Effect on organic manure and inorganic fertilizers on productivity parameters and quality traits of wheat (Triticum aestivum L.) under central plain zone of Uttar Pradesh.

Abstract

A field trial was conducted on sandy loam soil having low status of organic carbon and accessible nitrogen, medium in accessible phosphorous and high in accessible potassium at pot house of department of Soil Science and Agricultural Chemistry of C.S.A.U.A&T, Kanpur (campus) under Indo-Gangetic Plain zone of Uttar Pradesh, amid Rabi season of 2021-22. The experiment comprised of 9 treatment combinations in randomized block design with three replications. Wheat variety K-1006 was grown with the recommended agronomic practices. Recommended dose of fertilizer (R.D.F.) i.e., NPK @ 120:60:40 ha^{-1} and FYM @ 10 ton ha^{-1} were applied. On the premise of the comes about exuded from the present investigation, it might be concluded that application of 100% RDF+FYM+ S_{20}+ Zn_5 (T_9) significantly recorded maximum grain yield, straw yield, biological yield and harvest index viz. 57.65 q ha^{-1}, 88.20 q ha^{-1}, 145.85 q ha^{-1} and 39.52 % respectively. And among the quality traits maximum protein content 12.75 % and lysine content 3.10 % was recorded also associated with application of 100% RDF+FYM+ S_{20}+ Zn_5 (T_9). The present investigation clearly points out the significance of balanced use of nutrients including FYM in wheat for improving the productivity and quality of wheat crop.

Key word: Crop yield, Fertilizer, Grain quality and Organic manure.

Introduction

Wheat (*Triticum aestivum* L.) is the most widely cultivated food crop in the world. After rice, it is India's second most important stable crop. Wheat is regarded as the world's king of cereals and is grown on the largest scale Wheat, in contrast to rice, is grown on every continent on the planet **(Jat *et al.,* 2013)**. It consumed mostly in the form of bread as (chapati) and wheat straw is use for feeding the cattle. The approximate nutritional composition of the wheat kernel is carbohydrate 60-70%, protein 10-12%, water 8-17%, cellulose 2-3%, fat 1.5-2%, sugar 2-3%, and mineral matter 1.5-2%. Gluten of the wheat

kernel contains about 17.6% nitrogen **(Anonymous, 2018).** The percentage of nitrogen determined by analysis is multiply by 6.25 to determine the protein content **(Mckenzie and Wallace, 1954)**. The crop is most successfully grown between latitudes of 30°N to 60°N and 27°S to 40°S in world, with a high altitude of 5000 meter. In India wheat is grown between 11° to 30°N latitudes from the sea level up to an elevation of 3500 meter in the Himalayas. The optimum temperature range for ideal germination of wheat seed is 20-25 □. Wheat can be successfully grown on lighter soils provided their water and nutrient holding capacity are improved. Heavy soils with poor structure and poor drainage are not suitable as wheat is sensitive to water logging. Approximately 95 per cent of wheat grown in the world is hexaploid bread wheat (*Triticum aestivum,* L.), used for making wide range of food items and remaining about 5 per cent being tetraploid durum wheat (*Triticum durum, Desf*.) commonly used for pasta and noodles etc. Protein content and composition is a critical quality factor in the production of these products **(Shewry, 2009)**. Wheat being an energy rich winter cereal contributes around 35% to the food grain basket of the country. Globally wheat (*Triticum aestivum* L.) is grown in 124 countries and occupied an area of about 215 million hectares with a production of 734.50 mt. of grain during 2019-20 **(Anonymous, 2020).** The major wheat producing states of India are Uttar Pradesh, Madhya Pradesh, and Punjab with the production of 32.59, 19.61, and 17.57 mt., respectively. The Uttar Pradesh ranked first in wheat production with the second of Madhya Pradesh and third of Panjab. But Punjab has highest productivity followed by Haryana with 5008 kg ha^{-1}, 4687 kg ha^{-1}, respectively. **(Anonymous, 2021).** Nitrogen is an important metabolic element for growth and development of plant. It is essential for synthesis of protein and other products. Nitrogen is directly concerned with physiological process occurring with plant. Nitrogen is required throughout the growing period of the crop. Phosphorus is second important major plant nutrient for crop production. It is necessary for such life process of plant as photosynthesis, development of plant cell as well as synthesis and breakdown of carbohydrates and transfer of energy with in plant. Potassium plays an important role in the maintenance of cellular organization **(Singh *et al.*, 2019).** Nitrogen application improved grain protein and reduced phosphorous percentage **(Waraich *et al*., 2002).** Nitrogen split dose also affect the protein and yield of wheat crop compare to control **(Madan *et al.*, 2009).** Phosphorus (P) is the second most important essential nutrient for crop production after nitrogen **(Venkatesh *et al*., 2020).** This nutrient plays various roles in the plant metabolism and structural role in molecules **(Yousuf *et al*. 2017)**. The yield of wheat increased with increasing phosphorus level. Maximum yield of wheat was recorded at 120 kg ha^{-1} P_2O_5 application **(Khan *et al.***

2011). Potassium is a "work horse" plant nutrient. It should not be surprising that a shortage of potassium can result in loss of crop yield, quality and profitability **(Ducan *et al.*, 2018)**. It increases the resistance of plants against various insects and pests. Potassium deficiency leads to the malfunctioning of stomata. Sulphur is required for synthesis of sulphur containing amino-acids mainly cysteine, cysteine and methionine which are components of protein **(Jarvan *et al.*, 2012).** Zinc also involved in the auxin metabolism like tryptophan synthesis and tryptamine metabolism. Protein content in wheat seed (grain) was significantly improved by using Zn **(Seilsepour *et al.*, 2006).** FYM is a good source of nutrients and contributed towards build-up of organic matter in soil **(Kumar *et al.*, 2017)**. Available P and K content also increased due to FYM and nitrogen application **(Vinay *et al.*, 2011).**

MATERIALS AND METHODS

Nature of Soil

The experimental field is sandy loam in texture, good aeration (46.2 % porosity), alkaline in reaction (pH 7.7), low in organic carbon (0.42%), medium in accessible N (253.0 kg ha^{-1}), medium in accessible P (14.20 kg ha^{-1}), and medium in accessible K (132.00kg ha^{-1}).

Layout and Design of the Experiment

The experiment was carried out in RBD (randomized block design) with three replications. The total numbers of unit plots were 27. The size of a unit plot was 1.0 m x 1.0 m. The width of the main irrigation channel is 1 m.

Treatments of the Investigation

The experiment comprised of 9 treatment combinations in randomized block design with three replications consisted of T_1: [Control], T_2: RDF (50%) + FYM, T_3: RDF (50%) + FYM +S_{20}, T_4: RDF (50%) + FYM+ Zn_5, T_5: RDF (100%), T_6: RDF (100%) + FYM, T_7: RDF (100%) + FYM + S_{20}, T_8: RDF (100%) + FYM + Zn_5, T_9: RDF (100%) + FYM + Zn_5+S_{20}.

Nutrient Composition of FYM

The decomposed material of dung and urine of farm animals along with litter and left-over material from roughages or fodder fed to cattle. The detailed nutrient composition in FYM are mentioned in chart 1.

Chart 1: Nutrient ratio in organic manure

Organic manure	N (%)	P (%)	K (%)
FYM (Farm Yard Manure)	0.5	0.2	0.5

Agronomic Practices:

Land Preparation

The plots filled with soil properly prepared with the help of khurpi and required moisture level was maintained by irrigating the plots properly at required time.

Fertilizer and Manure Application

Fertilizers were applied as per treatments whereas nitrogen, phosphorus, potash, Zinc and Sulphur were applied through urea, DAP, Muriate of Potash, Zinc oxide and elemental Sulphur respectively. The sum of nitrogen in DAP was balanced within the sum of urea. Prescribed dose of fertilizer i.e., NPK at 120:60:40 ha^{-1}, were incorporated into soil 15 days before sowing of the crop.

Sowing of Seed

The seeds of Wheat K-1006, were sown at 100 kg ha^{-1} in shallow furrows with the help of manual labour at a row spacing of 22.5 cm and plant spacing 10 cm apart. Depth of sowing was kept 4-5 cm.

Thinning and Gap Filling:

The extra plants were thinned out and maintained the spacing of 22.5 cm apart in rows. Thinning and gap filling were done 15 days after sowing to maintain proper and uniform plant stand.

Intercultural Practices:

The intercultural operation (weeding and hoeing) was done with the help of *khurpi* after 30 and 45 days after sowing in all the plots to check the weed growth and retention of soil moisture through creating dust mulch.

Irrigation

Other than one pre-sowing irrigation, the crop was given six irrigations at diverse stages *viz.*, CRI, tillering, late jointing, flowering, milking and dough stage during the period of experimentation.

Yield Studies:

Seed Yield:

The seed yield was weighted in kilogram for each plot after threshing which was then converted in to q ha^{-1}.

Straw Yield:

It was found out for each plot by subtracting the seed yield from the total biological production in kilogram and was converted into q ha^{-1}.

Biological yield:

It is total sum of yield of grain and straw.

Biological yield = Grain yield + Straw yield

Harvest Index (%):

The efficient utilization of assimilation and CO_2 fixation i.e., photosynthesis is expressed in terms of harvest index. The harvest index was worked out with the help of following formula:

$$\text{Harvest Index}(\%) = \frac{\text{Seed yield}(q\ ha^{-1})}{\text{Biological yield}(q\ ha^{-1})} \times 100$$

Protein Content:

Protein content in grain was obtained by multiplying the nitrogen content in grain with factor 6.25.

Lysine Content:

Lysin content in grain was determined by Colorimetric method as suggested by Tsai *et al.* (1972).

Experimental Findings

Productivity Parameters

It is obvious from the data given in table 1 and depicted in Fig.1 clearly shows that among the productivity parameters viz. grain yield, straw yield, biological yield except harvest index significantly affected by different treatment combinations of organic manure and inorganic fertilizers. Maximum grain yield (57.65 q ha^{-1}), straw yield (88.20 q ha^{-1}), biological yield (145.85 q ha^{-1}) and harvest index (39.52%) was associated with the plot fertilized with 100% RDF+FYM+S_{20}+Zn_5 has been statically par with the plot fertilized with 100% RDF+FYM+Zn_5. Minimum grain yield (25.37 q ha^{-1}), straw yield (43.12 q ha^{-1}), biological yield (68.49 q ha^{-1}) and harvest index (37.04 %) has been associated with the control plot. The results of the present investigation are also in agreement with the findings of **El-Lattief (2016), Singh and Singh. (2018), Singh *et al.* (2020), Sharma and Singh (2021) and Choudhary *et al.* (2022).**

Table 1: Effect of different treatment on grain yield and straw yield of wheat:

Treatments	Treatments Combinations	Grain Yield (q ha^{-1})	Straw Yield (q ha^{-1})	Biological Yield (q ha^{-1})	Harvest Index (%)
T_1	Control	25.37	43.12	68.49	37.04
T_2	50% RDF+ FYM	45.30	74.75	120.05	37.73
T_3	50% RDF+ FYM+S_{20}	49.08	79.01	128.09	38.31
T_4	50% RDF+ FYM+Zn_5	50.70	81.12	131.82	38.46
T_5	100% RDF	47.45	77.34	124.79	38.02
T_6	100% RDF+FYM	52.08	82.28	134.36	38.76
T_7	100% RDF+FYM+S_{20}	54.50	85.56	140.06	38.91
T_8	100% RDF+FYM+Zn_5	55.25	86.19	141.44	39.06
T_9	100% RDF+FYM+ S_{20}+ Zn_5	57.65	88.20	145.85	39.52
	SE ± (m)	**1.16**	**1.86**	**2.86**	**1.01**
	CD at 5%	**3.53**	**5.64**	**8.64**	**N.S.**

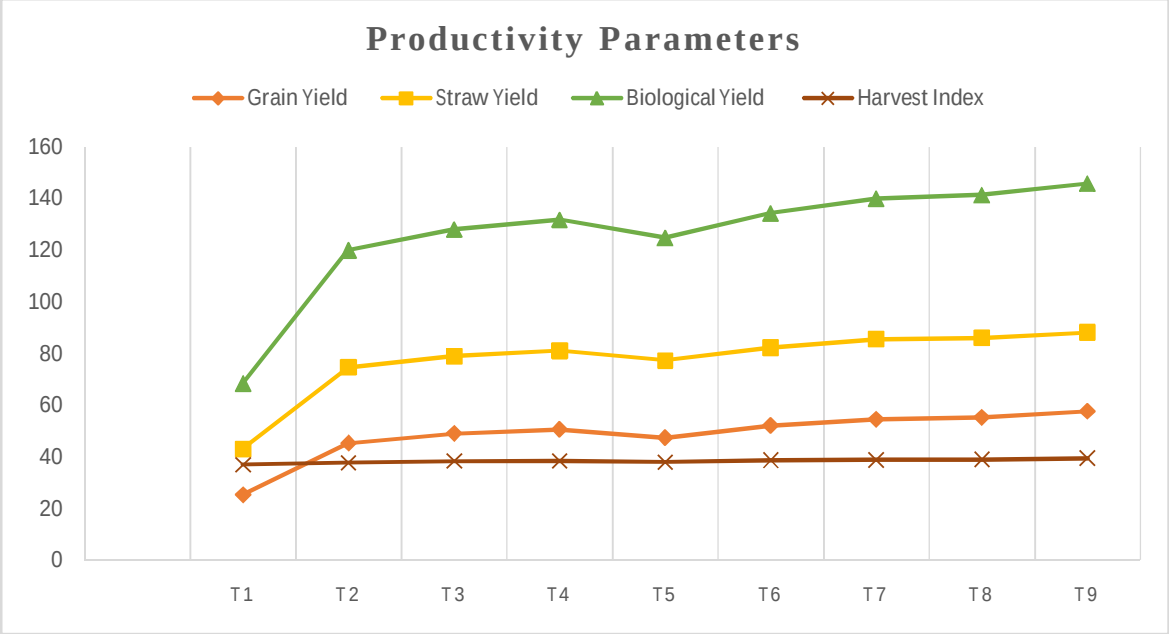

Fig.-1: Effect of different treatment combinations on productivity parameters of wheat.

Quality Traits

At a glance over the data given in table -2 and depicted in fig. no.-2 clearly show that among the quality traits of wheat grain such as protein content (%) and lysine content (%) significantly affected by different treatment combinations of organic manure and inorganic fertilizers. Maximum protein content (12.75%) and lysine content (3.10 %) was associated with the plot fertilized with 100% RDF+FYM+S_{20}+Zn_5 has been statically par with the plot fertilized with 100% RDF+FYM+Zn_5. Minimum protein content (11.31 %) and lysine content (2.65 %) in wheat grain was associated with the control plot. The consequences of the current investigation are additionally in concurrence with the investigation of **Madan *et al.* (2009), Majumdar *et al.* (2012), Kumar Dinesh *et al.* (2017), Sharma and Singh (2021) and Choudhary *et al.* (2022).**

Table 2: Effect of different treatments on Protein and Lysine content in wheat grain:

Treatments	**Treatments Combination**	**Protein (%)**	**Lysine (%)**
T_1	Control	11.31	2.65
T_2	50% RDF+ FYM	11.56	2.68
T_3	50% RDF+ FYM+S_{20}	12.00	2.76
T_4	50% RDF+ FYM+Zn_5	12.06	2.79
T_5	100% RDF	11.75	2.72
T_6	100% RDF+FYM	12.31	2.84
T_7	100% RDF+FYM+S_{20}	12.37	2.89
T_8	100% RDF+FYM+Zn_5	12.56	2.90
T_9	100% RDF+FYM+ S_{20}+ Zn_5	12.75	3.10
	SE ± (m)	**0.24**	**0.05**
	CD at 5%	**0.73**	**0.17**

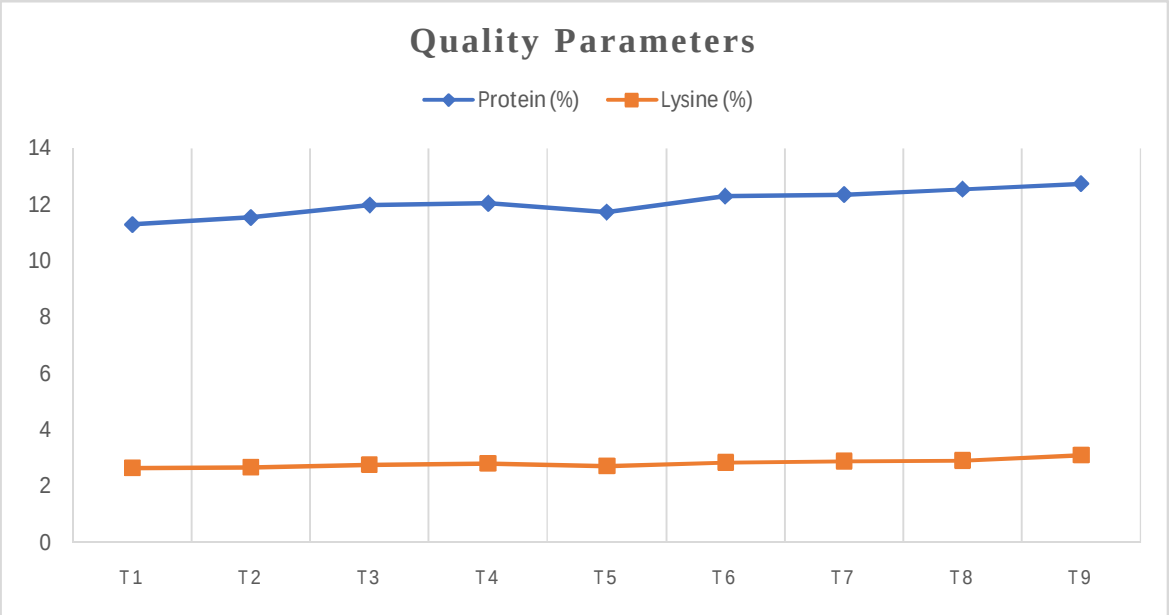

Fig.-2: Effect of different treatment combinations on quality parameters of wheat.

Conclusion:

The combination of 100% RDF+FYM+ S_{20}+ Zn_5 recorded the highest yield as well as quality traits in wheat crop as compared to other combinations of organic and inorganic fertilizers. Thus, it may be concluded that 100% RDF+FYM+ S_{20}+ Zn_5 applied is a nice choice for accomplishing higher yield and quality parameters in wheat crops. It is strongly recommended that farmers of the central U.P adopt wheat variety K-1006 with the dose of 100% RDF+FYM+ S_{20}+ Zn_5 doses for better crop yield.

REFERENCES

Anonymous. (2018). Agricultural statistics at a glance.

Anonymous. (2021). Directorate of Economics and Statistics, Department of Agricultural and Corporation, New Delhi.

Choudhary, L., Singh, K. N., Gangwar, K., & Sachan, R. (2022). Effect of FYM and Inorganic fertilizers on growth performance, yield components and yield of wheat (Triticum aestivum L.) under indo-gangetic plain of Uttar Pradesh.

Choudhary, L., Singh, K. N., Gangwar, K., Sachan, R., & Pandey, H. P. (2022). Effect of FYM and Inorganic Fertilizers on Nutrient Content, Uptake and Quality Traits of Wheat (Triticum aestivum L.) under Indo-Gangetic Plain of Uttar Pradesh.

Duncan, E. G., O'Sullivan, C. A., Roper, M. M., Biggs, J. S., & Peoples, M. B. (2018). Influence of co-application of nitrogen with phosphorus, potassium and sulphur on the apparent efficiency of nitrogen fertiliser use, grain yield and protein content of wheat. *Field crops research*, *226*, 56-65.

El-Lattief, E. A. A. (2016). Influence of Integrated Nutrient Management on Economic Return of Wheat under Upper Egypt Conditions. *International Journal of Advanced Research in Engineering and Applied Sciences*, *5*(1), 1-6.

Järvan, M., Lukme, L., Akk, A., Edesi, L., & Adamson, A. (2012). Effect of nitrogen and sulphur fertilization on yield, crop quality and baking properties of winter wheat. *Agraarteadus*, *23*(1), 12-20.

Jat, L. K., Singh, S. K., Latare, A. M., Singh, R. S., & Patel, C. B. (2013). Effect of dates of sowing and fertilizer on growth and yield of wheat (Triticum aestivum) in an Inceptisol of Varanasi. *Indian Journal of Agronomy*, *58*(4), 611-614.

Hussain, N. A. Z. I. M., Khan, M. B., Ahmad, R. I. A. Z., Ali, M. A., Ahmed, N. I. A. Z., & Saeed, S. H. A. F. Q. A. T. (2011). Physiochemical traits, productivity and net return of wheat as affected by phosphorus and zinc requirements under arid climates. *Pakistan Journal of Botany*, *43*(2), 991-1002.

Kumar, D., Prakash, V., Singh, P., Ahamid, A., Kumar, C., & Kumar, S. (2017). Effect of integrated nutrient management modules on yield, quality and economics of wheat. *Journal of pharmacognosy and phytochemistry*, *6*(6), 709-711.

Madan, H. S., & Renu, M. (2009). Effect of different level of N on protein content of wheat. *Journal of Agriculture and Biological Science*, *4*, 26-31.

Gajanand, J., Majumdar, S. P., Santosh, C., & Jat, N. K. (2012). Influence of potassium and zinc fertilisation on productivity, quality, nutrient uptake, morpho-physiological and bio-chemical parameters of wheat. *Indian Journal of Fertilisers*, *8*(10), 20-27.

McKenzie, H. A., & Wallace, H. S. (1954). The Kjeldahl determination of nitrogen: a critical study of digestion conditions-temperature, catalyst, and oxidizing agent. *Australian Journal of Chemistry*, *7*(1), 55-70.

SILSPOUR, M. (2006). Study of zinc effects on quantitative and qualitative traits of winter wheat in saline soil condition.

Sharma, S., and Singh, D. (2021). Effect of Zinc Application on Nutrient Content and Quality of Wheat Crop in Alluvial Soils of Eastern UP. International Advanced Research Journal in Science, Engineering and Technology Vol. 8, Issue *7,* July 2021 DOI: 10.17148/IARJSET.2021.8707.

Shewry, P. R. (2009). Wheat. *Journal of experimental botany*, *60*(6), 1537-1553.

Singh, B., & Singh, A. P. (2018). Response of wheat (Triticum aestivum L.) to FYM and phosphorus application in alluvial soil. *Int. J. Curr. Microbiol. App. Sci*, *7*(6), 418-423.

Singh, V., Pyare, R., & Singh, G. K. (2019). Yield, economics and quality improvement of wheat (Triticum aestivum L.) as affected by integrated nutrient management under late sown condition. *Journal of Pharmacognosy and Phytochemistry*, *8*(3), 3266-3268.

Singh, N., Pandey, S. B., Ranjan, R., Verma, A. K., Pathak, R. K., Dubey, S., ... & Singh, R. (2020). Integrated use of organic (FYM), inorganic and biofertilizer (PSB) on productivity, nutrient uptake of wheat and soil properties. *The Pharma Innovation Journal*, *9*(3), 345-347.

Singh, R., & Agarwal, S. K. (2001). Growth and yield of wheat (Triticum aestivum) as influenced by levels of farmyard manure and nitrogen. *Indian Journal of Agronomy*, *46*(3), 462-467.

Paramesh, V., Dhar, S., Dass, A., Kumar, B., Kumar, A., El-Ansary, D. O., & Elansary, H. O. (2020). Role of integrated nutrient management and agronomic fortification of zinc on yield, nutrient uptake and quality of wheat. *Sustainability*, *12*(9), 3513.

Yousuf, P. Y., Abd_Allah, E. F., Nauman, M., Asif, A., Hashem, A., Alqarawi, A. A., & Ahmad, A. (2017). Responsive proteins in wheat cultivars with contrasting nitrogen efficiencies under the combined stress of high temperature and low nitrogen. *Genes*, *8*(12), 356.