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# 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

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## 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 2018-19. The experiment comprised of 5 treatment combinations in randomized block design with four replications consisted of $T_1$: [Control], $T_2$: [100% RDF], $T_3$: [75% RDF + FYM at 6 t $ha^{-1}$], $T_4$: [50% RDF + FYM at 12 t $ha^{-1}$], $T_5$: [25% RDF + FYM at 18 t $ha^{-1}$]. Wheat variety PBW-343 was grown with the recommended agronomic practices. On the premise of the comes about exuded from the present investigation, it might be concluded that application of 25% RDF + FYM at18 t $ha^{-1}$ significantly recorded maximum nutrient content viz. N, P and K content in grain is 1.97%, 0.25% and 0.36% respectively and N,P, and K content in straw is 0.32%, 0.064% and 1.76% respectively. Maximum nutrient uptake viz. N, P and K uptake in grain is 86.58 %, 10.77% and 5.85% respectively and N, P, and K uptake in straw is 22.98%, 4.16% and 1.76 % respectively. Among the quality traits maximum protein content

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(11.78 %) was also associated with application of 25% RDF + FYM at 18 t $ha^{-1}$. The present investigation clearly points out the significance of balanced use of nutrients including FYM in wheat for improving the nutrient content and uptake indices and quality of wheat crop.

*Keywords: FYM; grain; nutrient content; nutrient uptake; protein and straw.*

## 1. INTRODUCTION

Wheat (*Triticum aestivum* L), also known as "king of cereals," is the most prominent staple food grain crop. India is the world's second-largest wheat-producing country [1]. Starch accounts for 63-71 percent of the wheat kernel's chemical composition, while protein accounts for 10-12 percent, water for 8-17 percent, cellulose for 2-3 percent, fat for 1.5-2 percent, sugar for 2-3 percent, and mineral matter for 1.5-2 percent. The gluten in wheat kernels contains roughly 17.6% nitrogen [2].

Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, Haryana, and Bihar are the largest wheat producing states, accounting for 33 %, 18 %, 12 %, 10%, 9%, and 8% of total wheat cultivation in the country, respectively. In India, the most noteworthy productivity of wheat is recorded in Punjab [3].

Nitrogen is one of the major lacking plant supplements especially in sandy loam soil of semi-arid region of western Uttar Pradesh. An ideal supply of nitrogen is imperative for incredible vegetative development, chlorophyll formation and carbohydrate utilization. But N use efficiency in cereals is quite low. Conjoint utilize of inorganic and natural sources of N is suggested to preserve soil and crop productivity. The integrated N management also increased organic carbon content and accessibility of plant supplements in soil. Integration of chemical and natural sources and their productive administration have appeared promising come not as it were in maintaing the production but moreover in keeping up soil well-being [4]. Jat *et al.* [5] proposed that advancement in supplement utilize effectiveness will ended up conceivable by adjusted utilize of N, P and K fertilizers and by judicious utilize of natural excrements in wheat systems.

Phosphorus (P) is the second most critical fundamental supplement for crop production after nitrogen [6]. This supplement plays different parts within the plant metabolism including a structural role in molecules, such as nucleic acids and proteins, for energy transfer, respiration, carbohydrate metabolism, glycolysis, redox reactions, enzyme activation/inactivation, membrane synthesis and stability, and in nitrogen obsession [7]. Phosphorus is a component of DNA and RNA, which carries heredity used to synthesize proteins. Phosphorus is basically vital to human creatures moreover; it is included within the development and repair of body cells and tissues. Its insufficiency in children influences normal bone teeth development hence, there's rising concern over broad lack of P within the agrarian lands of the world [8].

Potassium may be a "work horse" plant nutrient. Maybe usually why it is not bound into any particular plant part. Subsequently, potassium is free to travel and to wheel and deal with in the plant almost at well. It ought to not be shocking that a deficiency of potassium can result in misfortune of trim surrender, quality and benefit [9].

The part of organic matter is well set up in administrating the supplement fluxes, microbial biomass and enhancement in soil physical chemical and biological properties [10]. Keeping up soil wellbeing is of most extreme vital to guarantee nourishment and dietary security of nation [11]. For most proficient utilize of fertilizers, all supplements must be utilized in adjust extent. However, there is a need of information with respect to the performance of FYM and nitrogen in relation to productivity and fertility of soil under wheat cultivation [12].

FYM is a great source of supplements and contributed towards build-up of organic matter in soil [13]. Nitrogen is a crucial component for ideal working of crops. The increment in eco-friendly production of wheat can be made conceivable by far reaching selection of progressed innovations of which fertilizer administration especially that of nitrogen though organic manure can play a key part. Hence, present investigation was carried out to study the growth, yield and nutrient uptake behaviour of wheat to define optimum dose under integrated use of FYM [14].

Application of Farm yard Manure helps to increase the dry matter production, leaf area, yield and nutrient uptake by wheat [15]. Also, the application of organic fertilizer increased nitrogen use efficiency [16]. The combination of mineral fertilizers, with organic manures, helped in increasing the productivity of wheat compared to a system with only mineral fertilization [17].

## 2. MATERIALS AND METHODS

### 2.1 Nature of Soil

The experimental field is sandy loam in texture, good aeration (42.9 % porosity), alkaline in reaction (pH 7.6), low in organic carbon (0.32%), low in accessible N (169.4 kg $ha^{-1}$), medium in accessible P (16.3 kg $ha^{-1}$), and high in accessible K (154.7 kg $ha^{-1}$).

### 2.2 Layout and Design of the Experiment

The experiment was carried out in RBD (randomized blok design) with four replications. The total numbers of unit plots were 20. The size of a unit plot was 1.0 m x 1.0 m. The width of the main irrigation channel is 1.5 m.

### 2.3 Treatments of the Investigation

The experiment comprised of 5 treatment combinations in randomized block design with four replications consisted of $T_1$: [Control], $T_2$: [100% RDF], $T_3$: [75% RDF + FYM at 6 t $ha^{-1}$], $T_4$: [50% RDF + FYM at 12 t $ha^{-1}$], $T_5$: [25% RDF + FYM at 18 t $ha^{-1}$].

### 2.4 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.

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

### 2.5 Fertilizer and Manure Application

Fertilizers were applied as per treatments whereas nitrogen, phosphorus and potash were applied through urea, DAP, Murate of Potash, 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 applied. Half of nitrogen and full dosage of phosphorus and potash were applied as basal at the time of sowing by placement method. The remaining half of the nitrogen was applied at the time of first irrigation. The amount of FYM required for substituting a specified amount of nitrogen as per treatment was calculated and incorporated into soil 15 days before sowing of the crop.

### 2.6 Seed and Sowing

The seeds of Wheat PBW-343, were sown at 125 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.

### 2.7 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.

### 2.8 Plant Analysis for Content and Uptake of Nutrient

The chemical analysis of plants for the nutrient content was done when grain and straw samples were collected from each treatment at harvest to analyse nitrogen, phosphorous, potassium concentration (%) and zinc concentration (ppm) and their uptake (kg $ha^{-1}$). The plant material was oven dried (70 ± $5^0$C for 72 hours) and ground separately and then subjected to analysis. Plant analysis for the determination of nutrient content in grain and straw were done with the standard procedures viz., nitrogen concentration in plant (both grain and straw) was determined by micro-kjeldahl's method [18], phosphorus by vanado-molybdo phosphoric acid yellow colour method [18], potassium by flame photometer [18]. The uptake of nitrogen, phosphorus and potassium were calculated by taking after equations:

Nutrient uptake (N, P, K kg $ha^{-1}$) = Nutrient content in grain and straw (%) x Seed and Straw Yield (kg $ha^{-1}$) / 100

**Protein Content**

The content of protein was calculated by multiplying the N content with 6.25 Mckenzie and Wallace [19].

## 3. RESULTS AND DISCUSSION

### 3.1 Productivity Parameters

A cursory glance of data revealed that the highest grain yield (43.95 q $ha^{-1}$), straw yield (72.95 q $ha^{-1}$), biological yield (116.90 q $ha^{-1}$) and harvest index (37.59 %) was recorded in $T_5$: [25% RDF + FYM at 18 t $ha^{-1}$] followed by grain yield (42.20 q $ha^{-1}$), straw yield (71.05 q $ha^{-1}$), biological yield (113.25 q $ha^{-1}$) and harvest index (37.26%) in $T_4$: [50% RDF + FYM at 12 t $ha^{-1}$] and the lowest grain yield (29.75 q $ha^{-1}$), straw yield (50.65 q $ha^{-1}$), biological yield (80.40 q $ha^{-1}$) and harvest index (37.00 %) in $T_1$ [Control]. These result are understanding with the finding of Singh *et al.,* [20] and Hussain *et al.,* [21].

### 3.2 Nutrient Content in Grain and Straw of Wheat

The information uncovered that highest response of nutrient content viz on N (1.97%), P (0.250%) and K(0.136%) in wheat grain and N (0.32%), P (0.064%) and K (1.76%) in wheat straw was recorded from $T_5$: [25% RDF + FYM at 18 t $ha^{-1}$] followed by $T_4$: [50% RDF + FYM at 12 t $ha^{-1}$] with nutrient content N (1.95%), P (0.242%) and K (0.130%) in wheat grain and N (0.31%), P (0.056%) and K( 1.751%) in wheat straw but significantly superior over other treatments. However, the minimum nutrient content viz on N (1.79%), P (0.221%) and K (0.122%) in wheat grain and N (0.29%), P (0.044%) and K (1.711%) in wheat straw recorded with $T_1$ [Control]. Similar findings were reported by Chaudhary *et al.,* [22] and Islam *et al.* [23].

### 3.3 Nutrient uptake by Grain and Straw of Wheat

A perusal of data has been presented that the highest response of nutrient uptake viz on N (86.58 kg $ha^{-1}$), P (10.77 kg $ha^{-1}$), and K (5.85 kg $ha^{-1}$) uptake in wheat grain and N (22.98 kg $ha^{-1}$), P (4.16 kg $ha^{-1}$), and K (127.88 kg $ha^{-1}$) in wheat straw (kg $ha^{-1}$) was recorded with $T_5$: [25% RDF + FYM at 18 t $ha^{-1}$] followed by $T_4$: [50% RDF + FYM at 12 t $ha^{-1}$] with nutrient content N (82.29 kg $ha^{-1}$), P (10.21 kg $ha^{-1}$), and K (5.49 kg $ha^{-1}$) uptake in wheat grain and N (22.24 kg $ha^{-1}$), P (3.98 kg $ha^{-1}$), and K (124.41 kg $ha^{-1}$) in wheat

**Table 1. Effect of treatment combinations on productivity parameters**

| Treatment | Treatment Combination | Grain yield (q $ha^{-1}$) | Straw yield (q $ha^{-1}$) | Biological Yield zq $ha^{-1}$) | Harvest Index (%) |
|---|---|---|---|---|---|
| $T_1$ | Control | 29.75 | 50.65 | 80.40 | 37.00 |
| $T_2$ | 100% RDF | 40.45 | 67.41 | 107.86 | 37.05 |
| $T_3$ | 75% RDF + FYM @ 6 t $ha^{-1}$ | 41.15 | 69.40 | 110.55 | 37.22 |
| $T_4$ | 50% RDF + FYM @ 12 t $ha^{-1}$ | 42.20 | 71.05 | 113.25 | 37.26 |
| $T_5$ | 25% RDF + FYM @ 18 t $ha^{-1}$ | 43.95 | 72.95 | 116.90 | 37.59 |
| SE(d) | | 1.01 | 1.91 | 1.33 | 1.69 |
| C.D. | | 2.22 | 4.16 | 3.01 | 3.37 |

**Table 2. Effect of different treatment combination on %N, %P and %K content in Wheat grain and Straw**

| Treatments | Nutrient Content in Grain | | | Nutrient Content in Straw | | |
|---|---|---|---|---|---|---|
| | % N | % P | % K | % N | % P | % K |
| $T_1$ | 1.79 | 0.221 | 0.122 | 0.29 | 0.044 | 1.711 |
| $T_2$ | 1.92 | 0.238 | 0.125 | 0.30 | 0.054 | 1.742 |
| $T_3$ | 1.94 | 0.240 | 0.129 | 0.31 | 0.055 | 1.750 |
| $T_4$ | 1.95 | 0.242 | 0.130 | 0.31 | 0.056 | 1.751 |
| $T_5$ | 1.97 | 0.250 | 0.136 | 0.32 | 0.064 | 1.760 |
| S. Em± | 0.04 | 0.0063 | 0.0026 | 0.006 | 0.0038 | 0.0122 |
| C.D. (P= 0.05) | 0.11 | 0.0113 | 0.0056 | 0.011 | 0.0084 | 0.0281 |

**Table 3. Effect of different treatment combination on %N, %P and %K uptake in Wheat grain and Straw**

| Treatments | Nutrient Uptake in Wheat Grain (kg ha$^{-1}$) | | | Nutrient Uptake in Wheat Straw (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|
| | N | P | K | N | P | K |
| $T_1$ | 53.25 | 6.87 | 3.63 | 15.04 | 2.48 | 86.66 |
| $T_2$ | 77.66 | 9.63 | 5.06 | 20.83 | 3.64 | 117.43 |
| $T_3$ | 79.83 | 9.88 | 5.31 | 21.65 | 3.82 | 121.45 |
| $T_4$ | 82.29 | 10.21 | 5.49 | 22.24 | 3.98 | 124.41 |
| $T_5$ | 86.58 | 10.77 | 5.85 | 22.98 | 4.16 | 127.88 |
| S. Em± | 2.58 | 0.48 | 0.33 | 0.76 | 0.077 | 5.16 |
| C.D. (P= 0.05) | 5.62 | 1.05 | 0.73 | 1.67 | 0.168 | 11.24 |

**Table 4. Effect of different treatment combination on Protein Content (%)**

| Treatment | Treatment Combination | Protein Content (%) |
|---|---|---|
| $T_1$ | Control | 11.15 |
| $T_2$ | 100% RDF | 11.59 |
| $T_3$ | 75% RDF + FYM @ 6 t ha$^{-1}$ | 11.69 |
| $T_4$ | 50% RDF + FYM @ 12 t ha$^{-1}$ | 11.72 |
| $T_5$ | 25% RDF + FYM @ 18 t ha$^{-1}$ | 11.78 |
| SE(d) | | 0.038 |
| C.D. | | 0.085 |

straw (kg ha$^{-1}$) but significantly superior over other treatments. However, the lowest nutrient uptake viz on N (53.25 kg ha$^{-1}$), P (6.87 kg ha$^{-1}$) and K (3.63 kg ha$^{-1}$) uptake in wheat grain (kg ha$^{-1}$) and N (15.04 kg ha$^{-1}$), P (2.48 kg ha$^{-1}$) and K (86.66 kg ha$^{-1}$) in wheat straw (kg ha$^{-1}$) recorded with $T_1$ [Control]. Similar findings were reported by Rajdhar *et al.,* [24] and Sepat *et al.,* [25].

## 3.4 Protein Content

The Data showed significant increase in all the treatments over control. Highest protein content 11.78% was recorded with $T_5$: [25% RDF + FYM @ 18 t ha$^{-1}$] followed by 11.72 % protein content in $T_4$: [50% RDF + FYM @ 12 t ha$^{-1}$] (11.72%) and lowest 11.15 % at $T_1$ [Control]. Integration of FYM and inorganic fertilizer also showed slight increase in protein content. These results are accordance with the finding of Tea *et al.,* [26] and Madan *et al.,* [27].

## 4. CONCLUSION

The combination of 25% RDF + FYM @ 18 t ha$^{-1}$ recorded highest yield, plant nutrients status, nutrients uptake as well as quality traits in wheat crop as compared to other combinations of organic and inorganic fertilizers. Thus, it may be concluded that 25% RDF + FYM at 18 t ha$^{-1}$ applied is nice choice for accomplishing higher yield, content of nutrients, uptake and quality traits of wheat crop. The combination of organic manures and inorganic fertilizers sustain the soil health, produced maximum yield and uptake of nutrient in grain so fortification of nutrient occurs.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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