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# Effect of Farm Yard Manure and Nitrogen Application on Growth and Productivity of Wheat under Long Term Experimental Conditions

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Author VSH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors Kavinder, YPM and Devraj managed the analyses of the study. Author Harender and Kavita managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

To study the effect of farm yard manure (FYM) and nitrogen application on growth and productivity of wheat under long term experimental conditions a field experiment was conducted comprised of two level of FYM (0 and 15 t/ha) and three mode of application (*kharif*, *rabi* and both *kharif* and *rabi*) in main plots whereas two levels of nitrogen (0 and 120 kg/ha) in sub plot was laid out in split plot design with three replications. Plant height, dry matter accumulation, number of tillers/$m^2$, yield (grain yield, straw yield and biological yield) and yield attributing characters, were significantly higher for FYM 15 t/ha was applied in both *kharif* and *rabi* season as compared to FYM at 15 t/ha applied either in *rabi* or *kharif* and control. Application of 120 kg N/ha significantly increased growth parameters, yield and yield attributes as compared to control. Application of 15 t/ha FYM along with 120 kg N/ha significantly improved the growth and yield of wheat.

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## 1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crop in the world and staple food of about one third of the world's population [1]. It is the second most important source of staple food in India after rice. There is hardly any scope for expansion of area under wheat and the main emphasis would be on increasing the productivity of wheat by adopting the improved cultivation practices. If agronomic practices are fine-tuned and weeds are managed properly, the wheat productivity can be enhanced further. Long term experiments are valuable tools for determining yield trend, understanding changes in yield, estimating nutrient dynamics and assessing system sustainability.

Wheat is an exhaustive feeder and requires substantial amount of nutrients for higher productivity. Nitrogen is costly input and a major share of it is used for cereal cultivation. The cost of nitrogen fertilizers is increasing day by day. Under such a situation, suitable alternative nutrient combinations are to be evaluated. FYM is a good source of nutrients and contributed towards build up of organic matter in soil [2]. Nitrogen is an indispensable element for optimum functioning of crops [3]. The increase in eco-friendly production of wheat can be made possible by widespread adoption of improved technologies of which fertilizer management particularly that of nitrogen and organic manure can play a key role. Use of organic manures like farm yard manure (FYM), goat manure, poultry litter etc. for crop production might be a substitute of the chemical fertilizers [4]. The use of fertilizer is very essential for better crop production. Low fertilizer use efficiency is caused by imbalanced use of fertilizer and inappropriate method of their application. Organic manure increases the nutrient use efficiency and reduce the environmental pollution due to fertilizers. Use of organic manure and organic waste was also found good for crop production [5], but the use of farm yard manure (FYM) and chemical fertilizer has been found too much effective [6]. In the light of this view, the present study was carried out to study the effect of farm yard manure and nitrogen application on growth and productivity of wheat under long term experimental conditions.

## 2. MATERIALS AND METHODS

Studies on the use of FYM and nitrogen fertilizer were started in October, 1967 on a sandy loam, Typic Ustochrept soil using pearlmillet-wheat cropping sequence at Research Farm of Department of Soil Science, CCS Haryana Agricultural University, Hisar, Haryana (India). The site is located between 29°16' N latitude and 75°75' E longitude in the north-west part of India. The texture of the surface soil of the experimental field was sandy loam, having alkaline pH and EC varied from 0.17 to 0.42. The OC content of soil was medium to high (0.6 to 2.23). Available N, P and K varied from 35 to 132 kg/ha, 10 to 49 kg/ha and 132 to 356 kg/ha, respectively. This long term field experiment was selected to study the effect of long term application of FYM and nitrogen on growth and yield of wheat variety WH 711 during 2014-15. Two levels of FYM (0 (control) and 15 t/ha) and two levels of nitrogen (0 (control) and 120 kg/ha) under different mode of application (*rabi, kharif* and both *kharif* and *rabi*) were selected as treatments. Nitrogen was applied in split, half at sowing time and the other half at first irrigation. Biological yield was recorded; straw and grain were separated with mini thresher. FYM was incorporated in the field 30 days before sowing. All other cultural practices, including irrigation, hoeing and weeding were carried out uniformly for all subplots as per package and practices of CCS HAU, Hisar.

The data was statistically analyzed using analysis of variance (ANOVA) and the significance of treatment effects on the different variable was measured. In case of significant differences, least significance difference (LSD) test and special planned mean comparisons were made to achieve the specific objective of the research [7].

## 3. RESULTS AND DISCUSSION

### 3.1 Growth Studies

Among doses and mode of FYM, significantly higher plant height at 70 DAS was observed under application of 15 t/ha FYM in *rabi, kharif* or in both *kharif* and *rabi* seasons than under no FYM. Maximum plant height was observed under application of 15 t/ha FYM in both *kharif* and *rabi* seasons followed by application of 15 t/ha FYM in *rabi* season and 15 t/ha FYM in *kharif* season alone. Among two nitrogen treatments, significantly taller plants were observed under application of 120 kg/ha nitrogen than no nitrogen application. The interaction effect of

nitrogen and FYM treatments on plant height was found to be non-significant.

Likewise, significantly higher dry matter accumulation at 70 DAS was observed under application of 15 t/ha FYM in both *kharif* and *rabi* seasons than under 15 t/ha FYM *rabi*, *kharif* and no FYM. Among two nitrogen treatments, significantly higher dry matter accumulation and number of tillers/$m^2$ were observed under application of 120 kg/ha nitrogen than no nitrogen application (control). The interaction effect of nitrogen and FYM treatments on dry matter accumulation was found to be non-significant while the interaction effect of nitrogen and FYM treatments on number of tillers/$m^2$ was found to be significant. The balanced supply of nutrients plays an important role for rapid growth and development of a crop. Organic manures supply both macro and micro-nutrients and also improve the availability of native nutrients [8]. As only nitrogen was applied through inorganic fertilizers to all the plots and no phosphorus, potassium and other micro-nutrients were added to the control plots, the supply of these nutrients from organic manures had shown better effect on growth parameters of wheat crop. These findings are closely related with those of [9,10,11]. Significantly higher number of tillers/$m^2$ were observed under application of 120 kg/ha nitrogen and 15 t/ha FYM in both *kharif* and *rabi* season than other treatments (Table 1). These findings are in accordance with those of [12,13,9].

## 3.2 Yield Attributing Characters

Application of FYM at 15 t/ha in both *kharif* and *rabi* seasons produced significantly more numbers of effective tillers (417/$m^2$), spike length (9.5 cm), number of grains/spike (49.1) and 1000 grain weight (44.5 g) than all other treatments, whereas, significantly lower number of effective tillers (280/$m^2$), spike length (7.6 cm), no. of grains/spike (43.7) and 1000 grain weight (40.5 g) were observed under control as compared to all other treatments (Table 2). All yield attributes *viz.* number of effective tillers, spike length, number of grains/spike and 1000 grain weight were significantly more under application of FYM 15 t/ha in *rabi* compared to FYM 15 t/ha in *kharif*. Among nitrogen application treatments, 120 kg N/ha was found to produce significantly more number of effective tillers (409), spike length (9.3), number of grains/spike (48.2) and 1000 grain weight (42.3) over control. The interaction effect of nitrogen and FYM treatments on no. of effective tillers/$m^2$ was found to be significant while these effect on all other yield attributing characters was nonsignificant. Application of 120 kg N along with 15 t/ha FYM in both *kharif* and *rabi* season gave maximum yield attributing characters as compare to other treatments (Table 2). An increase of 48, 25 and 9 per cent in number of effective tillers, length of spike and grain weight per spike was observed with FYM 15 t/ha applied in both *kharif* and *rabi* over no FYM application, respectively. FYM has also been reported to contain more number of nitrogen fixing, phosphate solubilizing and other beneficial microbes, antibiotics, vitamins, hormones, enzymes, etc., which should better effect on the growth and yield of the plants [14]. An increase of 56, 25 and 3 per cent in number of effective tillers, length of spike and grain weight per spike was observed with 120 kg N/ha over no nitrogen application, respectively. Nitrogen is the principal raw nutrient required for the growth and higher the yield of the crop. The increase in grain and straw yields are due to increase in yields attributes to the crop. Similar results were obtained by [15,9,16,17].

## 3.3 Yield Studies

Grain yield, straw yield and biological yield of wheat as influenced by different modes and doses of FYM application and nitrogen are given in Table 3. Application of FYM at 15 t/ha in both *kharif* and *rabi* seasons produced significantly higher grain yield (4.2 t/ha) and harvest index (42.0) while significantly lower grain yield and harvest index were recorded under control. Maximum straw yield (5.8 t/ha) and biological yield (9.9 t/ha) were recorded under application of FYM at 15 t/ha in both *kharif* and *rabi* which were at par with application of FYM at 15 t/ha in *rabi* (5.7 t/ha and 9.7 t/ha respectively) while significantly higher than treatment FYM at 15 t/ha applied in *kharif* and control. The beneficial effect of organic manures on grain, straw and biological yields might be assigned to the fact that after proper decomposition and mineralization, these manures supplied available plant nutrients directly to the plants and also had solubilizing effect on fixed forms of nutrients in soil [8].

Application of 120 kg N/ha produced significantly higher grain yield (4.1 t/ha), straw yield (5.8 t/ha), biological yield (9.9 t/ha) and harvest index (41.5) over control (2.6 t/ha, 3.9 t/ha, 6.5 t/ha and 40.1 respectively). Application of 120 kg N/ha led to

**Table 1. Plant height, Dry matter accumulation and number of tillers as influenced by different mode and doses of FYM and nitrogen treatment at 70 days after sowing**

| Treatment (Doses & Mode of FYM) | Plant height (cm) | | | Dry matter accumulation (g/m$^2$) | | | Tillers/m$^2$ | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) |
| 0 t/ha (control) | 44.5 | 50.8 | 47.6 | 351.1 | 595.9 | 473.5 | 241 | 456 | 348 |
| 15 t/ha (*rabi*) | 52.7 | 55.1 | 53.9 | 534.3 | 788.5 | 661.4 | 413 | 498 | 456 |
| 15 t/ha (*kharif*) | 50.7 | 55.7 | 53.2 | 514.0 | 758.5 | 636.3 | 365 | 447 | 406 |
| 15 t/ha (*rabi* & *kharif*) | 54.0 | 55.5 | 54.8 | 555.9 | 819.6 | 687.7 | 440 | 529 | 484 |
| **Mean (Nitrogen)** | 48.5 | 53.1 | | 442.9 | 692.4 | | 323 | 474 | |
| **C.D. (FYM)** | 1.7 | | | 16.6 | | | 10.7 | | |
| **C.D. (Nitrogen)** | 1.2 | | | 7.7 | | | 8.6 | | |
| **C.D. (FYM × Nitrogen)** | N/A | | | N/A | | | 21.0 | | |

**Table 2. Yield attributes of wheat as influenced by different mode and doses of FYM and nitrogen treatments**

| Treatment (Doses & Mode of FYM) | Effective tillers (No./m$^2$) | | | Spike length (cm) | | | No. of grains/spike | | | 1000 grain wt. (g) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) |
| 0 t/ha (control) | 203 | 356 | 280 | 6.6 | 8.7 | 7.7 | 41.5 | 46.0 | 43.7 | 40.1 | 40.9 | 40.5 |
| 15 t/ha (*rabi*) | 326 | 474 | 400 | 8.3 | 10.0 | 9.1 | 44.6 | 50.2 | 47.4 | 42.3 | 43.6 | 42.9 |
| 15 t/ha (*kharif*) | 306 | 419 | 362 | 7.7 | 9.2 | 8.5 | 43.6 | 48.9 | 46.3 | 41.1 | 42.3 | 41.7 |
| 15 t/ha (*rabi* & *kharif*) | 342 | 492 | 417 | 8.7 | 10.4 | 9.5 | 46.3 | 52.0 | 49.1 | 43.8 | 45.1 | 44.5 |
| **Mean (Nitrogen)** | 263 | 409 | | 7.4 | 9.3 | | 43.2 | 48.2 | | 41.3 | 42.3 | |
| **C.D. (FYM)** | 12.88 | | | 0.19 | | | 1.51 | | | 0.37 | | |
| **C.D. (Nitrogen)** | 6.59 | | | 0.18 | | | 1.18 | | | 0.21 | | |
| **C.D. (FYM × Nitrogen)** | 16.15 | | | N/A | | | N/A | | | N/A | | |

**Table 3. Yield and harvest index of wheat as influenced by different mode and doses of FYM and nitrogen**

| Treatment (Doses & Mode of FYM) | Grain yield (t/ha) | | | Straw yield (t/ha) | | | Biological yield (t/ha) | | | Harvest index (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) | 0 Kg N/ha | 120 Kg N/ha | Mean (FYM) |
| 0 t/ha (control) | 2.0 | 3.6 | 2.8 | 3.2 | 5.0 | 4.1 | 6.2 | 7.5 | 6.9 | 38.8 | 41.8 | 40.3 |
| 15 t/ha (*rabi*) | 3.3 | 4.7 | 4.0 | 4.6 | 6.8 | 5.7 | 8.7 | 10.6 | 9.7 | 41.5 | 40.9 | 41.2 |
| 15 t/ha (*kharif*) | 3.1 | 4.2 | 3.6 | 4.4 | 6.1 | 5.3 | 7.9 | 9.8 | 8.9 | 40.9 | 40.6 | 40.7 |
| 15 t/ha (*rabi* & *kharif*) | 3.4 | 4.9 | 4.2 | 4.7 | 6.8 | 5.8 | 8.9 | 10.9 | 9.9 | 42.0 | 42.0 | 42.0 |
| **Mean (Nitrogen)** | 2.6 | 4.1 | | 3.9 | 5.8 | | 6.5 | 9.9 | | 40.1 | 41.5 | |
| **C.D. (FYM)** | 0.12 | | | 0.18 | | | 0.31 | | | 0.21 | | |
| **C.D. (Nitrogen)** | 0.06 | | | 0.09 | | | 0.15 | | | 0.12 | | |
| **C.D. (FYM × Nitrogen)** | 0.15 | | | 0.23 | | | 0.38 | | | 0.29 | | |

increased vigour of the plant during the vegetative phase, thus contributing towards higher growth and vigour of the plants and production of more tillers per plants or due to role of nitrogen in cell multiplication, cell elongation and tissue differentiation. Similar results were obtained by many researchers [18,9,16,17].

## 4. CONCLUSION

Application of FYM 15 t/ha during both *kharif* and *rabi* seasons along with 120 kg N/ha significantly improved the growth, yield attributes, yield and productivity of wheat crop. If the availability of FYM is only for one season then it should be applied in *rabi* as it gives significantly higher crop growth along with yield attributing characteristics and yield as compared to FYM applied in *kharif* season.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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