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Improving wheat (*Triticum aestivum* L.) and soil productivity through precision nitrogen management practices and efficient planting system

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Abstract
To investigation Improving wheat (*Triticum aestivum* L.) and soil productivity through precision nitrogen management practices and efficient planting system was conducted during *Rabi* season of year 2022-23 on Agricultural Farm at Rama University, Kanpur 209217 (U.P) India. The experiment was laid out in Randomized block design (factorial) with 16 treatment combinations and replicated thrice. Four tillage practices *viz*. T_1=Zero tillage (ZTW); T_2=Reduced tillage (RT); T_3= Rotavator tillage (RTW) T_4= Furrow irrigated raised beds (FIRB) and Precision N management N_1= Control ($N_0P_0K_0$); N_2= RDN (150: 75: 60 N: P_2O_5:K_2O kg /ha); N_3= Targeted yield 5.5 t/ha (170: 75: 60 N: P_2O_5: K_2O kg /ha); N_4= Leaf Colour Chart (75: 75: 60 N: P_2O_5: K_2O kg /ha). Higher growth attributing characters at different crop stages such as plant height, number of tillers, plant dry matter and yield attributing characters such as length of spike, number of spike, number of grains per spike and test weight were associated with Precision N management N_1= Conrol ($N_0P_0K_0$); N_2= RDN (150: 75: 60 N: P_2O_5:K_2O kg /ha); N_3= Targeted yield 5.5 t/ha (170: 75: 60 N: P_2O_5: K_2O kg /ha); N_4= Leaf Colour Chart ((75: 75: 60 N: P_2O_5: K_2O kg /ha), as basal Similarly, Higher grain yield, straw yield and harvest index along with B:C ratio were also associated with tillage practices. All these plant growth and yield attributing characters and yield along with net monetary income & B: C ratio was observed higher in variety T_4 by raised bed method followed by F_3 by raised bed method.

Keywords: Tillage practices, precision n management, grain yield, straw yield and harvest index

Introduction
Sustainability and profitability of wheat crop system in Indian agriculture is the lifeline and future of Indian economy with more than 60% people living in rural areas. The challenges are enormous ranging from conservation of natural resources to investment in new technologies. Increasing food production of the country in the next 20 years to much population growth is a big challenge in India. It is more difficult because, land area devoted to agriculture will stagnate or decline and better quality of land and water resources will be divided to the other sector of national economy. In order to grow more food from marginal and good quality lands, the quality of natural resources like seed, water, varieties, and fuel must be improved and sustained. The main reasons for its low productivity are poor crop establishment, improper scheduling of irrigation and deficient nutrition. Amongst the other agronomic practices proper crop establishment method may considerably increase the production of wheat to some extent. Ideal planting geometry is important for better and efficient utilization of plant growth resources get the optimum productivity of wheat. It is also well known fact that nutrient management is one of the major factors responsible for achieving better harvest in crop production. Both, crop establishment method and fertilization in wheat, which also affect its nutrient-use efficiency and economics.

In a crop production system traditional tillage practices contribute to an increase in the energy and labour costs resulting in lower economic returns (Kumar *et al*., 2013) [17]. Furthermore, intensive ploughing results to a decrease in soil organic matter by accelerating the oxidation and breakdown of organic matter which leads to degradation of soil properties.

Furthermore, in wheat, delay in sowing under conventional agricultural practices due to late rice harvest causes to decline yield because of terminal heat stress (Pathak *et al*., 2003) [18]. There are many other constraints under traditional/conventional agricultural practices. Unavailability of labour and increasing in its costs are serious concerns for the timely planting of crops (Jat *et al*., 2014) [19]. On the other hand in IndoGangetic Plains (IGP), water is increasingly becoming scarce because agriculture is facing rising competition from the urban and industrial sectors. According to Naresh *et al*. (2012) [20] in many parts of the region, over-exploitation and poor groundwater management has led to declining of water table and negative environmental impacts. Various researchers also confirmed that in this region there is a deterioration of land quality due to different forms of soil degradation and excess residue burning (Das *et al*., 2013) [21].

Materials and methods

A field experiment entitled "Improving wheat (*Triticum aestivum* L.) and soil productivity through precision nitrogen management practices and efficient planting system" was conducted during *Rabi* season of 2022-23 at agriculture farm Rama University, Mandhana, Kanpur (UP) India. The materials used and methods employed during field experimentation and laboratory estimations have been described in this chapter.

Yield

Grain/seed yield (q ha^{-1})

The threshing was done by manually and then seed yield of each plot was weighed. The seed yield of each net plot which was recorded and later on converted into q ha^{-1}. Similar procedure was adopted for all experimental crops.

Straw/stover yield (q ha^{-1})

The Stover yield was worked out after deducting the seed yield from the total biomass production for each plot. It was then calculated in q ha^{-1}.

Biological yield (q ha^{-1})

The crop from the net plot area was harvested and dried in sun for 2-3 days in respective plots. It was weighted to record the biological yield and expressed in q ha^{-1}.

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:

$$\text{H.I. (\%)} = \frac{\text{Seed/grain yield (q ha}^{-1})}{\text{Biological yield (q ha}^{-1})} \text{X0}$$

Results and Discussion

Grain yield

The grain yield wheat crop recorded at maturity where statistically analysed and presented in Table 1. Likewise grain yield the straw yield remained non-significant under different tillage option however, among the nutrients management practices the treatment F_2 recorded the maximum grain yield and significantly superior to that of F_1, F_3 and F_4 during the study. The Factorial RBD based N management practice (F_2) also recorded a considerable amount of grain yield which was statistically at par with F_4 wherein, the F_1 has the lower application of N fertilizer with higher N use efficiency than F_2 during the study. The minimum grain yield was found in treatment F_1 (Nitrogen enrich plots) during the study. This indicated that judicious and timely application of nitrogen fertilizer can maintained good amount of grain yield in wheat without affecting the grain yield. The interaction was found non-significant.

Straw yield

The straw yield wheat crop recorded at maturity where statistically analysed and presented in Table 1. Likewise grain yield the straw yield remained non-significant under different tillage option however, among the nutrients management practices the treatment F_2 recorded the maximum straw yield and significantly superior to that of F_1, F_3 and F_4 during the study. The Factorial RBD based N management practice (F_2) also recorded a considerable amount of straw yield which was statistically at par with F_4 wherein, the F_1 has the lower application of N fertilizer with higher N use efficiency than F_2 during the study. The minimum straw yield was found in treatment F_1 (nitrogen enrich plots) during the study. This indicated that judicious and timely application of nitrogen fertilizer can maintained good amount of straw yield in wheat without affecting the grain yield. The interaction was found non-significant.

Harvest index

The harvest index calculated from grain yield and straw yield was statistically analysed and presented in Table 1. Likewise economic yield the harvest index did not vary significantly within the different tillage practices. However, the N management practices exerted significant effect on harvest index. The treatment F_2 recorded the highest harvest index which was statistically at par with F_4 and significantly superior to the F_1, and F_4 during the study. The lower harvest index was recorded in treatment F_3. The interaction was found non-significant.

Table 1: Effect of tillage and nutrient management practices on grain yield (q ha^{-1}), straw yield (q ha^{-1}) and harvest index in wheat crop

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index
	2022-23	2022-23	2022-23
Tillage Practices			
T_1	43.4	57.3	40.6
T_2	45.3	59.2	43.1
T_3	44.3	58.8	42.5
T_4	45.0	61.9	43.0
SEM (±)	0.15	1.20	0.83
CD(P=0.05)	NS	NS	NS
Nutrient management			
F_1	44.3	59.1	42.4
F_2	49.4	66.4	45.8
F_3	38.8	59.3	39.9
F_4	45.5	63.9	44.6
SEM (±)	0.85	2.00	1.01
CD(P=0.05)	2.69	6.31	3.18
Interaction	NS	NS	NS

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