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AGRONOMY

Studies on the Effect of Phosphorus Levels on Yield Attributes and Yield of Groundnut in South Odisha Condition

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ABSTRACT

Proper basal application of phosphorus has a tremendous influence on the kernel yield, pod yield and other yield contributing characteristics. In view of this, an experiment was conducted during summer season (February to June) of 2018 at Bagusala Farm (23°39′ N latitude, 87°42′ E longitude) of M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha to find out the effect of various phosphorus levels on yield attributes and yield of groundnut. Seven levels of basal application of phosphorus rates, namely, 0 (control), 20, 40, 60, 80, 100, and 120 kg P ha^{-1} were tested in randomized complete block design (RCBD) design with four replications. The experiment revealed that the basal application of P_2O_5 at the rate of 100 kg ha^{-1} registered superior performance in expression of yield attributes like number of pods per plant, number of kernels per plant, kernel weight per plant and yield of groundnut. It may be concluded that to obtain higher productivity of groundnut during summer season in sandy loam soils of south Odisha, basal application of P_2O_5 @ 100 kg ha^{-1} is recommended.

Highlights

- Basal application of phosphate (P_2O_5) @ 100 kg ha^{-1} emerged as the best option for obtaining sustainable yield under South Odisha agroecology.

Keywords: Groundnut, phosphorus, basal application, yield

Groundnut (*Arachis hypogaea* L) is an annual legume native to South America, and it is presently grown worldwide mostly in tropical, sub-tropical and warm temperate regions. In India, it is grown in 11 states in an area of 4.6 million ha with a production of 6.73 million tonnes of pods per annum. The average productivity of groundnut in India is about 1465 kg ha^{-1} as against the world's average yield of 1590.1 kg ha^{-1} (GoI, 2017). However, in Odisha the productivity of groundnut is 1098 kg ha^{-1} which is lower than the national average. The groundnut productivity in Odisha is low due to some production constraints like poor and imbalanced nutrition of crop, growing groundnut on marginal lands and improper agronomic management. Among different agronomic practices, nutrient management is one which accelerates growth and productivity of the crop. Therefore, it is essential to have more focus to the nutrition of the groundnut to enhance its productivity. Groundnut is called a self fertilizing crop, nevertheless, it is very exhaustive crop compared to other legumes because a very little portion of the plant residue is left in the soil after harvest (Varade and Urkude 1982). Faulty nutrient management has been identified as one of the important constraints in groundnut production. Among different fertilizers, phosphorus is having some distinct role for the proper functioning of the nodules and root growth in legumes. Generally, a oilseed crop has greater requirement for phosphorus (Pasricha and Aulakh 1986). Besides, phosphorus is essential for the formation of chlorophyll and protoplasm, cell division and development of meristematic tissues, also helps in the seed development and maturity of plant (Black 1965). Thus, it is imperative to application of sufficient phosphorus for maximum yield of groundnut. Earlier researchers noted significant impact of applied P fertilizers on growth characters, yield attributes and yield of groundnut (Barik *et al*. 1994; Sharma and Yadav 1997; Rao and Shaktawat 2001; Shivakumar *et al.* 2014). There is insufficiency in research activities on phosphorus requirement of groundnut and the present study has been carried out to evaluate the requirement of phosphatic fertilizer under south Odisha conditions.

MATERIALS AND METHODS

The field experiment was carried out during the summer of 2018 (Feb- May) at Bagusala Farm, M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha on sandy loam soil, having a pH-6.5 with 226 kg ha^{-1} of available nitrogen, 324 kg ha^{-1} of available phosphorous, 591 kg ha^{-1} of available potassium and medium in organic carbon 0.50 %. The experimental field was a medium land with good irrigation and drainage facilities. The soil was a typical new alluvial, inceptisol having moderate water holding capacity. The experiment was conducted in randomized completely block design. The experiment has 7 levels of phosphorus, namely, P_0 – control (No P_2O_5), P_1 – Basal application of P_2O_5 @ 20 kg ha^{-1}, P_2 – Basal application of P_2O_5 @ 40 kg ha^{-1}, P_3 – Basal application of P_2O_5 @ 60 kg ha^{-1}, P_4 – Basal application of P_2O_5 @ 80 kg ha^{-1}, P_5 – Basal application of P_2O_5 @ 100 kg ha^{-1}, P_6 – Basal application of P_2O_5 @ 120 kg ha^{-1}. The K-6 variety of groundnut seeds were sown on 2nd February 2018 at a spacing of 30 cm × 10 cm. A common dose of 20 kg N, varied P rates as per the treatments and common dose of 40 kg K_2O ha^{-1} in all treatments were applied as basal dose through urea, single super phosphate and muriate of potash fertilizers respectively. Five irrigations were given during entire crop growth period. Rainfall received during the crop growth period was 12.73 cm. Observations on yield attributes and yield were recorded and briefly discussed in the following paragraphs.

RESULTS AND DISCUSSION

Yield Parameters

Levels of phosphorus significantly influenced the yield attributing characters of groundnut. The highest number of pods $plant^{-1}$ (15.55) was recorded with P_5 (basal application of P_2O_5 @ 100 kg ha^{-1}) and it differed significantly with all other treatments. Application of phosphorus had no significant effect on the number of kernels per pod^{-1}. Maximum number of kernels pod^{-1} (1.50) was recorded by P_5 (basal application of P_2O_5 @ 100 kg ha^{-1}), whereas the lowest number of kernels pod^{-1} (1.30) was recorded by P_2 (basal application of P_2O_5 @ 40 kg ha^{-1}). The number of kernels $plant^{-1}$ was affected significantly by the application of different levels of phosphorus. The highest number of kernels $plant^{-1}$(21.30) was recorded with P_5 (basal application of P_2O_5 @ 100 kg ha^{-1}) which was significantly superior to all other treatments except P_6 (basal application of P_2O_5 @ 120 kg ha^{-1}). The highest shelling percentage (73.12%) was recorded under P_1 (basal application of P_2O_5 @ 20 kg ha^{-1}) and the lowest shelling percentage (64.31%) was recorded with P_4 (basal application of P_2O_5 @ 80 kg ha^{-1}). The highest kernel weight $plant^{-1}$ (5.85 g) was recorded was recorded with P_5 (basal application of P_2O_5 @ 100 kg ha^{-1}) and P_0 (No P_2O_5) recorded the lowest kernel weight $plant^{-1}$ (4.45g) and P_0 (No P_2O_5) was found to be statistically at par with P_1 (basal application of P_2O_5 @ 20 kg ha^{-1}). The application of different levels of phosphorus had no significant effect on the 100 kernel weight. Highest values of 100 kernel weight (36.76 g) was recorded by P_5 (basal application of P_2O_5 @ 100 kg ha^{-1}) and the lowest 100 kernel weight (36.38 g) was recorded under P_0 (No P_2O_5). The highest kernel yield (1370 kg ha^{-1}) was recorded with P_5 (basal application of P_2O_5 @ 100 kg ha^{-1}) followed by P_6 (1315 kg ha^{-1}) and it differed significantly with all other treatments. The lowest kernel yield (1017.5 kg ha^{-1}) was recorded with P_0 (No P_2O_5), which was 34.64% less than the best treatment P_5 (basal application of P_2O_5 @ 100 kg ha^{-1}).The basal application of P_2O_5 @ 120 kg ha^{-1} i.e. P_6 achieved maximum values of pod yield (2029.50 kg ha^{-1}). The oil content (%) and oil yield (kg ha^{-1}) of groundnut were influenced significantly by

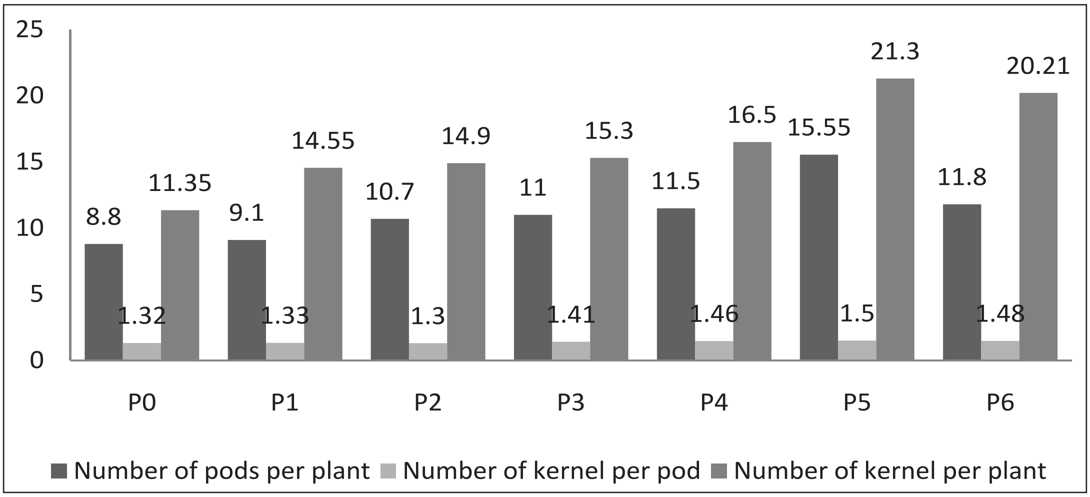

Fig. 1: Effect of phosphorus levels on number of pods per plant, number of kernel pod and number of kernel per plant

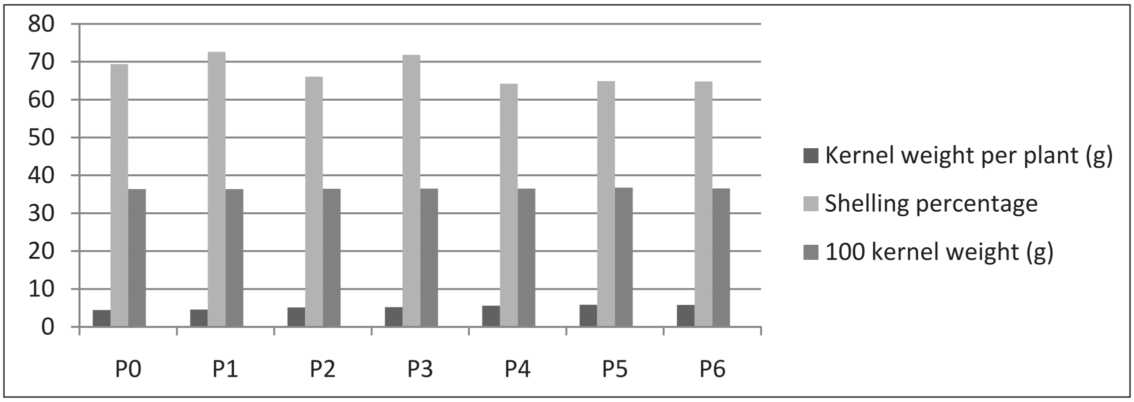

Fig. 2: Effect of phosphorus levels on kernel weight per plant, shelling percentage and 100 kernel weight

Table 1: Effect of phosphorus levels on the yield attributing characters of groundnut

Treatments	Yield attributes					
	Number of pods plant^{-1}	Number of kernel pod^{-1}	Number of kernel plant^{-1}	Kernel weight plant^{-1} (g)	Shelling percentage	100 kernel weight (g)
P_0– Control (No P_2O_5)	8.80	1.32	11.35	4.45	69.92	36.38
P_1 – basal application of P_2O_5 @ 20 kg ha^{-1}	9.10	1.33	14.55	4.55	73.12	36.40
P_2– basal application of P_2O_5 @ 40 kg ha^{-1}	10.70	1.30	14.90	5.10	66.25	36.47
P_3– basal application of P_2O_5 @ 60 kg ha^{-1}	11.00	1.41	15.30	5.20	72.43	36.50
P_4– basal application of P_2O_5 @ 80 kg ha^{-1}	11.50	1.46	16.50	5.60	64.31	36.52
P_5– basal application of P_2O_5 @ 100 kg ha^{1}	15.55	1.50	21.30	5.85	65.14	36.76
P_6– basal application of P_2O_5 @ 120 kgha^{1}	11.80	1.48	20.21	5.80	65.04	36.54
SEm ±	**0.61**	**0.09**	**0.63**	**0.28**	4.07	0.31
CD (P=0.05)	1.82	NS	1.87	0.85	NS	NS
CV (%)	10.95	—	7.75	10.97	—	—

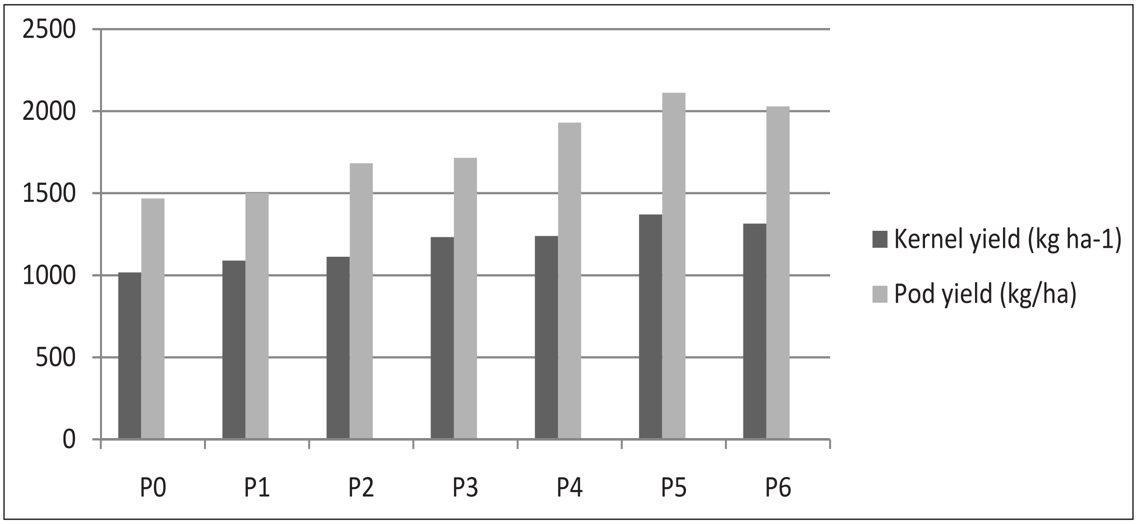

Fig. 3: Effect of phosphorus levels on the kernelyield (kg ha^{-1}), pod yield (kg ha^{-1})

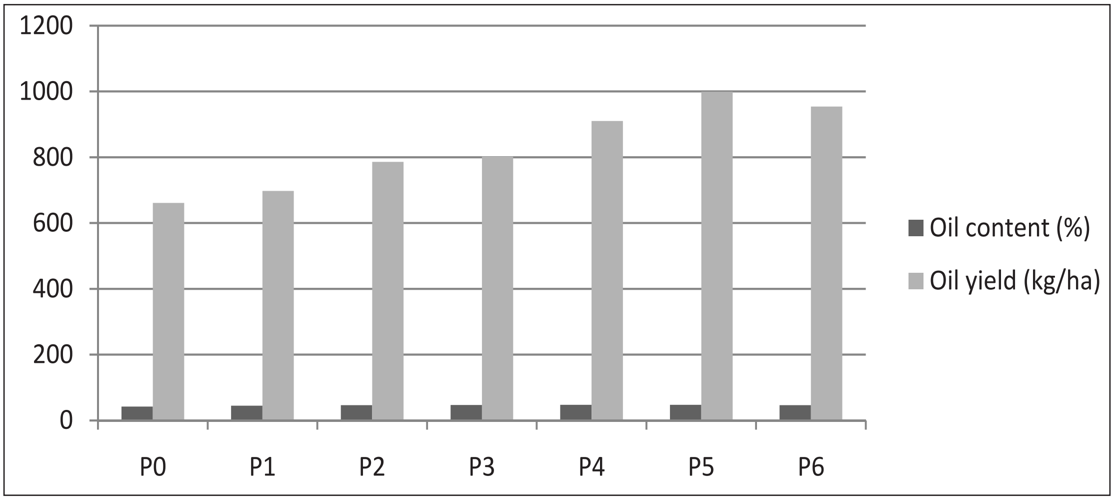

Fig. 4: Effect of phosphorus levels on the oil content (%) and oil yield (kg ha^{-1})of groundnut

Table 2: Effect of phosphorus levels on the kernel yield (kg ha^{-1}), pod yield (kg ha^{-1}), oil content (%) and oil yield (kg ha^{-1}) of groundnut

Treatments	Pod yield (kg ha^1)	Kernel yield(kgha^1)	Oil content (%)	Oil yield (kg ha^{-1})
P_0– Control (No P_2O_5)	1468.50	1017.50	42.55	661.16
P_1 – basal application of P_2O_5 @ 20 kg ha^1	1501.50	1090.00	44.75	697.89
P_2– basal application of P_2O_5 @ 40 kg ha^{-1}	1683.00	1112.50	46.70	786.12
P_3– basal application of P_2O_5 @ 60 kg ha^{-1}	1716.00	1232.50	47.25	802.26
P_4– basal application of P_2O_5 @ 80 kg ha^{-1}	1930.50	1240.00	47.52	910.25
P_5– basal application of P_2O_5 @ 100kgha^{-1}	2112.00	1370.00	47.92	998.99
P_6– basal application of P_2O_5 @ 120 kg	2029.50	1315.00	46.53	954.05
S. Em. (±)	**76.97**	**56.70**	**1.16**	**42.76**
C.D. (*p=0.05*)	**228.70**	**168.48**	**3.44**	**127.05**
C.V. (%)	**8.66**	**9.47**	**5.02**	**10.30**

Table 3: Production economic analyses (hectare^{-1} basis)

Treatments	Cost of Production (A+B)	Gross return (yield×selling price)	Net return (GR-CoP)	Cost:Benefit Ratio (NR/CoP)
P_0– Control (No P_2O_5)	37294	67551	30257	0.81
P_1 – basal application of P_2O_5 @ 20 kg ha^{-1}	37494	69069	31575	0.84
P_2– basal application of P_2O_5 @ 40 kg ha^{-1}	37694	77418	39724	1.05
P_3– basal application of P_2O_5 @ 60 kg ha^{-1}	37894	78936	41042	1.08
P_4– basal application of P_2O_5 @ 80 kg ha^{-1}	38094	88803	50709	1.33
P_5– basal application of P_2O_5 @ 100 kg ha^{-1}	38294	97152	58858	1.53
P_6– basal application of P_2O_5 @ 120 kg	38494	93357	54863	1.42

different levels of phosphorus application. Among the different phosphorus levels, basal application of P_2O_5 @ 100 kg ha^{-1} i.e. P_5 registered the highest oil content of 47.92% and oil yield of 998.99 kg ha^{-1}. The results are in conformity with the findings of Bandopadhyay and Samui (1999), Ranjit *et al*. (2007) and Shiva Kumar *et al.* (2014).

Economics

The maximum cost of production (₹ 38494 ha^{-1}) was recorded by P_6 (Basal application of P_2O_5 @ 120 kg) followed by P_5 (Basal application of P_2O_5 @ 100 kg ha^{-1}). The lowest cost of production (₹ 37294 ha^{-1}) was recorded by P_0 (No P_2O_5). The highest gross return of (₹ 97152 ha^{-1}) was recorded by P_5 (basal application of P_2O_5 @ 100 kg ha^{-1}) and the lowest gross return (₹ 67551ha^{-1}) was recorded by P_0 (No P_2O_5). The maximum net return of (₹ 58858 ha^{-1}) was recorded by P_5 (basal application of P_2O_5 @ 100 kg ha^{-1}) and the lowest gross return (₹ 30257 ha^{-1}) was recorded by P_0 (No P_2O_5). In terms of benefit: cost ratio, the highest value (1.53) was recorded by treatment P_5 (basal application of P_2O_5 @ 100 kg ha^{-1}) and the lowest benefit: cost ratio (0.81) was recorded by P_0 (No P_2O_5).

CONCLUSION

From the present investigation it may be concluded that groudndut may be cultivated with the basal application of P_2O_5 @ 100 kg ha^{-1} during summer season in south Odisha conditions.

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CONCLUSION

Thus, the following conclusion can be drawn from present investigation, Basal application of P_2O_5 beyond100 kg ha^{-1} significantly decreased the yield attributes and yield of groundnut.

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