all the treatments except with the application of Line sowing + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (35.13 g) was found statistically at par with Line sowing + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS. The improvement in yield attributes, i.e., the number of grains per spike of wheat with the application of organic manures may be assigned to the fact that proper decomposition and mineralization of these manures supplied available plant nutrients directly to plants and also had a solubilizing effect on the fixed form of nutrients in the soil (Singh and Singh, 2005). The observation regarding yield is given in Table 3. Grain yield is an important and considerable trait all the time. Maximum grain yield (3.16 t/ha) and Straw yield (4.48 t/ha) were recorded with the application of Line sowing + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS which were significantly superior overall the treatments except with the treatment of Line sowing + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS with grain yield (2.99 t/ha) and Straw yield (4.31 t/ha) which were statistically on par with Line sowing + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS. This in turn might have increased the values of growth and yield contributing attributes which are reflected in the grain and straw yield of wheat. A similar finding was reported by the higher yield maybe because these organic manures supply directly available nutrients such as nitrogen to plants and these organic manures improve the portion of water

holding stable aggregates of the soil (Channabasanagowda *et al*., 2008). While maximum harvest index (41.39 %) was recorded with application of Line sowing + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 /ha FS which were significantly superior over all the treatments except with the treatment of SWI + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (41.03 %), Line sowing + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (40.80 %) and SWI + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS (40.45 %) which were statistically at par with Line sowing + PM (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS. It might be due to enhancement of grain yield and straw yield which in turn results in a higher harvest index. Due to the yield and straw yield which is out turned into higher harvest index. Similar findings are found by the Amin and Baque (2019).

Conclusion

It is concluded that application of Line sowing + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrutha 500 l/ha FS was found more productive in grain yield (3.16 t/ha).

Acknowledgement

The authors are thankful to the Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj- 211007, Uttar Pradesh, India for providing us necessary facilities to undertake the studies.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Abbas, G., Khattak, J. Z. K., Mir, A., Ishaque, M., Hussain, M., Wahedi, H. M., ... & Ullah, A. (2012). Effect of organic manures with recommended dose of NPK on the performance of wheat (Triticum aestivum L.). *J. Anim. Plant. Sci*, *22*(3), 683-687.

Alam, M. S. (2012). Effect of sowing patterns and nitrogen rates on quality traits and yield of wheat. *Journal of Environmental Science and Natural Resources*, *5*(1), 267-272.

Amin, A. K. M. R., & Baque, M. A. (2020). Influence of Organic Manures on Drought Stress at Different Growth Stages of Wheat. *Bangladesh Agronomy Journal*, *23*(2), 81-86.

Anonymous, APEDA (2019). Analytical trade profile of Basmati rice. APEDA Agriexchange. In: https://agriexchange.apeda.gov.in/indexp/reportlist.aspx.

Auti, A.K., Wadile, S.C. and Pawar, V.S. 1999. Yield, quality, and nutrient removal of wheat (*Triticum aestivum* L.) as influenced by levels and sources of fertilizer. *Indian J. Agron.* 44(1): 119-120.

BARI (Bangladesh Agricultural Research Institute). Annual report for (2016). *Bangladesh Agril. Res. Inst*., Joydebpur, Gazipur, Bangladesh 2016, 22-23.

Chandrashekara, C. P., Harlapur, S. I., Muralikrishna, S., & Girijesh, G. K. (2000). Response of maize (Zea mays L.) to organic manures with inorganic fertilizers. *Karnataka Journal of Agricultural Sciences*, *13*(1), 144-146.

Channabasanagowda, N. K., Patil, B., Patil, B. N., Awaknavar, J. S., Ninganurn, B. T., & Hunje, R. (2008). Effect of organic manures on growth, seed yield and quality of wheat. *Karnataka J. Agric. Sci*, *21*(3), 366-368.

Dhar, S., Barah, B. C., Vyas, A. K., & T. Uphoff, N. (2016). Comparing System of Wheat Intensification (SWI) with standard recommended practices in the northwestern plain zone of India. *Archives of Agronomy and Soil Science*, *62*(7), 994-1006.

Gee, G.W. and Baudev, J.W. 1986. Particle size analysis. In methods of soil analysis. Part 1, Physical and mineralogical method (A. kluse Ed) pp. 404-408. Agronomy monogram No.9, American Society of Agronomy, Madison, w1.

Gomez, K.A. and Gomez, A.A. 1984. *Statistical Procedures for Agricultural Research*. 2nd edition. New York, 680p.

Hegsted, D. N., 1965, What challenges to nutritionists. *Cereals Sci*. Today, 10:257-259.

Jackson, M. L. (1973). Soil chemical analysis, pentice hall of India Pvt. *Ltd., New Delhi, India*, *498*, 151-154.

Mac Gillivray, J.H., and Basley, J. B., 1962, Amino acid production per acre by plants and animals. *Acon. Bot*., 16:25-30.

Nelson, D.W. and Sommers, L.E. 1975. A rapid and accurate procedure for estimation of organic carbon in the soil. *Proceedings of Indian Academy of Sciences* 64; 1815-1826.

Papen, H., Gabler, A., Zumbusch, E. and Rennenberg, H. 2002. Chemo litho autotrophic nitrifiers in the phyllosphere of a Spruce ecosystem receive high nitrogen input .*International Journal of Current Microbiology and Applied Sciences*. 44: 56-60.

Raghuwanshi, R.K.S. and Umat, Rajiv 1994. Integrated nutrient management in sorghum (*Sorghum bicolor*)-wheat (*Triticum aestivum*) cropping system. *Indian Journal of Agronomy* 39(2): 193-197.

Rasul G.A.M, Ahmed, S.T., Ahmed, M.Q. 2015. Influence of different organic fertilizers on growth and yield of wheat. Am-Euros. *J. Agric. & Environ. Sci.* 15(6):1123-1126.

Singh, C.M., P., Mishra, P. K., Singh, A. P., Verma, R., Raha, P., 2011. Impact of integrated nutrient management on growth, yield, and nutrient uptake by wheat (*Triticum aestivu*m L.). *Asian J. Agriculture Research*. 5(1):76-82.

Singh, J., & Singh, K. P. (2005). Effect of organic manures and herbicides on yield and yield-attributing characters of wheat. *Indian Journal of Agronomy*, *50*(4), 289-291.

Subbaiah, B. V., & Asija, G. L. (1956). A rapid method for estimation of available N in soil. *Current Science*, *25*, 259-260.

Swaminathan, C., Swaminathan, V. and Vijayalakshmi, K. 2007. Panchagavya: Boon to organic farming. *International Book, Distributing Co.,* Lucknow.

Uphoff, N., Kassam, A., & Harwood, R. (2011). SRI as a methodology for raising crop and water productivity: productive adaptations in rice agronomy and irrigation water management. *Paddy and Water Environment*, *9*(1), 3-11.