

Farmer's fertilizer practices in wheat:

A case study for high yield in north western plain zone

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A total of 100 farmers from Karnal district of Haryana were chosen for a study and their soils were analysed and fertilizer practices and yields in wheat were recorded. The results indicate that 27% of farmers are applying a low amount of nitrogen (while the remaining 71% of farmers are applying a higher amount of nitrogen), and all farmers are applying a lower quantity of phosphorus (P_2O_5) and no potassium (K) compared to the recommended fertilizer levels (150-60-40 kg N- P_2O_5 - K_2O /ha). Farmers tended to apply higher nitrogen levels in the hopes of achieving greater yields. However, this leads to lodging, where the crop bends or falls over during the last irrigation or rainstorms, resulting in reduced yields. As a consequence, the cost of cultivation increases, and the profit margin is decreased. To address this problem, multilocation trials were conducted to develop a strategy for achieving higher wheat yields in the north western plain zone (NWPZ). The results revealed that early sowing (last week of October) coupled with 150% of RDF (recommended dose of fertilizers) and 15 tonnes FYM/ha (farm yield manure) and two sprays of 0.2% CCC+0.1% tebuconazole at first node and flag leaf stage produced 10% higher grain yield (67.19 q/ha) owing to 10.9% increase in earhead/m² and 7% biomass and simultaneously reducing 10% plant height. This technology will reduce the lodging to a great extent which is a burning problem under high N and irrigated conditions.

Keywords: Early sowing, Farmers' practice, Fertilizer, Wheat

The north-western states of India, which include Punjab, Haryana, Delhi, West Uttar Pradesh, and North Rajasthan, are renowned for their rice-wheat farming system. This region, occupying an area of approximately 10.5 million hectares, is often referred to as the grain bowl or bread basket of the country. These states have a predominant agricultural economy and are known for their extensive cultivation of the rice-wheat cropping system. This system has gained popularity due to several factors like agro-climatic suitability, government support and market demand. However, the intensive cultivation of the rice-wheat cropping system has also led to several challenges, such as overuse of water, excessive reliance on chemical fertilizers, depletion of groundwater resources,

soil degradation, and ecological imbalances. The excessive use of nitrogen in Haryana by farmers can be attributed to several factors, viz. green revolution, lack of knowledge and awareness, perception of higher yields, economic incentives and lack of alternative practices. These issues have highlighted the need for sustainable agricultural practices, crop diversification, and the promotion of alternative cropping systems to ensure long-term agricultural viability in the region. Therefore, trials were conducted in 10 villages of Karnal to gather accurate information about the farming practices employed by farmers (100 no.) in the region. The purpose of this study was to obtain first-hand knowledge and ground truth regarding agricultural techniques, including the use of

inputs, cropping patterns, and other practices, adopted by the farmers in Karnal.

Case study

A study was conducted in the Karnal district of Haryana, involving 100 wheat growers from 10 villages (Nalvi Khurd, Nabipur, Jaroli Khurd, Mehmadpur, Kunjpura, Gagsina, Staundi, Raipur Jattan, Phurlak, Shahjahanpur) with 10 farmers from each village. The research started with farmers' fields soil analysis just before the wheat sowing in the winter (*rabi*) season of 2022-23. The soil samples were carefully collected from a depth of 0-15 cm and subsequently dried in shaded areas. The dried samples were then analyzed at the resource management laboratory of ICAR-Indian Institute of Wheat

and Barley Research, Karnal to determine various soil properties, including pH, electrical conductivity (dS/m), organic carbon content (%), available nitrogen (N), phosphorus (P), and potassium (K). The analysis revealed that all the soils exhibited a slightly alkaline nature and were not saline.

Among these fields, 25 had low organic carbon levels, 37 had medium organic carbon levels, and 38 had high organic carbon levels. In terms of available nitrogen, all fields exhibited low levels ranging from 52.9–170.5 kg/ha. The available phosphorus content ranged from 4.0–35.1 kg/ha, with 79 fields having low levels (<10 kg/ha), 20 fields having medium levels (10–25 kg/ha), and 1 field having high levels. Available potassium varied from 87.4–558.9 kg/ha, with 19 fields having low levels (<140 kg/ha), 54 fields having medium levels (140–280 kg/ha), and 27 fields having high levels (>280 kg/ha).

All the farmers in the district followed a rice-wheat cropping system. Detailed records of the farmers' activities, from sowing to harvesting, were maintained. It was observed that 71 out of 100 farmers applied nitrogen at doses exceeding the recommended amount of 150 kg N/ha. All farmers used di-ammonium phosphate (DAP) for phosphorus application, with quantities ranging from 11.5–40.9 kg/ha. Most farmers applied one bag (50 kg) of DAP per acre (0.4 ha) as a basal dose. Many farmers in the region applied urea after irrigation to facilitate moisture evaporation from the fields, which led to reduced nitrogen use efficiency. This practice, however, resulted in a yield penalty in fields where excessive nitrogen doses were applied, leading to the lodging of wheat plants.

Out of the surveyed farmers, 22 farmers chose to sow wheat at the end of October, 12 farmers opted to sow their wheat crop between the 1st and 15th of November, while the rest of the farmers sowed after the 15th of November. The cumulative average based on time of sowing revealed that early sowing of wheat subjected



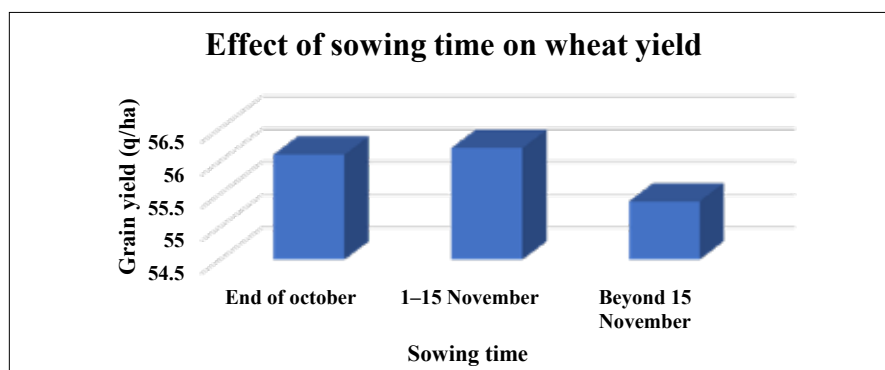
Lodging in wheat at the grain filling stage in Kunjpura village due to excessive use of nitrogen

the crop to lodging and caused yield penalty, while sowing beyond 15th November recorded less yield due to late sowing beyond the optimum time of sowing. Timely sowing (1–15 November) recorded comparatively more grain yield.

High-yield technology in NWPZ

To address the challenges of lodging, disease and pest issues, reduced grain yield, high cost of cultivation, etc., there is a need to develop an ideal wheat plant type that combines lodging resistance with a high yield potential of 8.0 t/ha. Desired characteristics include thicker diameter of the basal wheat culm, thicker stem walls, and robust root density. Agronomists are tasked with developing production technologies to manage lodging at higher yield levels. To overcome this problem, a multi-location experiment was conducted to maximize wheat yield with a target of 8 t/ha. The experiment involved using higher levels of inorganic and organic fertilizers, along with the application of a growth retardant to control lodging.

The experiment consisted of two nutrient management treatments: the recommended doses of fertilizers (RDF) and 150% RDF + 15 tonnes of farmyard manure (FYM)/ha + two sprays of chlormequat chloride (0.2%) + tebuconazole (0.1%) of the commercial product dose at the first node and flag leaf stage. Six different centres were selected for the experiment, and high-yielding wheat genotypes were tested across three replications. Sowing took place during the last week of October, using a normal seed rate of 100 kg/ha. Early sowing was chosen to provide sufficient time for grain filling and to avoid the negative effects of hot winds during this period. Irrigation and weed control were implemented according to recommended practices. The application of 150% RDF, along with 15 t/ha of FYM and two sprays of growth retardants, resulted in significant increases in biomass (7.02%), grain yield (10.85%), earheads/m² (10.9%), and grains per earhead (5.59%), with minimal lodging. The growth retardants had a dual effect of reducing plant



Effect of sowing time on wheat yield

height and promoting tillering, leading to additional grains on each earhead. Although there was a slight decrease in 1000-grain weight and plant height, the overall results demonstrated the effectiveness of using growth retardants in controlling lodging while increasing yield potential.

Replacing RDF with 150% RDF + 15 t/ha FYM + growth retardants further increased biomass, grain yield, earheads/m², and grains per earhead, while slightly reducing 1000-grain weight and plant height. This indicates that integrated management of fertilizers and the use of growth retardants can effectively control lodging in high-yield potential wheat varieties.

Do's

- Farmers must sow wheat at the proper time, any delay in sowing causes yield penalty. Early sowing can increase grain yield by applying 150% of RDF and 15-tonne FYM/ha and two sprays of 0.2% CCC + 0.1% tebuconazole at the first node and flag leaf stage.
- With the widespread availability of LPG (liquefied petroleum gas) in the country, the reliance

on dung cakes as a fuel source has significantly decreased. As a result, farmyard manure (FYM) can now be made more readily available for application to wheat crops before sowing, leading to increased yields and income. The total bovine population in the country, including cattle, buffalo, Mithun, and yak, amounts to 302.79 million. On average, these animals produce approximately 10 kg dung per day, resulting in a yearly dung production of almost 1,100 mt. Considering that the net cropped area of the country is 139.9 mha, this substantial dung production can adequately provide 7–8 tonnes of dung per hectare per year. Therefore, farmers have the opportunity to utilize farmyard manure as a valuable resource for enhancing wheat yields on a per-unit area basis.

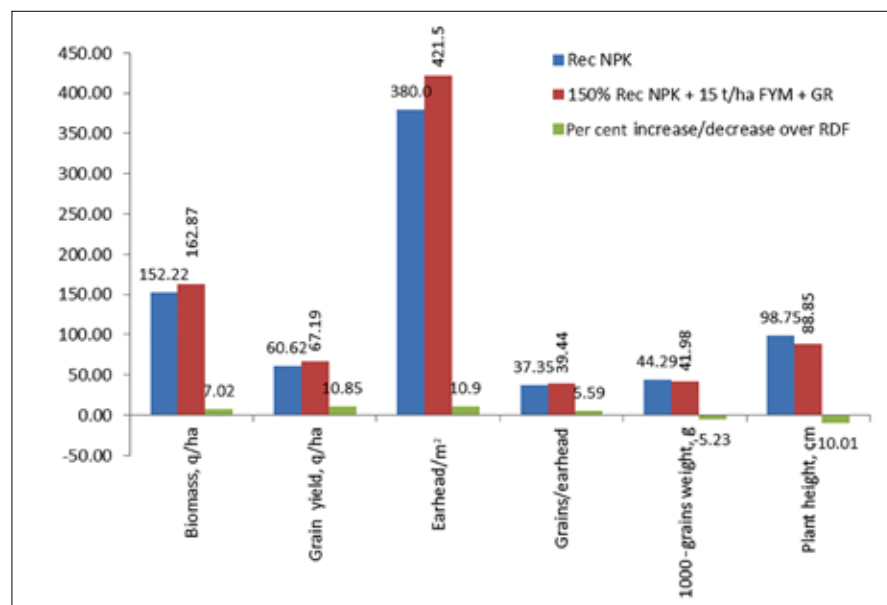
- The recommended dose of fertilizers (150:60:40 kg NPK/ha) must apply in timely sown wheat with 1/3rd of nitrogen (50 kg/ha) along with a whole dose of phosphorus and potassium as a basal dose. The remaining dose of nitrogen should be applied

in two equal splits just before irrigation at first (21 DAS) and second irrigation (45 DAS).

- Urea should be applied just before irrigation as it not only helps to save nitrogen but also improves yield by enhancing nitrogen use efficiency.
- Lodging can be prevented by applying two sprays of chlormequat chloride (0.2%) + tebuconazole (0.1%) at the first node (45–50 DAS) and flag leaf stage (70–75 DAS) in high-yielding tall varieties of wheat.
- Light irrigation should be applied at the grain-filling stage of wheat. Under high wind velocity, it should be delayed or applied when the wind slows down or ceases.

SUMMARY

In India, the annual per capita wheat consumption is projected to rise to 74 kg by 2030 and further to 94 kg by 2050. Hence, there exists a pressing requirement to leverage high-yielding wheat varieties in order to maximize production within a given land area. To address this concern, farmers can opt for the practice of early wheat sowing, coupled with the application of recommended dose of fertilizers (150-60-40 kg/ha), and the judicious utilization of farmyard manure. The farmers of Indo-Gangetic plains of India (including Haryana, Punjab and Western UP) are facing a problem of lodging at grain filling/harvesting stage. To prevent the problem of lodging, two sprays of chlormequat chloride (0.2%) + tebuconazole (0.1%) at the first node (45–50 DAS) and flag leaf stage (70–75 DAS) in high-yielding tall varieties of wheat can be applied. Implementing these practices holds the potential to not only meet future wheat demand but also generate profits for farmers.



Yield attributes and yields as affected by RDF alone or along with 15 t/ha FYM + growth regulators

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Earth provides enough to satisfy every man's needs, but not every man's greed.

—Mahatma Gandhi