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# Effect of split application of nitrogen at different growth stages on grain yield in late sown wheat (*Triticum aestivum* L.)

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**Abstract**
Field research was conducted at the Department of Agriculture research farm, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala while the Rabi season of 2022. with eight treatments, In order to set up the experiment, a randomized block design was used: $T_1$: (Control), $T_2$: (100% RDN @ sowing), $T_3$: (50% RDN @ sowing + 50% @ CRI stage), $T_4$: (50% RDN @ sowing + 50% @ tillering stage), $T_5$: (50% RDN @ sowing + 50% @ jointing stage), $T_6$: (50% RDN @ sowing + 25% @ CRI stage + 25% at tillering stage), $T_7$: (50% RDN @ sowing + 25% RDN @ CRI stage + 25% RDN @ flowering stage) and $T_8$: (25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage). In this research the hybrid variety of wheat HD-2967 was taken. The results from the data under this research revealed that by the application of 25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage) the recorded highest in all parameters like growth attributes, yield and its attributes and economics. Highest grain yield, straw yield and biological yield was (48.26, 57.99, 106.25 q $ha^{-1}$) respectively. Among all the treatments, the application of (25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage) recorded highest in all plant height at harvest, at 30, 60, 90 and at harvest stage DAS. Yield and its attributes like harvest index, grain yield and straw yield and biological yield was also observed under $T_8$ (25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage).

**Keywords:** Split application, nitrogen, economics, *Triticum aestivum* L., nutrients

## Introduction
Wheat (*Triticum aestivum* L.) is grown as crucial component crop for global food security. Its production worldwide is around 788.5 million metric tonnes in the year (Anonymous, 2023) [2]. Major wheat growing countries are China, India, Russia, USA and some parts of Africa. India is second largest producer of wheat in the world, behind China. India total area under wheat crop during 2021-2022 is (304.69 lakh ha) and production of wheat during 2021-2022 was estimated at 106.84 million tonnes (Anonymous, 2023) [2]. It exceeded the average wheat production of last 5 years by 2.96 million tonnes, totaling 103.88 million tonnes for both the area under wheat cultivation and its production. Uttar Pradesh has the highest production at around (33.95 million tonnes), followed by Madhya Pradesh (22.42 million tonnes) and Punjab (14.82 million tonnes). In Haryana, total production of wheat was reported at (10.45 million tonnes) in 2021-2022 (Anonymous, 2021-2022) [3]. Wheat responds to nitrogen application however, its response depends on the manner and timing at which we apply nutrients.

## Materials and Methods
A field Experiment research was carried out to determine" Effect of split application of nitrogen at different growth stages on grain yield in late sown wheat (*Triticum aestivum* L.) under late sown conditions" in 2022-2023 winter (*Rabi* season at the research farm of the Department of Agriculture at Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala, Haryana. In order to set up the experiment, randomised block design was used with eight

nutrient treatments: $T_1$: (Control), $T_2$: (100% RDN @ sowing), $T_3$: (50% RDN @ sowing + 50% @ CRI stage), $T_4$: (50% RDN @ sowing + 50% @ tillering stage), $T_5$: (50% RDN @ sowing +50% at jointing stage), $T_6$: (50% RDN @ sowing + 25% @ CRI stage + 25% @ tillering stage), $T_7$: (50% RDN @ sowing + 25% RDN @ CRI stage + 25% RDN @ flowering stage) and $T_8$: (25% RDN @ sowing+ 25% RDN at CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage). In this research the variety of wheat HD-2967 was taken. The sowing was carried out using a tractor-drawn seed drill at a row-to-row spacing of 22.5 cm and plant to plant spacing 5 cm. The seeds were planted 4-5 cm deep. Observation were recorded on plant height at 30, 60, 90 DAS and at harvest, yield and yield attributes, and economic studies. The data was analyzed using ANOVA (Analysis of Variance) table.

## Results and Discussion

### Growth Studies

**Plant height (cm):** Plant height at 30DAS data (Table 1) showed that the treatment $T_2$ (100% RDN@ sowing) recorded the highest plant height (21.00 cm). Furthermore, $T_8$ (25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage) recorded the highest plant height at 60, 90 and at harvest stage (46.8, 90.4, and 95.5 cm) which was statistically significant over $T_7$ (50% RDN @ sowing + 25% RDN @ CRI stage + 25% RDN @ flowering stage) *i.e.* (45.5, 87.2 and 92.7 cm). The least plant height at 30, 60, 90 days after sowing and at harvest stage (17.7, 39.3, 80.9 and 82.4 cm) was recorded in $T_1$ (Control) respectively. Increase in plant height with increased nitrogen levels also reported by Gurjar *et al.* (2022) [5] Singh *et al.* (2020) [4].

### Observation to be recorded

**Yield and yield attributes:** Among treatments (Table 2), $T_8$ (25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage) registered highest grain yield (48.26) which was significantly better than the rest treatments and followed by $T_7$ (50% RDN @ sowing + 25% RDN @ CRI stage + 25% RDN @ flowering stage) (45.91). The lowest grain yield was registered with $T_1$ (Control) (34.37).

Among treatments (Table 2), $T_8$ (25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage) registered highest quantity of straw yield (57.99) which was significantly better than the rest treatments and followed by $T_7$ (50% RDN @ sowing + 25% RDN @ CRI stage + 25% RDN @ flowering stage) (56.49). The lowest quantity of straw yield was recorded with $T_1$ (Control) (47.67).

Among treatments (Table 2), $T_8$ (25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage) (106.25) registered highest amount of biological yield (111.99) which was significantly better than the rest treatments and followed by $T_7$ (50% RDN @ sowing + 25% RDN @ CRI stage + 25% RDN @ flowering stage) (102). The lowest quantity of biological yield was registered with $T_1$ (Control) (60.25).

Among treatments (Table 2), $T_8$ (25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage) registered highest harvest index (45.42%) which was significantly better than the rest treatments and followed by $T_7$ (50% RDN @ sowing + 25% RDN @ CRI stage + 25% RDN @ flowering stage) (44.61%). The lowest harvest index recorded with $T_1$ (Control) (39.69%). Similar results of improvement in grain yield, straw yield, biological yield, harvest index with split doses methods of nitrogen were reported by Gurjar *et al.* (2022) [5].

**Table 1:** Effect of nitrogen by split application on plant height at 30, 60, 90 and at harvest days after sowing in late sown wheat.

| Symbols | Treatments | Height (cm) | | | |
|---|---|---|---|---|---|
| | | 30DAS | 60DAS | 90DAS | HARVEST |
| $T_1$ | Control | 17.7 | 39.3 | 80.9 | 82.4 |
| $T_2$ | 100% RDN @ sowing (150:60:60) | 21.0 | 41.2 | 82.3 | 87.1 |
| $T_3$ | 50% RDN @ sowing + 50% @ CRI stage | 20.2 | 44.4 | 85.7 | 91.4 |
| $T_4$ | 50% RDN @ sowing + 50% @ tillering stage | 20.3 | 43.7 | 84.2 | 90.2 |
| $T_5$ | 50% RDN @ sowing + 50% @ jointing stage | 20.4 | 42.8 | 82.6 | 88.6 |
| $T_6$ | 50% RDN @ sowing + 25% @ CRI stage + 25% @ tillering stage | 20.4 | 46.6 | 88.6 | 94.4 |
| $T_7$ | 50% RDN @ sowing + 25% RDN @ CRI stage + 25% RDN @ flowering stage | 20.5 | 45.5 | 87.2 | 92.7 |
| $T_8$ | 25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage | 18.7 | 46.8 | 90.4 | 95.5 |
| Factors | C.D. 5% | 0.5 | 0.8 | 0.96 | 1.00 |
| | SE(m) ± | 0.2 | 0.2 | 0.31 | 0.30 |

**Table 2:** Effect of nitrogen by split application on Yield in late sown wheat

| Symbols | Treatments | Yield (q/ha) | | | Harvest Index (%) |
|---|---|---|---|---|---|
| | | Grain | Straw | Biological | |
| $T_1$ | Control | 24.05 | 36.54 | 60.59 | 39.69 |
| $T_2$ | 100% RDN @ sowing (150:60:60) | 35.25 | 52.23 | 87.47 | 40.29 |
| $T_3$ | 50% RDN @ sowing + 50% @ CRI stage | 44.01 | 54.58 | 98.6 | 44.64 |
| $T_4$ | 50% RDN @ sowing + 50% @ tillering stage | 41.97 | 54.03 | 95.99 | 43.72 |
| $T_5$ | 50% RDN @ sowing + 50% @ jointing stage | 40.07 | 52.53 | 92.6 | 43.27 |
| $T_6$ | 50% RDN @ sowing + 25% @ CRI stage + 25% @ tillering stage | 46.35 | 57.41 | 103.76 | 44.67 |
| $T_7$ | 50% RDN @ sowing + 25% RDN @ CRI stage + 25% RDN @ flowering stage | 45.51 | 56.49 | 102 | 44.61 |
| $T_8$ | 25% RDN @ sowing+ 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage | 48.26 | 57.99 | 106.25 | 45.42 |
| Factors | C.D. 5% | 1.64 | 0.71 | 2.04 | |
| | SE(m) ± | 0.54 | 0.23 | 0.67 | |

## Conclusion

Application of different nitrogen doses on critical stages of late sown wheat (*Triticum aestivum* L.) was found to be an effective and efficient technique for nutrient supplementation of wheat, yielding results that were comparable to those obtained with the full prescribed dose of soil applied fertilizers. Application of combination of urea as a soil (25% RDN @ sowing + 25% RDN @ CRI stage + 25% RDN @ jointing stage + 25% RDN @ flowering stage) was found the most suitable dose of fertilizer to be adopted as it gives significantly higher performance in growth and yield parameters such as plant height, grain yield, straw yield, biological yield.

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