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Effect of phosphatic fertilizer on growth, yield and uptake of nutrients in wheat crop (*Triticum durum* L.)

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Abstract
A field experiment was conducted during the Rabi season 2021-2022 at Instructional farm AKS University, Satna. The experiment was aimed to study the effect of different levels of phosphorus on growth, yield and uptake of nutrients. It was conducted in Randomized block design with ten treatments (0, 20, 25, 30, 35, 40, 45, 50, 55 and 60 kg P_2O_5 /ha) replicated thrice, with increasing the level of phosphorus significantly increased growth, yield and nutrient uptake by both seed and straw respectively over the control. Finally result conclude that Overall, the application of phosphorus @60 kg/ha plays an important role in improving wheat yield and quality and maintaining phosphorus in the soil.

Keywords: Phosphorus, wheat, nutrient uptake

Introduction
Wheat (*Triticum aestivum* L.) is the second most important food crop in India after rice (*Oryza sativa* L). It is often prioritized among grain due to its high nutritional value (70% carbohydrate, 12% protein, 1.7% fats, 2.7% minerals and 2% fiber). India now ranks second in the world in terms of wheat producer, following China and surpassing Russia and the USA.
Phosphorus is vital for plant development starting when wheat is just at seedling stage and continuing all the way to maturity. Aside from contributing to the quality and development of seed, Phosphorus aids in consistent heading and strengthens the plant's ability to withstand wind. As a vital nutrient, phosphorus is less abundant in the soil. Unlike nitrogen, which can be restored by air fixation, phosphorous cannot be replenished without external sources. The roots take phosphorus mostly in the form of orthophosphates $H_2PO_4^-$ and HPO_4^{2-}, but they can also absorb organic phosphorus. In general, Phosphorus deficiency slows down the processes of carbohydrate utilization, decreased fodder quality, small leaf size and deformation in vegetables.

Materials and Methods
A field experiment with wheat was conducted at the instructional farm, AKS University, during rabi season of 2021- 22. Geographically it is located at 24.34 ° N latitude and 80.49 ° E longitude at an elevation of 315 meters above mean sea level. The soil was clay loam in texture and alkaline in reaction (pH 7.80). The status of organic carbon, available N, P and K, was 0.76%, 147.3, 10.2 and 335.9 kg ha^{-1}, respectively. Treatments namely T_1 =control, T_2=20, T_3=25, T_4=30 T_5 =35 T_6= 40, T_7=45, T_8=50 T_9=55 T_9=60 kg P_2O_5 /ha. It was conducted in Randomized block design replicated thrice. Pusa Tejas variety of wheat was selected for the study. Which was planted during rabi season in 2021 at 22.5cm× 10cm spacing. Half of the N and full amount of P and K as per treatments were applied at the time of sowing and the remaining N was top dressed at two stages in equal amounts. The source of N, P_2O_5 and K_2O were urea, single superphosphate and muriate of potash, respectively. The wheat (Pusa Tejas) was sown in the second week of November. The crop was harvested at physiological maturity and grain yield was recorded. Observations on growth, yield attributes and uptake of nutrients were recorded at harvest.

Result and Discussion
Growth characters are highlighted in (Table 1) revealed that application of 60 kg P_2O_5/ha found to be superior by producing significant plant height, number of tillers per running meter followed by T_9 (55kg P_2O_5 /ha) minimum were noticed in the T_1 (control plot) where

phosphorus was not applied. Higher plant height produce more green areas and thus more photosynthetic activity which will shared to grain yield. Increased P levels also encourage various plant metabolic processes such as photosynthesis and cellular energy transfer. Application of P enhances root growth and leads to the development of an extensive root system, which improves the plant ability to gather water and nutrients. More tillers bring better crop condition, which ultimately increases yield. These findings tally with the findings of Takahashi and Anwar (2007) [16], Majeed *et al.* (2014) [7] and Sharma *et al. (*2012) [15].

Yield and yield attributes are summarized in (table 2) revealed that number of spikelets per spike, spike length, grain yield and 1000 grain yield found to be significantly increase while increasing the levels of phosphorus. Maximum recorded in T10 (60kg P2O5 /ha) followed by T9 (55kg P2O5 /ha). It was also observed from the table that minimum were noticed in the T1 (control plot) where Phosphorus was not applied. Phosphorus appears to have an additive effect on crop development when given in a proportion equal to that of nitrogen. Maximum grain output at the greatest level of P_2O_5/ha might be due to adequate nutritional availability during seed filling, resulting in the growth of reproductive parts, particularly in seed when phosphorus was abundant. The main reason for the increased grain yield from the application of phosphorus is the proper phosphorus supply during early vegetative growth of the crop, which is believed to be essential for the development of its reproductive stage. These findings tally with the findings of Rasul (2016) [12], Shafi *et al.* (2020) [13] and Yadav *et al.* (2017)

Nutrient uptake differed significantly due to application of different levels of phosphorus presented in (Table 3). The utilization of nitrogen, Phosphorus, potash by wheat seed and Straw was showed significantly higher over the control. Uptake of N, P and K in straw and seed is that phosphorus can have a beneficial effect on nitrogen. Phosphorus fertilization may have resulted in higher nitrogen buildup as a result of increased production. Increase in phosphorus concentration in the soil solution with increased phosphorus treatment. Larger P content, as well as in grain and straw yields with higher P doses, could explain the increase in P uptake. Increased potassium uptake may be due to the synergistic impact between phosphorus and potassium, resulting in improved root growth. These findings tally with the findings of Sharma *et al.* (2011) [14], Afzal and Bano (2008) [2] and Baier J (1997) [3].

Table 1: Effect of different levels of phosphorus in growth parameters of wheat

Treatments	Plant height (cm)			No of effective tillers per running meters	
	30 DAS	60DAS	90DAS	30 DAS	60DAS
Control	29.75	54.96	71.68	3	22.73
20 kg P_2O_5 /ha	30.86	55.22	72.34	3.3	23.33
25 kg P_2O_5 /ha'	31.11	56.74	74.47	3.6	23.66
30 kg P_2O_5 /ha	31.96	58.0	75.96	3.8	24.4
35 kg P_2O_5 /ha	32.77	59.43	76.68	3.93	24.53
40 kg P_2O_5/ha	33.22	60.33	77.7	4.13	24.73
45 kg P_2O_5 /ha	33.6	60.48	79.58	4.4	25
50 kg P_2O_5/ha	33.86	61.74	81.66	4.53	25.2
55 kg P_2O_5 /ha	34.14	62.35	82.74	4.86	25.66
60 kg P_2O_5 /ha	34.59	62.70	83.2	5.0	26.13
S.Em.±	0.57	1.123	1.136	0.25	0.41
C.D. (P= 0.05)	1.705	3.363	4.073	0.71	1.24

Table 2: Effect of different levels of phosphorus in yield and yield attributes of wheat

Treatments	Spike length (cm)	Spkelets per spike	Grain yield (kg/ha)	Test weight(g)
Control	5.65	17.66	2220	49.1
20 kg P_2O_5 /ha	5.99	18.46	2357	49.8
25 kg P_2O_5 /ha	6.59	18.86	2489	50.36
30 kg P_2O_5 /ha'	6.59	19.6	2633	51.13
35 kg P_2O_5 /ha	6.61	20.33	2773	52.46
40 kg P_2O_5 /ha	6.82	20.73	2883	53.38
45 kg P_2O_5/ha	7.13	21.06	2940	54.66
50 kg P_2O_5 /ha	7.33	21.66	3080	55.2
55 kg P_2O_5/ha	8.03	22.06	3308	55.0
60 kg P_2O_5 /ha	8.45	22.13	3523	55.4
S.Em.±	0.336	0.943	1.57	0.934
C.D. (P= 0.05)	1.007	2.824	4.70	2.824

Table 3: Effect of different levels of phosphorus in uptake of nutrients (N, P and K) in seed and straw.

Treatments	Nitrogen (kg/ha)		Phosphorus (kg/ha)		Potassium (kg/ha)	
	Seed	Straw	Seed	Straw	Seed	Straw
Control	61.13	20.46	8.29	4.12	23.47	46.72
20 kg P_2O_5 /ha	62.19	21.44	9.31	4.98	25.06	48.40
25 kg P_2O_5/ha	65.24	25.74	9.92	5.12	27.32	52.17
30 kg P_2O_5/ha'	64.31	26.07	10.37	5.93	26.13	55.38
35 kg P_2O_5 /ha	67.51	29.29	10.87	6.22	27.54	57.13
40 kg P_2O_5 /ha	71.02	26.23	11.65	6.84	28.24	59.22

45 kg P_2O_5 /ha	72.31	31.15	12.36	7.23	30.11	61.23
50 kg P_2O_5 /ha	74.76	32.34	12.84	7.77	31.36	62.69
55 kg P_2O_5 /ha	75.14	33.71	13.18	7.68	33.79	64.27
60 kg P_2O_5/ha	79.20	35.88	13.93	7.94	34.36	65.22
S.Em.±	1.807	1.958	0.893	0.537	1.185	2.735
C.D. (P= 0.05)	5.411	5.862	2.637	1.715	3.548	8.19

Conclusion

On the basis of experimental finding, it may be concluded that the application of 60 kg P_2O_5 / ha is required to achieve optimal and higher yields on wheat. It shows superiority in all parameters such as yield and yield attributes, nutrients available in the soil, nutrient uptake of wheat (N, P and K) in seed and straw.

Overall, the application of phosphorus @60 kg/ha plays an important role in improving wheat yield and quality and maintaining phosphorus in the soil.

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