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Effect of different levels of nitrogen and phosphorus on yield, quality and uptake of nutrients by wheat (*Triticum aestivum. L*.)

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ABSTRACT

A field experiment was conducted at during Rabi season 2018-2019 at R.B.S. Collage Research Farm Bichpuri Agra (U.P.) on sandy loam soil to evaluate the effect of different levels of nitrogen and phosphorus on yield, yield attributes and uptake of nutrient by wheat. (Triticum aestivum L.) The combination of three nitrogen level (40, 80 and 120kg ha^{-1}) and two phosphorus (30 and 60kgha^{-1}) level with control were evaluated in R.B.D. Design with three replications. Results revealed that there was a steady rise in plant height and dry matter accumulation, but number of tiller's increased markedly up to 60 day after sowing and declined gradually till the harvest. Application of nitrogen phosphorus levels showed a positive effect of growth parameters at all the stage of growth. Application of N @120 kgha^{-1} and phosphorus @ 60 kgha^{-1} yield attributes i.e. grain/ear and test weight of wheat increased significantly over control. Application of N-120 kgha^{-1} and P- 60 kg ha^{-1} improved grain (41.9 q ha^{-1}) and straw (71.6 q ha^{-1}) yield significantly over control. Protein content in grain (10.62%) and straw (5.3%) were found maximum with N-120 kg ha^{-1} and P-60 kg ha^{-1} doses.

Keywords: Nitrogen, Phosphorus, yield attributes, yield, wheat crop

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second important cereal crop after rice India wheat crop has been reported to sign of productivity decline. Wheat is Rabi season crops considering the quality wheat has been divide by into two categories soft and hard wheat. *Triticum aestivum* (bread wheat) is known as soft wheat and *Triticum durum* is known as hard wheat in India mainly three species of *Triticum aestivum* (94%), durum (4%) and *dicaccum* is (0.1), respectively Optimum nutrition is required for getting maximum yield and good quality of produce (Pandey *et al.* 2020). Nitrogen is one of the major deficient plant nutrients particularly in light textured soils of semi-arid region of western Uttar Pradesh. An optimum supply of nitrogen is important for vigorous vegetative growth, chlorophyll formation and carbohydrate utilization. But nitrogen use efficiency in cereal is quite low. The crop removal of nitrogen or apparent recovery of applied nitrogen is often used as one of the important criteria to judge the crop response to nitrogen application. Application of nitrogen has shown promising results not only sustaining the production but also increased the quality of produce (Singh and Singh, 2017). The management of use efficiency of fertilizer nitrogen applied seems to be crucial factors in increasing productivity of wheat. Wheat is quite responsive to phosphorus (Singh at al., 2020). Phosphorus is an important nutrient needed for normal growth and development of the plants. It plays an important role in energy transformation and metabolic processes in plants. Phosphorus is essential plant nutrient for crop growth. Alberta soil are generally deficient or low in phosphorus for optimum crop production (< 60 PPM). Successful crop production requires the addition of phosphorus in the form the landscape can negatively impact water quality, phosphorus can move with eroded soil or be dissolved in runoff water and carried to nearby surface water bodies. Too much phosphorus in lakes reservoirs, rivers and streams can speed up aquatic plant and algae growth. This process is called eutrophication which can lead to oxygen depletion release of toxin degraded water quality fish deaths and adours. When Beneficial Management practices are used in the management of phosphorus losses are minimized crops receive maximum benefit.

MATERIALS AND METHODS

A field experiment was conducted at research farm R.B.S. College Bichpuri (Agra). The experiment soil was sandy loam in texture

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alkaline in reaction (pH 8.2), low in organic carbon (3.6g kg^{-1}), available nitrogen (155 kg ha^{-1}), phosphorus (9.0 kg ha^{-1}), Potassium (115 kg ha^{-1}), EC (0.40dSm^{-1}). Treatments were used as N_0- control, N_1-40 kg ,N_2-80kg, N_3-120kg and P_0-control, P_1-30 kg, P_3-80 kg. The treatment was land out in randomized block design with three replication. Wheat (HD 2967) crop was grown by adopting standard agronomic practice. Yield attributes (ear length and test weight) and yield were recorded at harvest all the data were statistically analyzed using the procedure of analysis of variance appropriate of design as advocated by fisher and Yates (1963) and Cochran and cox (1962) the significance to treatment effect was judge with the help of 'F' test of variance ratio critical difference CD at (P = 0.05) error d.f. was used determine the significance of difference between treatment means.

RESULTS AND DISCUSSION

Number of tiller

A study of Table 1 indicates that the average number of tiller in wheat crop increased markedly up to 60 days after sowing and attained the maximum number of tillers declined gradually till harvest. Application of nitrogen significantly increased the tiller over control and tillers (93.6) were recorded 120 kg N/ha^{-1} and minimum tiller's no (82.6) at control. The present findings are in consonance with those Kumar *et al* (2018) and Singh *et.al*. (2018). Phosphorus application found significant improved plant growth in term of number of tillers over control. Phosphorous levels up to 60 kg/ha^{-1} tiller no (89.25) recorded and control (87.0) the increase in number of tiller may be attributed to increased availability of nitrogen and phosphorus to plant.

Plant Height

Wheat crop increased markedly up to 60 days after sowing and attained the maximum plant height declined gradually till harvest. Application of nitrogen significantly increased the plant height over control and plant height (89.6cm) were recorded 120 kg N ha^{-1} and minimum plant height no (82.7 cm) at control. The present findings are in consonance with those Kumar *et al* (2018) and Singh *et.al*. (2018). Phosphorus application found significant improved plant growth in term of plant height over control. Phosphorous levels up to 60 kg ha^{-1} plant height (83.6 cm) recorded and control (81.5 cm). The increase in plant height may be attributed to increased availability of nitrogen and phosphorus to the plant.

Table 1: Effect of nitrogen and phosphorus levels on plant height, no of tiller m^2 and spike length (cm) of wheat

Treatments	Plant height at harvest (cm)	No of tiller /m^2	Spike length (cm)
Nitrogen level (kg ha^{-1})			
0	75.6	82.6	11.6
40	80.2	86.2	12.5
80	85	90	13.3
100	89.6	93.6	14.2
S.Em.±	0.17	0.38	0.11
CD at 5%	0.36	0.79	0.23
Phosphorus level (kg ha^{-1})			
0	81.5	87	12.7
30	82.75	88.25	13
60	83.6	89.25	13.6
S.Em.±	0.13	0.28	0.08
CD (P =0.05)	0.27	0.59	0.17

Spike length

Wheat crop increased markedly up to 60 days after sowing and attained the maximum spike length declined gradually till harvest. Application of nitrogen significantly increased the spike length over control and spike length (14.25 cm) were recorded 120 N kg ha^{-1} and minimum spike length (11.6 cm) at control. The present findings are in consonance with those Kumar *et al* (2018) and Singh *et.al*. (2018). Phosphorus application found significant improved plant

Table 2: Effect of nitrogen and phosphorus levels yield attributes, grain, straw and protein content in wheat

Treatments	No. of grain/ spike	Test weight/ 1000 grain (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Protein content in grain (%)
Nitrogen levels (kg ha^{-1})					
0	56.66	33.80	34.30	53.40	9.75
40	59.30	39.00	37.00	59.40	10.30
80	62.00	40.16	39.50	66.70	10.83
100	64.60	40.00	41.90	71.60	11.43
S.Em.±	0.39	0.92	0.16	0.30	0.14
CD at 5%	0.80	1.01	0.33	0.63	0.30
Phosphorus level(kg ha^{-1})					
0	60.25	39.20	37.70	60.83	10.44
30	60.75	39.60	38.50	62.75	10.61
60	61.00	36.70	38.70	65.80	10.61
S.Em.±	0.29	0.69	0.12	0.22	0.11
CD at 5%	0.60	1.43	0.25	0.47	0.23

growth in term of spike length over control. Phosphorous levels up to 60 kg ha^{-1} spike length (13.06 cm) recorded and control (12.7 cm). The increase in spike length may be attributed to increased availability of nitrogen and phosphorus to plant.

Grain and straw

A study of Table 2 indicates the grain and straw yield of wheat recorded a significant increase over control with application of graded doses of N up to 120 N kg ha^{-1}. The application of 120 N kg ha^{-1} increased the mean grain and straw yield by 41.6 kg^{-1} and 71.6 kg^{-1}, respectively over control. As grain yield is primarily a function of cumulative effect of yield attributing characters, the higher values of these attributes can be assigned as the most probable reason for significant increase in significant improvement in yield owing to N influenced the grain and straw yield of wheat which increased up to 60 kg P ha^{-1}. The increases in grain yield were from 38.7-37.7 kg ha^{-1} and straw is 65.08 to 60.83kg ha^{-1}, respectively as the doses of P increased from 0 to 60 kg P ha^{-1}.

Test weight /1000 grain

The results indicated that the application of nitrogen enhance significantly the 1000-grain weight of wheat increase in each nitrogen dose increase the 1000-grain weight significantly over control. The maximum value regarded at N_3 (41.1gm) as compared to N_2 (40.16gm), N_3 (41.19gm), N_1 (39.0gm) and minimum under N_0 (33.83gm) treatment**.** The present findings are in consonance with those Sushila and Gajendra (2000) and Kumpawat *et al.,* (2009). Phosphorus treatments 1000-grain weight of wheat significantly affected by nitrogen levels. The highest 1000-grain weight in grain was under the treatment P_2 (36.7gm) followed by P_1 (39.6gm) and control in P_0 (39.2gm). The present findings are in consonance with those Singh and Singh (2007) and Kumar *et al.,* (2010).

Number of Grain / Ear

Indicates the number of grain per spike of wheat Increased significantly with increasing levels of nitrogen. It is quite clear that the maximum value was recorded under highest level of nitrogen N_3 (64.6) is compared to N_2 (62.0), N_2 (59.3) and minimum under N_0 (56.6) control, respectively, Similar results were observed by Singh *et.al* (2009), Kulhari *et al.,* (2013) and Kumpawat (2009). Phosphorus application number of grains per spike was significantly increased with the application of P_2O_5. The number of grains per spike was found to be maximum under P_2(61.0) treatment followed by P_1(60.75) and lowest under P_0 (60.25) treatment. The similar result also reported by Singh and Singh (2007) and Kumar *et al.,* (2010). Application of 120 kg N ha^{-1} along with 60 kg P ha^{-1} yields of wheat. On the other hand, minimum yields of wheat were recorded without nitrogen and phosphorus (control) treatment.

Table 3: Effect of nitrogen and phosphorus levels on N, P and K content (%) in wheat

Treatments	Nitrogen content (%)		Phosphorus (%)		Potassium content (%)	
	Grain	Straw	Grain	Straw	Grain	Straw
Nitrogen Levels(kg ha^{-1})						
0	1.56	0.61	0.23	0.12	0.62	1.947
40	1.65	0.66	0.25	0.14	0.64	1.98
80	1.69	0.7	0.26	0.16	0.60	2.01
100	1.83	0.74	0.27	0.17	0.67	1.99
S.Em.±	0.001	0.004	0.002	0.003	0.013	0.008
CD at 5%	0.003	0.009	0.005	0.007	0.028	0.017
Phosphorus Levels(kg ha^{-1})						
P_0	1.67	0.68	0.253	0.14	0.60	1.98
P_1	1.7	0.688	0.258	0.15	0.64	1.99
P_2	1.68	0.67	0.26	0.155	0.65	1.97
S.Em.±	0.001	0.003	0.001	0.002	0.010	0.006
CD at 5%	0.002	0.007	0.004	0.005	0.020	0.012

Protein content in grain

Indicates the higher protein content in grain (11.43 %) was obtained with 120 kg N ha^{-1} which was significantly higher than that of control. Significant increase in grain N content with increasing levels of nitrogen could be attributed to more nitrogen uptake by the crop and more translocation of N to grain. Nitrogen, being the precursor of protein, increased grain protein content accordingly. Similar results were reported by Singh and Singh (2017) and Kumar et.al (2009). Increasing levels of N from 0 to 120 kg N ha^{-1} increased the protein yield significantly over control. The increase in protein yield may be attributed to increased grain yield and improvement in protein content due to N application (Singh and Singh 2013).Protein content in wheat grain was markedly increased due to phosphorus application higher recoded (10.68 %) in P level 60 kg ha^{-1} over control plot. The magnitude of increase in protein content due to phosphorus application varied from in wheat significantly. . Application of 120 kg N ha^{-1} along with 60 kg P ha^{-1} yields of wheat. On the other hand, minimumyields of wheat were recorded without nitrogenand phosphorus (control) treatment.

Nitrogen content

The results (Table 3) indicate that the application of nitrogen enhanced significantly, the nitrogen content in wheat grain and straw. Increase in each nitrogen dose increased the nitrogen content significantly over control. The corresponding in increase N content in grain 1.56 to 1.83 percent and straw 0.61 to 0.74 percent. Our findings are in accordance with those of Singh (2009), Singh *et al.* (1980) and Kumpawat (2009). Nitrogen content in grain and straw of wheat increase significantly with increasing the levels of phosphorus as compare to control. The P_2O_5 60kgha^{-1} has highest content of both grain and straw as compared to P_2O_5 30 kgha^{-1}and lowest under without phosphorus as control. Similar findings were also reported by Narolia *et al.* (2013), Jat *et al.* (2015) and Ray *et al.* (2006).

Phosphorus content

Phosphorus content in wheat grain and straw was affected by various treatments are seen that the increasing levels of nitrogen enhanced the content of phosphorus in wheat grain and straw significantly over control. The mean content in grain increased from 0.23 to 0.27 percent with addition of 120kg N ha^{-1}. The corresponding increase in P content is straw were from 0.12 to 0.17 percent. A significant effect of nitrogen application on P content in grain and straw may be due to close inter relationship between nitrogen and phosphorus metabolism in plant cell. These results are in close agreement with the findings of Singh (2002) and Kumpawat (2009).The phosphorus content in grain and straw of wheat increased significantly with increasing levels of P_2O_5 as compared control. The maximum P content in grain (0.26%) and straw (0.15%) was recorded at highest level of P_2O_5 (60 kg ha^{-1}) and minimum P content it grain (0.15%) and straw (0.14%) under control treatment. Our findings are in accordance with Narolia *et al.* (2013), Jat *et al.* (2015) and Sharma *et al.* (2010).

Table 4: Effect of nitrogen and phosphorus levels on N, P and K uptake (kg ha^{-1}) of wheat

Treatments	Nitrogen uptake (kg ha^{-1})		Phosphorus uptake (kg ha^{-1})		Potassium uptake (kg ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw
Nitrogen Levels(kg ha^{-1})						
0	54.19	33.65	8.17	6.89	21.51	104.56
40	61.45	40.94	9.30	8.58	23.87	117.9
80	68.80	46.21	10.47	10.57	36.05	130.07
100	77.19	53.71	11.71	12.74	28.03	143.12
S.Em.±	0.90	0.41	0.10	0.24	0.15	0.31
CD at 5%	1.88	0.85	0.22	0.49	0.32	0.64
Phosphorus Levels(kg ha^{-1})						
P_0	63.9	41.89	9.67	9.45	24.5	120.78
P_1	66.2	44.63	10.05	9.82	25.16	124.00
P_2	66.04	44.37	10.09	10.12	25.19	127.02
S.Em.±	0.68	0.30	0.08	0.18	0.11	0.23
CD at 5%	1.41	0.63	0.16	0.37	0.24	0.48

Potassium content

Potassium content in wheat grain and straw as affected by applied nitrogen and phosphorus are the result indicate that the application of nitrogen enhance significantly the content of potassium in wheat both grain and straw. Increase in each nitrogen levels, increased the content of potassium significantly over control. The K content increased both grain and straw (0.62 and 1.94%) at control to (0.67 and 1.99%) at 120 kg N ha^{-1} an increase in K content with N application was also reported by Singh (2009) and Singh *et al.*(1980). Phosphorus increased the concentration of potassium in both the grain and straw significantly as compared to control. Maximum value were recorded in grain (0.65%) and straw (1.97%) at P_3 treatment and lowest under grain (0.6%) and straw (1.90%) control P_0 treatment, similar results were reported by Jat *et al.* (2015) and Sharma *et al.* (2010).

Nitrogen uptake

The N uptake by wheat grain and straw (Table-4) increased significantly at all the levels of nitrogen as compared to control. The highest nitrogen uptake was observed under N3 (77.19 kg ha^{-1}) treatment followed by N2, N1 and control. The increase crop with an increase the dose of N was seen in the case of both wheat grain and straw. This increase can invariably be attributed to increased grain and straw yield and higher nutrient demand for plant growth.Indicated that the uptake of nitrogen by wheat grain and straw increased significantly with application of nitrogen. The highest N uptake was recorded under P3 (66.04kg ha^{-1}) treatment and lowest under control.These result are in agreement with those reported by Tiwari *et al.* (1974), Kumar (2009).

Phosphorus uptake

The mean phosphorus removal by the wheat grain and straw increased from 8.17 to 11.71 kg ha^{-1} and from 6.89 to 12.74 kg ha $^{-1}$, respectively, the dose of nitrogen was increased from 0 to 120 kg ha^{-1} . The effect of nitrogen application in increasing phosphorus uptake may be associated with physiological stimulation of plant rather than increased ramification of roots system. These results are in agreement with those reported by Singh (2010), Kumar *et al.*, (2018).

Potassium uptake

Potassium uptake by wheat grain and straw are presented inshowed that the uptake of potassium as comparison to control. The highest potassium uptake was observed under 120 kg N ha^{-1} followed by lowest under 0 kg N ha^{-1}. This concentration as a result of nitrogen application. Similar results were also reported by Singh (2010). Yadav et al (1980) and Vikash Kumar (2017). An evaluation of data showed that the phosphorus application influenced the utilization of potassium by wheat. The potassium uptake increased significantly with increasing the level of phosphorus in comparison to control. The more beneficial effect on potassium uptake by wheatgrain and straw was noted with highest level of phosphorus (60 kg ha^{-1}).

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