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RESEARCH PAPER

Effect of nitrogen on wheat genotypes in Jharkhand

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Abstract : A field experiment was conducted at Birsa Agricultural University Farm, Ranchi during *Rabi* season on sandy loam soil (silt 20% and clay 19.6%), acidic in reaction (pH 6.6), low in available nitrogen (182 kg N/ha), medium in phosphorus (24 kg P_2O_5/ha) and potassium (198 K_2O kg/ha), to study the effect of different levels of nitrogen on growth, development, yield, nitrogen utilization and profitability of wheat genotypes. The experiment was laid out in Split Plot Design consisted of 3 nitrogen levels *viz*., 120, 150 and 180 kg/ha in main plot and 6 genotypes (NW 2026, WH 736, HD 2790, HUW 468, PBW 343 and HD 2733) in sub plots and replicated thrice. The results revealed that crop with 150 kg N/ha produced higher grain yield (49.37 q/ha), grain production rate (138.93 kg/ha/day), physical productivity (40.76 kg/ha/day), straw yield (77.12 q/ha) and biomass production rate (104.54 kg/ha/day), productive tillers (387.06/m^2), spike length (8.96 cm), fertile spikelet (17.79), grains/spike (48.01), net return (Rs. 26,918/ha), benefit cost ratio (2.25) and monetary productivity (222 Rs./ha/day) than the crop with 120 kg N/ha. Crop with 150 N/ha also absorbed more nitrogen (104.23 kg/ha) than the crop with 120 kg N/ha (85.12 kg/ha). Further increase in nitrogen beyond 150 kg N/ha was not at all beneficial. Wheat genotype NW 2026 produced maximum grain yield (51.43 q/ha), grain production rate (141.84 kg/ha/day), physical productivity (42.50 kg grain/ha/day) nitrogen utilization efficiency (34.28 kg grain/kg N applied) and biomass production rate (100.31 kg/ha/day) because of higher productive tillers (424.47/m^2) than the remaining genotypes tested. 'NW 2026' wheat also had maximum net return (27,293 Rs./ ha) benefit cost ratio (Rs. 2.28 per rupee investment) and monetary productivity (226 Rs./ha/day) compared to rest of genotypes tested. Further PBW 343 was the second best genotype having grain yield of 48.97 q/ha, net return of 25,645 Rs./ha and benefit cost ratio of Rs. 2.14.

Key Words : Genotypes, Nitrogen, Wheat, Yield

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INTRODUCTION

Wheat [*Triticum aestivum* (L.) Emend. Fiori & Paol], an energy rich winter cereal contributes 35 per cent to the food grain basket of the country from 27.4 million hectare with the production of 75.75 million tones. This crop is grown in traditional wheat belt, environmentally a high productive zone consisting of Punjab, Haryana, Western Uttar Pradesh as well as in traditional rice belt, a low productive zone consisting of Eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal and Assam. These two mega environments account for almost 80 per cent of total wheat area which dictates the wheat production of the country. In fact the national need of wheat would be about 109 million tonne to feed a population of 1.3 billion by 2020 and much of it has to come though vertical increase in productivity. However, its productivity in traditional rice belt is lower (2.2 t/ha) than the traditional what belt (3.5 t/ha) because of relatively warmer climate (5-7^{0}C higher temperature) during crop growing period. The low productivity zone also get hot wind at grain filling stage which reduces grain growth duration, size of grain, thus necessitates the need to identify heat tolerant genotypes which have potential to perform well even in this situation.

Actually Eastern States have shorter wheat growing period due to shorter winter but have potential to produce 4.5 tonne of wheat/ha as evident from the front line demonstrations conducted at several locations. The future production gain is expected to be from this low productive zone due to shrinkage of area in high productive zone because of severe infestation of *Phalaris minor,* fast declines in water

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table or inclusion of high value crops in cropping system.

Almost all the Indian soils are deficient in nitrogen in general and Jharkhand state in particular. Consequently higher yield potential of any crop variety can not proper without its management. In fact major reason of low productivity of wheat in Eastern Indian is low use of nutrients particularly nitrogen as it is essential element responsible for most of the physiological and biochemical processes, occurring in the plant for growth, development and yield. Since genotypes differ in their nitrogen assimilation as well as metabolism rates, some of the physiological and biochemical processes of nitrogen metabolism can be used as selection criteria (Cregan and van Berkun, 1984). The efficiency of nitrogen can be further improved with the choice of right genotypes of wheat well suited to this region. However, limited information related to reaction of wheat genotypes to nitrogen rates is available in plateau region of Jharkhand.

MATERIAL AND METHODS

A field experiment was conducted at Birsa Agricultural University farm, Ranchi during *Rabi* season on sandy loam soil (silt 20% and lay 19.6%), acidic in reaction (pH 6.6), low in available nitrogen (182 kgN/ha), and potassium (198 K_2O kg/ha), to study the effect of different levels of nitrogen on yield, nitrogen utilization and profitability of wheat genotypes. The experiment was laid out in Split Plot Design consisted of 3 nitrogen levels *viz.*, 120, 150 and 180 kg/ha in main plot and 6 genotypes (NW2026, WH 793, HD 2790, HUW 468, PBW 343 and HD 2733) in sub plots and replicated thrice. NW2026, WH 736 and HD2790 recently evolved wheat genotypes were tested against standard checks HUW 468, PBW 343 and HD 2733, recently released and recommended for timely seeding (second-third week of November) under irrigated conditions in Jharkhand state having synchronous tillering, good grain appearance, high thousand grain weight (40g PBW 343, 42.8 g HD 2733 and 43 g HUW 468) with moderate protein (10.5-11.0%), good chapatti making quality resistant to rusts and leaf blight. The crop was sown on November 15, 22cm apart below with a seed rate of 125kg/ha during both year of experimentation. Nitrogen as urea was applied as per treatment in two equal split, half at seeding and remaining half after first irrigation at crown root initiation stage. A uniform dose of 60 kg P_2O_5/ha as single superphosphate and 40 kg K_2O/ha as muriate of potash was applied at the time of sowing. The crop received irrigation at CRI, maximum tillering, boot and milk stages apart from a light irrigation immediately after sowing to ensure satisfactory initial stand establishment. Hoeing was done once at the 30 days after sowing. Grain and straw yield, physical productivity and economics along with yield attributing characters were analyzed to asses the nitrogen levels of wheat genotypes.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of nitrogen levels and genotypes on yield attributes and yield of wheat :

Maximizing the economic yield is the ultimate aim of agronomic investigation. In fact, yield is a function of genotype (genetic make up), soil, climate and management. Wheat crop fertilizes with 150 kg N/ha produced significantly higher grain yield of49.37 q/ha which was 14.26% higher than the crop grown with 120 kg N/ha. However, further increase in nitrogen (180 kg N/ha) significantly decreased grain yield compared to 150 kg N/ha. In fact yield is cumulative expression of yield determinants. In present investigation spike bearing tillers (387.06/m^2), spike length (8.96cm), fertile spikelets(17.79) and grains/spike (48.01), were higher with the crop receiving 150 kg N/ha than crops grown with 120 or 180 kg N/ha. (Table 1 and 2). This led to higher grain production rate (138.93kg/ha/day) and physical productivity (40.76 kg grain/ha/day) with the crop receiving 150 kg N/ha than the crop with 120 and 180 kg N/ha. Straw yield was similar to grain yield. Consequently biomass production rate was higher with the crop receiving 150 kg N/ha (104.54 kg/ha/day) than the crop with 120 kg N/ha (88.05 kg/ha/day) as well as 180 kg N/ha (82.55 kg/ha/day). It is in agreement of the findings of Thakur *et al.* (2000) who also observed beneficial effect of increasing nitrogen on grain yield of wheat upto 150 kg N/ha. Decline in yield due to heavy nitrogen (180 kg/ha) fertilization in base poor acid alfisols might be attributed to reduction in soil pH, resulting in an unfavourable effect on balance between acidic and basic soil constituents available for absorption by the crop plants (Troug, 1967) as well higher concentration of micronutrient cations (iron, copper, manganese and zinc) and deficiency of molybdenum (Brady, 1996).

Wheat genotype NW 2026 being similar to PBW 343 (48.97 q/ha) gave maximum grain yield 51.43 q/ha which was 14.82, 17.29, 22.92 and 33.31 per cent higher than WH 736, HD 2733, HUW 468 and HD 2790, respectively because of maintenance of higher LAI for a longer duration resulting into higher productive tillers 424.47/m^2 which led to higher grain production rate 141.84 kg/ha/day, physical productivity 42.50 kg grain/ha/day and more grain/kg N applied (34.28 kg grain/kg N applied). In spite of low spike bearing tillers (11.70% lower than NW 2026), grain yield of PBW 343 was similar to NW 2026 because of its 18.94% higher test weight (44.34 g). This was due to compensatory effect. This is in agreement with the findings of Sharma *et al.* (2001).

Effect of nitrogen levels and genotypes on nitrogen content uptake of wheat:

In the present investigation, grain and straw nitrogen content of wheat increased significantly with increasing nitrogen (Table 3). Crop fertilized with 180 kg N/ha had maximum nitrogen content in grain (2.053%) as well as in straw (0.363%) which was 0.143% and 0.035% more than that crop fertilized with 150 kg N/ha. Similarly the corresponding increase in nitrogen content of grain and straw of wheat grown with 150 kg N/ha was in the order of 0.092 and 0.023% compared to wheat raised with 120 kg N/ha. This is because of increased availability of nitrogen in root zone with its increasing level. N uptake by grain of wheat crop fertilized with 150 kg N/ha (82.98 kg/ha) being similar to that receiving 180 kg N/ha (76.11 kg/ha) had significant edge (20.03%) over the crop raised with 120 kg N/ha. Further, wheat crop fertilized with 150 kg N/ha had removed significantly more nitrogen through straw (21.25 kg/ha) and total biomass (104.23 kg/ha) than the crop grown with 120 as well as 180 kg N/ha. Although , nitrogen content in grain and straw increased with increasing nitrogen, higher biomass

Table 1 : Yield components of wheat genotypes under different levels of nitrogen

Treatments	Productive (tillers/m^2)	Spike length (cm)	Fertile spikelet's/spike	Grains/ spike	1000-grain weight (g)
Nitrogen (kg/ha)					
120	343.78	8.60	16.92	44.11	41.19
150	387.06	8.96	17.79	48.01	40.58
180	319.92	8.01	16.09	42.85	40.07
S.E.±	6.62	0.09	0.20	0.92	0.49
C.D. (P=0.05)	25.99	0.35	0.79	3.61	NS
Genotypes					
NW 2026	424.47	7.83	16.73	44.94	37.28
WH 736	348.07	8.35	16.17	42.43	40.63
HD 2790	279.97	8.22	16.32	43.54	43.08
HUW 468	33.43	9.18	17.50	46.89	37.63
PBW 343	374.80	8.64	16.23	45.70	44.34
HD 2733	340.51	8.92	18.63	46.43	40.74
S.E.±	8.22	0.097	0.19	1.90	0.52
C.D. (P=0.05)	23.74	0.280	0.55	NS	1.51

NS=Non-significant

Table 2 : Grain yield, grain production rate, physical productivity nitrogen utilization efficiency, straw yield, biomass production rate of wheat genotypes under different levels of nitrogen

Treatments	Grain yield (q/ha)	Grain production rate (kg/ha/day)	Physical productivity (kg grain/ha/day)	Nitrogen utilization efficiency kg grain /kg N applied	Straw yield (q/ha)	Biomass production rate (kg/ha/ day)
Nitrogen (kg/ha)						
120	43.21	142.38	35.96	36.00	62.45	88.05
150	49.37	138.93	40.76	32.91	77.12	104.54
180	42.13	114.95	34.48	23.40	58.59	82.55
S.E.±	1.00	3.59	0.98	0.94	3.40	4.00
C.D. (P=0.05)	3.93	14.09	3.85	3.69	13.35	15.70
Genotypes						
NW 2026	51.43	141.84	42.50	34.28	69.94	100.31
WH 736	44.79	121.12	36.12	29.86	68.99	91.72
HD 2790	38.58	120.61	33.54	25.72	55.53	81.83
HUW 468	41.84	127.86	36.07	27.89	62.95	90.33
PBW 343	48.97	128.92	39.18	32.64	68.51	93.98
HD 2733	43.85	116.17	34.83	29.23	70.45	90.79
S.E.±	1.43	4.68	1.39	1.40	2.67	3.59
C.D. (P=0.05)	4.13	13.52	4.01	4.04	7.71	10.37

production (grain + straw) with 150 kg N/ha resulted in greater total uptake of nitrogen. It is in agreement of the finding of Singh (1986). Nutrient uptake particularly nitrogen by a crop is the net result of a number of process, most of which are metabolically controlled. More than any thing else, N uptake is controlled by concentrations of nitrogen ($NH_4^+NO_3^-$) in the root zone.

Wheat genotypes differed differently in absorbing nitrogen from root zone and its utilization in metabolic activities. In present investigation nitrogen content of grain of different genotypes of wheat differed widely. Wheat genotypes HD 2790 (2.213%) recorded higher content of nitrogen in grain than PBW 343 (2.023%), HD 2733 (1.990%), WH 736 (1.883%), NW 2026 (1.766%) and HUW 468(1.686%). Similarly nitrogen content of straw of wheat genotype WH 736 (0.387%) registered its superiority over NW 2026 (0.360%), HUW 468 (0.356%), HD 2790 (0.316%), HD 2733 (0.316%) and PBW 343 (0.256%).

However, recovery of nitrogen by grain of wheat genotype PBW 343 (87.18 kg/ha) was 8.46, 13.53, 16.04, 17.46 and 40.03 per cent higher than NW 2026, HD 2733, HD2790, WH 736 and HUW 468, respectively. Similarly, N recovery by straw of WH 736 was more (22.43 kg/ha) than rest of the genotypes. Likewise total biomass of wheat

Table 3: Nitrogen content, nitrogen uptake and protein content of wheat genotypes under different levels of nitrogen

Treatments	Nitrogen content (%)		Nitrogen uptake (kg/ha)			Protein content in grain (%)
	Grain	Straw	Grain	straw	Grain + Straw	
Nitrogen (kg/ha)						
120	1.818	0.305	69.13	15.99	85.12	11.36
150	1.910	0.328	82.98	21.25	104.23	11.94
180	2.053	0.363	76.11	17.87	93.98	12.83
S.E.±	0.014	0.003	2.29	0.62	2.45	0.086
C.D. (P=0.05)	0.055	0.012	8.99	2.43	9.62	0.338
Genotypes						
NW 2026	1.766	0.360	80.38	21.15	101.53	11.04
WH 736	1.883	0.387	74.22	22.43	96.65	11.77
HD 2790	2.213	0.316	75.13	14.74	89..87	13.83
HUW 468	1.686	0.356	62.08	18.82	80.90	10.54
PBW 343	2.023	0.256	87.18	14.73	101.91	12.65
HD 2733	1.990	0.316	76.79	18.70	95.49	12.44
S.E.±	0.054	0.005	2.71	0.78	3.10	0.022
C.D. (P=0.05)	0.156	0.014	7.83	0.25	8.95	0.064

Table 4 : Economics of wheat genotypes under different levels of nitrogen

Treatments	Net return (Rs/ha)	Net benefit : cost ratio	Monetary productivity (Rs/ha/day)
Nitrogen (kg/ha)			
120	21798.00	1.88	181.00
150	26918.00	2.25	222.00
180	20014.00	1.63	164.00
S.E.±	694.22	0.06	5.70
C.D. (P=0.05)	2725.41	0.24	22.40
Genotypes			
NW 2026	27293.00	2.28	226.00
WH 736	23189.00	1.94	187.00
HD 2790	17853.00	1.496	155.00
HUW 468	20700.00	1.73	178.00
PBW 343	25645.00	2.14	205.00
HD 2733	22806.00	1.91	181.00
S.E.±	1141.00	0.09	9.30
C.D. (P=0.05)	3295.00	0.26	26.80

Selling rate of wheat grain: Rs 6.00/Kg
Selling rate of wheat bhusa: Rs 1.20/Kg

genotype PBW 343, NW 2026, WH 736 and HD 2733 as well as WH 736, HD 2733 and HD 2790 being similar to each other, absorbed more nitrogen then HUW 468.

Grain protein content of wheat crop increased significantly with increasing nitrogen. Crop fertilized with 180 Kg/ha had significantly higher protein (12.83%) than that obtained with 150kg N/ha (11.94%)which in its own turns showed its significant edge over that grown with 120 Kg N/ha (11.36%). Kataria and Bassi (1997) also reported that increased nitrogen supply resulted in better grain setting and protein synthesis.

Grain protein content of different genotypes differed significantly. HD2790 wheat had maximum grain protein content (13.83%) than PBW343 (12.65%), HD2733 (12.44%), WH736 (11.77%), NW2026 (11.04%) and HUW468 (10.54%) because of difference in nitrogen metabolism rates of genotypes. Similarly, Atale *et al.* (1996)working on different genotypes of wheat obtained maximum grain protein content (14.97%) in HD2189 while minimum (11.30%) in NI 9488, because of variation in nitrogen partitioning efficiency of genotypes.

Effect of nitrogen levels and genotypes on economics of wheat:

Crop production technology must be economically viable for adoption. In present investigation crop fertilized with 150kg N/ha, net profit of Rs. 2.25 on each rupee investment than the crops receiving either 120 or 180 kg N/ha due to high grain and straw yield which led to high monetary productivity of 222 Rs/ha/day (Table 4).According to Mahapatra *et al.* (1984) fertilizer use can be safely recommended when net benefit per rupee investment is 2 or more indicating wheat crop can be fertilized with 150 kg N/ha. This is in agreement with the findings of Thakur *et al.* (2000).

Wheat genotype NW 2026 being similar to PBW 343 (Rs. 25,645/ha net return and 2.14 net profit/rupee investment) had higher net return (Rs. 27,293/ha and 2.28 net profit/rupee investment) than reaming genotypes tasted because of identical grain and straw yielding ability and economic profitability both the genotypes can be recommended for cultivation in Jharkhand.

Based on the findings of present investigation 150kg/ha can be used for growing wheat to obtain high yield and profit. Further wheat genotypes NW2026 and PBW343 can be grown in agro-climatic conditions of Jharkhand for high yield and net return.

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