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Effect of different nutrient levels on yield and yield attributes of wheat (*Titicum aestivum* L.) varieties under late sown condition

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Abstract
A field experiment was conducted to study effect of different nutrient levels on yield and yield attributes of wheat varieties under late sown condition which was performed during *Rabi* season of 2020-21 at the Research farm, Bihar Agricultural University, Sabour, Bhagalpur. The experiment was laid out in factorial randomized block design with three replications. The experiment consisted of twelve treatment combinations of three fertility levels (F_0- No fertilizer, F_1-100% RDF, F_2 -125% RDF) and four varieties (V_1- Sabour Samridhi, V_2 –HD 2967, V_3 - Sabour Shreshtha & V_4 – DBW 107). Sowing time in wheat is a fundamental factor in determining yield of the crop. Balancing the interaction of sowing time with proper nutrient management can maximize yield and enhance the quality parameters in wheat. Result revealed that application of 125% RDF recorded significantly higher yield and yield attributes in all varieties under late sown condition while among the varieties, DBW107 performed better over Sabour Shreshtha and Sabour Samridhi but was found to be statistically comparable with HD 2967.

Keywords: Late sown wheat, yield, varieties, sowing time, recommended dose of fertilizer

Introduction
Wheat (*Triticum aestivum* L.) is one of the world's most cereal crops, ranking first both in acreage and production and it is the staple diet of almost a third of the world's population. After China, India is the world's second largest wheat producer. The area under wheat cultivation in Bihar is about 2.25 million hectares accounting the shares of 7.14% to the total wheat cultivated area of India with the production of 5.29 million tons and productivity of 2626 kg ha^{-1} (Directorate of Economics & Statistics, DAC & FW, 2019-20). Under prevailing Rice – Wheat cropping system of Bihar, Late harvesting of rice, unavailability of quality seeds at proper time, poor purchasing power of the farmers are some of the reasons that compel the farmers to sow available seeds (whether timely or late sown wheat variety) under delayed sowing condition. Under these circumstances fertilizer dose required by plant to produce high yield becomes a major deciding factor. Wheat varieties responses to different fertility levels and found that yield and yield attributing characters and growth of plants (plant height and dry matter production) were significantly increased with increase in dose of fertilizer (Patil, 2003) [12]. However, some improved varieties suitable for cultivation under varying environmental conditions have been developed which have high input use efficiency and are impregnated with the capacity to withstand climatic aberrations as well as to fill their seeds or grains quickly under heat stress situations (Tewolde *et al*. 2006). These varieties differ in genetical potential and show differential response to planting dates for yield attributing characters, phenological stages and their sensitivity to high temperature. Hence, the selection of fertilizer responsive varieties having the capacity of efficient partitioning of photosynthates even in stress situations is the demand of time. Better fertilization especially NPK under stress situations is important for enhancing the yield and grain quality of wheat. Therefore, an experiment was planned to evaluate the the effect of different nutrient levels on growth and yield of late and timely sown varieties in delayed sowing condition.

Materials and Methods
The field of experiment was conducted at the agricultural farm, Bihar Agricultural University, Sabour, Bhagalpur (Bihar). It is located at the south of river Ganges, between 25° 23' N latitude and 78° 07' E longitude at an altitude above the mean sea level.

Bhagalpur has sub-tropical climate, moderate annual rainfall, hot and dry summer and cold winter. Soil of experimental plots was sandy loam (sand: 47.4, silt: 32.6 and clay: 19.6), having pH 7.35. It was moderately fertile being medium in organic carbon (0.56%). Available N, P and K was 186.21, 18.91 and 165.42 kg ha^{-1} in soil, respectively. The experiment was laid out in factorial randomized block design with three replications. The experiment consisted of twelve treatment combinations of three fertility levels (F_0- No fertilizer, F_1- 100% RDF (120:40:20 NPK kg ha^{-1}), F_2 -125% RDF (150:50:25 NPK kg ha^{-1}), and four varieties (V_1- Sabour Samridhi, V_2 -HD-2967, V_3 - Sabour Shreshtha & V_4 - DBW-107) *viz*. F_0V_1, F_0V_2, F_0V_3, F_0V_4, F_1V_1, F_1V_2, F_1V_3, F_1V_4, F_2V_1, F_2V_2, F_2V_3, F_2V_4. Field was prepared by ploughing with the tractor drawn mould board plough followed by cross harrowing with disc harrow. Levelling of field was done by using tractor drawn leveler. Sowing of seeds was done manually with help the of hand plough at a spacing of 20 cm and required quantity of healthy and clean seeds were calculated using the seed rate of 120 kg ha^{-1}. Before sowing seeds were treated with Bavistin @ 2.5 g kg^{-1}seed. Basal dose of fertilizers was applied in required quantity as per treatment in experimental plots. Seeding was done manually and thereafter furrows were covered. The crop was sown on 20th December, 2020. Source of NPK used as Urea (46% N), DAP (46% P_2O_5) and muriate of potash (60% K_2O). Recommended dose of fertilizer (RDF) was 120:40:20 kg NPK ha^{-1}. Half dose of nitrogen was applied at sowing time as basal dose along with full dose of phosphorus and potash. Remaining half doses on N was applied in two splits as top dressing, first at 25 DAS and second at 60 DAS. Other agronomical practices were followed as per the need of the crops. Harvesting of crop was done on 15th April, 2021 with help of sickle at maturity by removing boarder rows.

Results and Discussion

Yield attributes

Number of earhead m^{-2}

The perusal of data clearly reveals that number of earhead m^{-2} was significantly influenced by fertility levels and varieties. Application of 125% was recorded significantly higher number of ear head (309.66 m^{-2}) over 100% RDF (262.92 m^{-2}) and F_0 (202.12 m^{-2}). These results are similar to those of Prasad *et al*. (2018) [13], and Singh *et al*. (2019) [14]. Among the varieties, DBW 107 produced significantly higher number of ear head (276.69 m^{-2}) over Sabour Shreshtha (246.85 m^{-2}) and Sabour Samridhi (232.23 m^{-2}) but was found at par with HD 2967 (262.30 m^{-2}). However, the variety Sabour Shreshtha and Sabour Samridhi were found to be statistically at par to each other. These results are in close agreement with those of Kale *et al*. (2015) [6] and Pathania *et al*. (2018) [11].

There exists no significantly interaction between the fertility levels and varieties in relation to number of earhead m^{-2}

Earhead length (cm)

The close scrutiny of data related to ear head length, presented in Table 01 reveals that ear head length was not significantly affected by fertility levels. However, maximum ear head length was recorded with 125% RDF (10.07 cm) followed by 100% RDF (10.02 cm), while the smallest ear head length was observed under F_0 (9.73 cm). These results are similar to those of Kale *et al*. (2015) [6] and Singh *et al*. (2016). Earhead length was significantly influenced by the varieties. Among the varieties, HD 2967 recorded significantly longer ear head (10.58 cm) than DBW 107 (9.15 cm) which was at par with Sabour Samridhi (10.40 cm) and Sabour Shreshtha (9.64 cm).

Earhead length did not influenced significantly due to interaction effect of fertility levels and varieties.

Number of grains earhead^{-1}

The perusal of data clearly reveals that number of grains earhead^{-1} was influenced significantly by fertility levels. The application of 125% RDF had recorded significantly higher number of grains earhead^{-1} (37.70) over F_0 (28.18) and it was found statistically at par with 100% RDF (35.01) which was also superior over F_0. These results are similar to those of Jat *et al*. (2013) [5], Kale *et al*. (2015) [6], Singh *et al*. (2016) and Singh *et al*. (2018) [15]. Among the varieties, the maximum number of grains earhead^{-1} was recorded with variety DBW 107 (37.48) and was found significantly superior over Sabour Shreshtha (34.14) and Sabour Samridhi (28.54) but statistically at par HD 2967 (34.36) which in turn was found superior over Sabour Samridhi but comparable with Sabour Shreshtha. These results are in close agreement with Singh *et al*. (2015), Kaur (2017) [7], Mahajan *et al*. (2018) [9] and Prasad *et al*. (2018) [13]. The interaction effect of fertility levels and varieties on number of grains earhead^{-1} was found non-significant.

Yield (q ha^{-1})

Grain yield (q ha^{-1})

The results revealed that the application of 125% RDF produced significantly higher grain yield (38.67 q ha^{-1}) than F_0 and it was found statistically at par with 100% RDF (37.01 q ha^{-1}) which in turn was found superior over F_0 (24.09 q ha^{-1}). A sufficient supply of nitrogen, phosphorus and potassium may have influenced high photosynthetic activity, vigorous vegetative growth and dark green colour, all of which influenced the better carbohydrate utilization and better assimilates translocation from leaves to storage organs, resulting into increased yield. These results are similar to those of Singh *et al*. (2018) [15], Prasad *et al*. (2018) [13] and Singh *et al*. (2019) [14]. Among the varieties, DBW 107 performed better in terms of grain yield (35.79 q ha^{-1}) over Sabour Shreshtha (32.24 q ha^{-1}) and Sabour Samridhi (30.00 q ha^{-1}) and it was statistically comparable to HD 2967 (34.99 q ha^{-1}). This might be related to genetic makeup of the varieties. Similar findings of highest grain yield were reported by Kale *et al*. (2015) [6], Kaur *et al*. (2017) [7], Mahajan *et al*. (2018) [9] and Prasad *et al*. (2018) [13].

Interaction effect of fertility levels and varieties on grain yield of wheat

The interaction effect of fertility levels i.e., 125% RDF, 100% RDF and F_0 (No fertilizer) and varieties (i.e., Sabour Samridhi, HD 2967, Sabour Shreshtha and DBW 107) on grain yield was presented in Fig 01. The wheat variety DBW 107 with 125% RDF was recorded significantly higher grain yield than the other combinations but it was comparable with combination of HD 2967 with 125% RDF and DBW 107 with 100% RDF. However, the combination of variety HD 2967 with 125% RDF and 100% RDF were found statistically comparable in case of grain yield. Similar results were also noticed by Prasad *et al*. (2018) [13] and Malghani *et al*. (2010) [10].

Straw yield (q ha^{-1})

The data of straw yield (q ha^{-1}) showed significantly maximum straw yield (64.21q ha^{-1}) under application of 125% RDF than F_0 (41.69 q ha^{-1}) and was found at par with 100% RDF (62.11q ha^{-1}). This might be owing to the adequate supply of nutrients to the crops. These results are resembled to those of Singh *et al*. (2018) [15] and Prasad *et al*. (2018) [13]. The varieties also registered significant effect on straw yield of wheat crop. DBW 107 had significantly higher straw yield (59.21 q ha^{-1}) than Sabour Shreshtha (53.81q ha^{-1}) and Sabour Samridhi (52.62 q ha^{-1}) and it was found statistically comparable with HD 2967 (58.38 q ha^{-1}). This might be due to the genetic inheritance of the varieties. These findings are similar to those finding of Mahajan *et al*. (2018) [9] and Prasad *et al*. (2018) [13]. Straw yield (q ha^{-1}) did not influenced significantly due to interaction effect of fertility levels and varieties.

Harvest index (%)

The data revealed that the maximum harvest index (37.60%) was recorded under application of 125% RDF followed by 100% RDF (37.34%) while lowest value of harvest index was recorded with F_0 (36.71). Similar findings were proposed by Singh *et al*. (2018) [15]. Varieties also failed to exert significant effect on harvest index. However, DBW 107 (37.64%) had the highest harvest index followed by HD 2967 (37.44%) and Sabour shreshtha (37.35%) while the lowest harvest index was observed with Sabour samridhi (36.45%). These results are in conformity with findings of Prasad *et al*. (2018) [13]. Harvest index did not influence significantly to the interaction effect of fertility levels and varieties.

Table 1: Effect of fertility levels and varieties on yield attributes of wheat crop

Treatments	Number of earhead (No. m^{-2})	Earhead length(cm)	Number of grains (No. ear head^{-1})
Fertility levels (kg ha^{-1})			
F_0- No fertilizer	202.12	9.73	28.18
F_1- 100% RDF	262.92	10.02	35.01
F_2- 125% RDF	309.66	10.07	37.70
S.Em±	8.73	0.30	0.95
CD (P=0.05)	25.62	NS	2.79
Varieties			
V_1- Sabour Samridhi	232.23	10.40	28.54
V_2- HD-2967	262.30	10.58	34.36
V_3- Sabour Shreshtha	246.85	9.64	34.14
V_4- DBW- 107	276.69	9.15	37.48
S.Em±	10.09	0.35	1.10
CD (P=0.05)	29.58	1.02	3.22
Interaction (F×V)	NS	NS	NS

Table 2: Effect of fertility level and varieties on grain, straw and biological yield and harvest index of wheat

Treatments	Yield (q ha^{-1})			
	Grain yield	Straw yield	Biological yield	H.I.
Fertility levels (kg ha^{-1})				
F_0- No fertilizer	24.09	41.69	65.78	36.71
F_1- 100% RDF	37.01	62.11	99.12	37.34
F_2- 125% RDF	38.67	64.21	102.88	37.60
S.Em±	0.59	1.18	1.24	0.68
CD (P=0.05)	1.74	3.45	3.65	NS
Varieties				
V_1- Sabour Samridhi	30.00	52.62	82.63	36.45
V_2- HD-2967	34.99	58.38	93.36	37.44
V_3- Sabour Shreshtha	32.24	53.81	86.06	37.35
V_4- DBW- 107	35.79	59.21	95.00	37.64
S.Em±	0.69	1.36	1.44	0.78
CD (P=0.05)	2.01	3.99	4.21	NS
Interaction (F×V)	S	NS	NS	NS

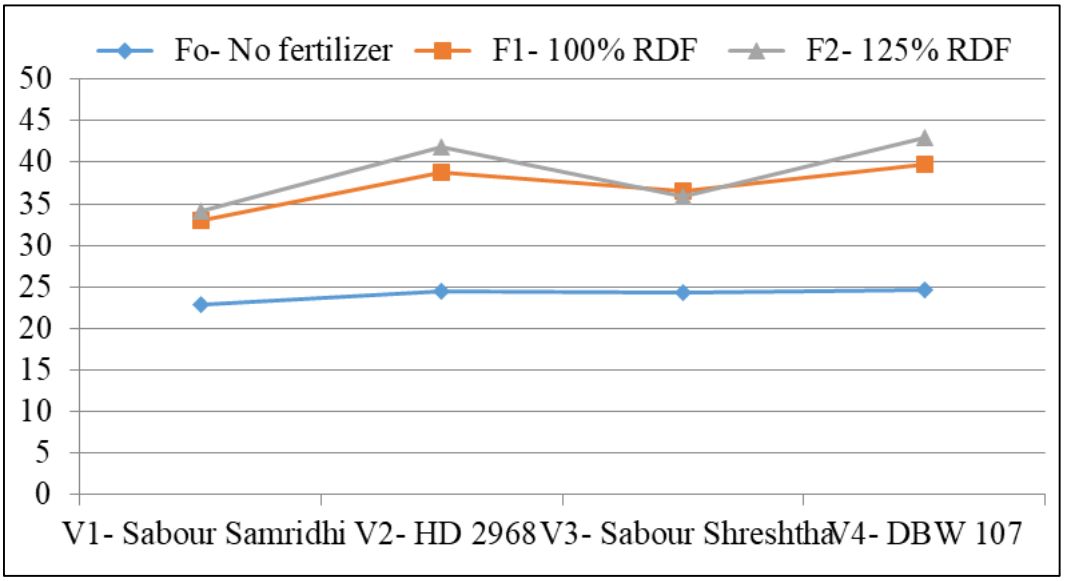

Fig 1: Interaction effect of fertility levels and varieties on grain yield (q ha^{-1}) of wheat

Conclusion

On the basis of the experiment's findings, it may be concluded that the application of 125% RDF (150:50: 25 kg NPK ha^{-1}) is suitable for getting higher yield and yield attributes in late sown condition either by using late sown variety DBW 107 or timely sown variety HD 2967. An extra supply of nitrogen, phosphorus and potassium may have influenced high photosynthetic activity, vigorous vegetative growth and dark green colour, all of which influenced the better carbohydrate utilization and better assimilates translocation from leaves to storage organs, resulting into increased yield under late sown condition.

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