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Influence of Phosphorus Levels and its Phases of Application on Yield Attributes,Yield and Composition of Wheat in Pigeonpea-Wheat Sequence

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Abstract

The results of field experiment revealed that 90 kg P_2O_5 ha^{-1} applied in rabi season in continuous pigeonpea-wheat sequence produced significantly more grain weight per plant and more grain yield of wheat and resulted more nitrogen and protein content and their uptake values. The extent of increase in grain yield was 25.1 and 10.3 percent over 30 and 60 kg P_2O_5 ha^{-1} application, respectively.

Keywords: Phosphorus levels, phases, yield, composition, wheat

Introduction

Phosphatic fertilizers are undoubtly costly and some times constraints, hence farmers do not apply phosphatic fertilizers as per recommendation in cropping systems. Its importance in legumes can not be ruled out, especially in pigeonpea-wheat system, which is being adopted on large scale by the farmers of Agra region. The optimum dose and its proper application may certainly improve the crop yields especially, in pulse based rotation. This paper will contribute information on the effect of phosphorus doses and its application on the yield and composition of wheat in pigeonpea-wheat sequence.

Aim of the Study

The field experiment was conducted at Raja Balwant Singh Agricultural Research Farm, Bichpuri, Agra with the following main aims :

1. To findout the optimum dose of phosphorus for wheat under pigeonpea-wheat sequence.
2. So work out the phases of phosphorus application for wheat in pigeonpea-wheat sequence over years for increasing P-use efficiency and to economize the cost of production.

Review of Literature

Gupta and Singh (1982) indicated that protein content of crops increased significantly with increasing levels of phosphorus fertilization over control.

Gupta, Neeraj and Singh, R.S. (1982) Effect of nitrogen, phosphorus and sulphar nutrition and amino acids in Bengal gram. Indians Journals of Agronomy 16(2) : 113-117.

Prasad et al (1988) were of the opinion that optimum phosphate fertilization ranged between 30-40 kg P_2O_5 ha^{-1}.

Prasad, R., Singh, S., Sharma, S.N. and Prasad, M. (1988) Effect of levels and sources of phosphate fertilizers on wheat. Fertilizer News 33(9) : 39-41.

Singhania and Goswami (1974) suggested that in rice-wheat system fertilizer phosphorus should be applied to wheat only for taking advantage of the residual effect on rice.

Singhania, R.A. and Goswami, N.N. (1974) use of radiation radio isotopes in studies of plant productivity. Proceeding Symposium, Department of Alomic energy, Govt. of India, P. 437.

Subbarao et al (1995) reported that the grain and straw yields and P-uptake by these components of wheat increased significantly upto 50 mg P kg^{-1} of soil levels.

Subbarao, A., Ganesh, Morthy, A.N., Sammi, Reddy, K. and Takkar, P.N. (1995) Evaluation of some phosphate carriers for their efficiency in vertic ustochrept to sustain high productivity of wheat and rice. Journal of the Indian Society of Soil Science, 43 : 386-391.

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Material and Methods

Field experiment was initiated during the year 1992-93 using pigeonpea-wheat cropping system with three levels of phosphorus as 30 kg (P_1) 60 kg (P_2) and 90 kg (P_3) P_2O_5 ha^{-1} applied as phosphorus application to both Kharif and Rabi crops (F_1), Phosphorus application to Kharif crop only (F_2), Phosphorus application to Rabi crop only (F_3), Phosphorus application in alternate years to Kharif crop only (F_4), Phosphorus application is Rabi crop only (F_5) and Phosphorus application in alternate years to both Kharif and Rabi crops. The wheat variety HD 2285 was sown on 27th Nov. 1995 in 5 $\times$ 4 m plots following split plot design with four replications. A basal dose of 60 kg N ha^{-1} and 40 kg K_2O ha^{-1} was applied and remaining 60 kg N ha^{-1} was given as top dressing after first irrigation. In all four irrigations were given and wheat crop was harvested at maturity. The yield data were recorded the grain and straw samples were processed for chemical analysis. The nitrogen content was estimated in grain and straw samples adopting standard methods of analysis. The protein content was calculated using nitrogen content data.

Results and Discussion

Yield Attributes

The data given in Table 1 reveal that there was no remarkable effect of phosphorus levels on spike length, per ear weight, number of grains per plant and 1000–grains weights of wheat. Where as the trend of increase in grain weight per plant from P_1 to P_2 was non–significant and thereafter from P_2 to P_3 the effect was significant. Hence 90 kg ha^{-1} phosphorus application produced 23.5 and 29.9 percent more grain weight per plant than 30 and 60 kg ha^{-1} phosphorus levels, respectively. The phases of phosphorus application did not show any statistical effect on spike length and per ear weight of wheat. On the other hand, among the phases of phosphorus application, F_4 (P-applied in alternate years to Kharif crop) produced the maximum number of grain per plant, 1000–grain weight and grain weight per plant and appeared significantly superior over F_1, F_5 and F_6 in case of number of grain per plant, F_6 and F_6 in case of grain weight per plant and F_1 and F_6 regarding 1000 – grain weight[4].

Grain and Straw Yield

It is evident from Table 1 that increasing the level of P_2O_5 enhanced significantly the grain and straw yield as compared preceding lower level of P_2O_5. The extent of increase due to 90 kg P_2O_5 ha^{-1} was 25.1 and 10.3 per cent over 30 and 60 kg P_2O_5 ha^{-1} levels, respectively. Among the phases of phosphorus application F_1 in case of grain yield and F_3 in case of straw yield proved significantly superior over F_4, F_5 and F_6 treatments. On an average the extent of increase due to F_1 over F_2, F_3, F_4, F_5 and F_6 was worked out to be 7.2, 2.2, 20.2, 24.9 and 11.0 percent, respectively. Hence 90 kg P_2O_5 ha^{-1} only in Rabi season in continuous pigeonpea-wheat sequence proved useful for wheat production in Agra region [2].

Grain composition

An examination of data given in Table 2 indicates that phosphorus level P_2 enhanced significantly the nitrogen and protein content in grain as compared to P_1 and it did not differ significantly with P_3 level. On the other hand phosphorus level P_3 increased significantly the nitrogen uptake values by grain over P_1 and did not show statistical difference with P_2. The phosphorus level P_3 increased significantly the protein uptake values by grain as compared to P_1 and P_2 levels of phosphorus.

The phases of phosphorus application did not show any significant difference in case of nitrogen and protein content of grain. The F_1, F_2 and F_3 phases of phosphorus application increased significantly the nitrogen and protein uptake values in comparison to F_4 and F_5 treatments in case of grains of wheat.

Straw Composition

It is clear from Table 2 that phosphorus levels and phases of phosphorus application did not affect significantly the nitrogen and protein content of straw. The phosphorus level of P_3 enhanced significantly the nitrogen and protein uptake values over treatments P_1 and P_2. The phosphorus level P_2 also had significant favourable effect on nitrogen and protein uptake values of straw than P_1. The F_2 and F_3 phases of phosphorus application proved significantly better than F_4 and F_5 treatments.

Conclusion

From the above results it may be concluded that phosphorus level 60 kg P_2O_5 ha^{-1} or above and phases of phosphorus application as P applications to Rabi crop only both proved useful regarding nitrogen and protein accumulation in tissues and their uptake by grain and straw both than other treatments. These findings confirm the results of earlier workers[1,3]. Who have been of the opinion that at higher doses of phosphorus the utilization of nitrogen is increased and residual effect of phosphorus is better when applied in wheat crop in cropping sequence management.

References

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Table – 1
Effect of Levels and Phases of Application of Phosphorus on Yield Attributes and Yield of Wheat

Treatments levels of P_2O_5	Spike length (cm)	Per ear weight (g)	Number of grains per plant	Grain weight per plant (g)	1000 – grains weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
P_1	9.13	6.60	121.41	4.65	41.12	37.75	64.33
P_2	11.29	6.31	131.36	4.89	36.29	42.83	71.33
P_3	10.86	7.89	149.25	6.04	35.63	47.23	78.58
SEm ±	0.95	0.40	6.67	0.26	2.33	1.30	1.65
CD at 5%	NS	NS	NS	0.93	NS	3.17	5.72
Phases of phosphorus application							
F_1	11.08	6.65	120.83	5.52	35.54	46.96	74.67
F_2	11.46	6.93	137.05	5.33	37.62	43.79	74.13
F_3	10.63	6.71	138.83	5.52	39.54	45.96	77.38
F_4	10.23	8.21	160.76	6.05	40.08	39.04	66.13
F_5	10.08	6.33	117.66	4.69	38.91	37.58	65.33
F_6	9.07	6.77	130.87	4.35	34.79	42.29	71.88
SEm ±	0.83	0.47	9.31	0.36	0.98	1.55	1.81
CD at 5%	NS	NS	25.82	1.02	2.65	3.13	5.30

Table – 2
Effect of Levels and Phases of Application of Phosphorus on Nitrogen and Protein Contents and their Uptake

Treatments levels of P_2O_5	Grain				Straw			
	Nitrogen (%)	Nitrogen uptake (kg ha^{-1})	Protein (%)	Protein uptake (kg ha^{-1})	Nitrogen (%)	Nitrogen uptake (kg ha^{-1})	Protein (%)	Protein uptake (kg ha^{-1})
P_1	2.19	82.43	12.51	471.41	0.70	282.59	4.41	44.69
P_2	2.33	99.69	13.28	566.32	0.72	322.77	4.54	51.15
P_3	2.23	104.76	12.73	597.35	0.72	356.18	4.52	56.51
SEm ±	0.03	1.60	0.19	8.84	0.01	9.60	0.10	1.50
CD at 5%	0.11	5.54	0.60	30.62	NS	33.24	NS	5.21
Phases of phosphorus application								
F_1	2.26	105.51	12.94	599.67	0.70	328.96	4.40	52.15
F_2	2.24	98.03	12.77	559.36	0.72	338.70	4.54	53.84
F_3	2.24	103.17	12.81	590.43	0.71	346.61	4.48	54.92
F_4	2.25	87.87	12.88	502.65	0.70	287.63	4.43	45.36
F_5	2.22	83.23	12.61	473.37	0.72	297.48	4.55	47.32
F_6	2.28	95.95	13.01	548.69	0.71	323.70	4.52	51.11
SEm ±	0.05	3.31	0.31	18.81	0.30	17.09	0.18	2.25
CD at 5%	NS	9.18	NS	52.16	NS	39.07	NS	6.26