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Effect of bio and nano phosphorus on yield, yield attributes and oil content of groundnut (*Arachis hypogaea.* l)

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Abstract

Leguminous crops suffer severely in soils poor in phosphorus. The experiment was conducted in college form college of agriculture, Rajendranagar, Hyderabad to explore the effect of Bio and Nano P fertilizer (soil application of bio and nano P @65 kg ha^{-1}and foliar application of bio Phosphorus @2 and 4ml l^{-1} and nano Phosphorus @1 and 2ml l^{-1}respectively) in terms of yield and yield attributes and quality of Groundnut (*Arachis hypogaea* L). DAP was applied as basal dose,while bio and nano phosphorus was applied according to the treatments.Concerning the main effects, bio phosphorus proved superior or equivalent to nano phosphorus gave the greatest values for yield and yield parameters.

Key words: Arachis hypogaea, bio phosphorus and nano phosphorus, yield and yield parameters

Introduction

A low level of soil phosphorus is a great obstruction tothe growth and development of leguminous crops In leguminous crops, phosphorus promotesroot nodulation, nitrogen fixation, nutrient-use efficiency, efficient partitioning of photosynthates between source andsink, and biomass production (Gitari and Mureithi 2003; Ogola *et al*., 2012). However, phosphatic fertilizers are notonly costly but also their supply is lower than their demand. Hence, it is highly desirable to explore the possibilities ofsaving phosphatic fertilizers without sacrificing economicyields. In order to reduce the use of chemical fertilizers, nano and bio phosphatic fertilizers could play a crucial role by increasing the availability of phosphorus and other nutrients to the crops (Selvakumar *et al*., 2012). For enhancement the efficiency of amendments that should increase contact of fertilizer with plant leading to increase in nutrient uptake, minimize of particle size, resulting in increased number of particles per unit of weight and specific surface area of a fertilizer that should increase contact of fertilizer with plant leading to increase in nutrient uptake (Brady, 1983). The particles below 100 nm as nano-particles could make plants use fertilizermore efficiently, more environmentally friendly through hamper of pollution and, dissolve in water more effectively thusincrease their absorption and distribution (Zheng *et al.,* 2005). Therefore, nanotechnology such as using Nano scalefertilizer may offer new techniques to be used for crop management. Phosphorus plays an important role in Agricultural production. Agriculture is the major user of phosphorus resources (P), accounting for 80–90% of the world demand for P (Gitari and Mureithi 2003). However, application of P fertilizers aggravates eutrophication problem in surface waters (Badsra and Chaudhary, 2001). Thus, numerous regulations, best managements practices (Singh and Singh, 1988) and remediation technology (Devi *et al*., 2012) have been proposed to reduce P fertilizer application to prevent the applied P from entering water bodies. However, few work on attempting to solve the eutrophication problem via the modifications of the chemical properties of fertilizers (e.g., reducing the fertilizer mobility in the soil or decreasing bioavailability of nutrients to the algae. The nano-scaling of a fertilizer is considered a mitigation method to get an effective fertilizer as well as reduces the risk of eutrophication.The experiment was conducted with the aim of effect of nano and bio phosphorus on yield and yield parameters of groundnut.

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Resources and methods

Field experiment was conducted during kharif season of 2015 at the college form college of agriculture, Pjtsau Rajendranagar.The soil of the experimental field was sandy loam in texture. The chemical composition of the soil was slightly alkaline in reaction (Ph8.1) with low in nitrogen (256 kg ha^{-1}) and phosphorus (22kg ha^{-1},) medium in potassium (376kg ha^{-1}) The experiment was laid out in randomized block design with nine treatment combinations and replicated three times.The plot sizes were 6.00 m x 4.00 m, respectively. Urea and muriate of potash were the sources of Nitrogen and potash, respectively. Full amount of N and K according to treatments was applied at the time of sowing. The uniform application of Phosphorus @ 40 kg ha^{-1} as basal dose through DAP was applied to groundnut. The treatments comprised of T_1-Control(no fertilizers were applied), T_2- RDF N,P_2O5,K_2O@20:40:50 kg ha^{-1},T_3-RDF NK +Soil application of Nanophos@65kgha^{-1} at sowing, T_4-RDF NK +Soil application of biophos@65 kg ha^{-1} at the time of sowing and T_5- RDF NK + foliar application of P as 1% DAP ,T_6- RDF NK +foliar application of]nanophos@1ml l^{-1} ,T_7- RDF NK +foliar application of nanophos@2ml l^{-1},T_8-RDF NK +foliar application of biophos@2ml l^{-1},T_9-RDF NK+ foliar application of nanophos@4ml l^{-1} foliar treatments were given at flowering and pod formation stages. The nanophos soil and foliar formulation had P content of 90 mg kg^{-1} and biophos soil and foliar formulation contains 5% P_2O_5.The crop was sown on 17th July, 2015 at 30 x 10 cm spacing.The observations on growth parameters were recorded periodically and yield contributing characters and yield at harvest.

Results and Discussion

The results of the present study are given in table number 1 to table number 4.

Yield attributes: At harvest, the plants of each plot were harvested above ground to measure the yield attributes, viz. pod yield and total biomass per plant, 100-seed weight, and number of pods per plant.

Yield and yield attributes

It can be reported that the application of phosphorus increase pod yield and oil content of groundnut. There was a significant difference observed among the treatments and highest pod yield was recorded in the treatment receiving RDF NK +soil application of biophos@ 65 kg ha^{-1}(1607 kg ha^{-1}) was followed by RDF NK+ soil application of nanophos@65kg ha^{-1}(1556 kg ha^{-1}), which was on par with the treatment receiving RDF NK+ foliar application of biophos@4ml l^{-1}(1506kg ha^{-1}). Lowest was recorded in the control (745 kg ha^{-1}). Yield attributing characters like dry matter production, no. of pods per plant, no. of filled pods per plant and hundred kernel weight all those parameters were recorded highest in the treatment receiving soil application of bio phosphorus @ 65kg ha^{-1}. The higher haulm yield was recorded in the treatment receiving RDF NK+ soil application of biophos@65kg ha^{-1}(2820kg ha^{-1})which was followed by RDF NK + soil application of nanophos@65kg ha^{-1}(2618kg ha^{-1}) and RDF NK + foliar spray of biophos@4ml l^{-1}(2545kg ha^{-1}) this two were on par with each other. Lowest was recorded in control (1102 kg ha^{-1}) The increasing in oil content and oil yield was reported in the treatment receiving RDF NK+ soil application of biophos@65kg ha^{-1} (40.46 % and 650.19kg ha^{-1}) this was followed by RDF NK+ soil application of nanophos@65kg ha^{-1}(40.34% and 637.52 kg ha^{-1}).The RDF NK+ foliar spray of biophos @4ml and 2ml l^{-1}(40.27% and 40.11%) also shows higher oil content. Lowest was seen in control (36.11%). Leguminous crops require more phosphorus than other crops to attain optimum growth and productivity (Gitari and Mureithi 2003). Therefore, the application of phosphorus has a dramatic effect on legumes when it is applied to soils low in phosphorus. Phosphorus helps leguminous plants in root-nodulation, efficient use of nutrients, nitrogen fixation, and efficient partitioning of photosynthates from vegetative to reproductive parts (Gitari and Mureithi 2003). As indicated by the main effects ofphosphorus,bio phosphorus gave the highest values for pod yield, and number of pod per plants.The application of biophos and nanophos showed on initial burst and subsequently slow release even up to 60th day as compared to the commercial fertilizers which released phosphorus heavily in the initial stages followed by low and non-uniform quantity until around 30 days. There is a possibility that the bio and nano phosphatic

Table.1.Effect of different sources and methods of application of phosphorus on dry matter production in groundnut at different growth stages

	Treatment	Dry matter production (kg ha^{-1})			
		30DAS	60DAS	90DAS	Harvest
T_1	Control (no fertilizers were applied)	745	1126	1999	2120
T_2	Recommended dose of $N:P_20_5:K_2O$ @20:40:50 Kg ha^{-1}	901	2254	2537	2630
T_3	RDF NK +Soil application of nanophos as impregnated granules@65 Kg ha^{-1} at sowing	984	3125	3370	3500
T_4	RDF NK + Soil application of biophos @65 Kg ha^{-1} at sowing	1100	3546	4128	4353
T_5	RDF NK + foliar application of 1% P as DAP	821	2297	2724	2914
T_6	RDF NK + foliar application of nanophos @1 ml l^{-1}	853	2300	2864	2940
T_7	RDF NK + foliar application of nanophos @2 ml l^{-1}	896	2394	2919	3034
T_8	RDF NK + foliar application of biophos @2 ml l^{-1}	933	2524	3125	3200
T_9	RDF NK + foliar application of biophos @4 ml l^{-1}	962	2950	3130	3333
	SE(m) ±	62	186	271	114
	CD	186	553	807	340

Table.2.Effect of different sources and methods of application of phosphorus on yield attributes in groundnut

S.No	Treatment	No. of pods plant^{-1}	No. of filled pods plant^{-1}	No. of kernels plant^{-1}	Hundred kernel weight
T_1	Control (no fertilizers were applied)	9.6	9.1	15.0	27.9
T_2	Recommended dose of $N:P_20_5:K_2O$ @20:40:50 Kg ha^{-1}	10.6	10.2	18.0	28.3
T_3	RDF NK +Soil application of nanophos as impregnated granules@65 Kg ha^{-1} at sowing	16.2	15.7	29.7	42.1
T_4	RDF NK + Soil application of biophos @65 Kg ha^{-1} at sowing	18.0	17.0	31.3	47.3
T_5	RDF NK + foliar application of 1% P as DAP	12.4	12.2	20.7	32.4
T_6	RDF NK + foliar application of nanophos @1 ml l^{-1}	13.1	12.8	21.0	34.3
T_7	RDF NK + foliar application of nanophos @2 ml l^{-1}	13.9	13.1	24.1	35.5
T_8	RDF NK + foliar application of biophos @2 ml l^{-1}	14.1	13.8	25.0	37.9
T_9	RDF NK + foliar application of biophos @4 ml l^{-1}	14.9	14.0	25.7	39.5
	SE(m) ±	0.8	0.5	1.0	1.4
	CD (P=0.05)	2.4	1.6	3.0	4.1

Table.3.Effect of different sources and methods of application of phosphorus on pod and haulm yield (kg ha^{-1})

S.No.	Treatment	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
T_1	Control (no fertilizers were applied)	7451.6	1102
T_2	Recommended dose of N:P_20_5:K_2O @20:40:50 Kg ha^{-1}	1246	1944
T_3	RDF NK +Soil application of nanophos as impregnated granules@65 Kg ha^{-1} at sowing	1556	2618
T_4	RDF NK + Soil application of biophos @65 Kg ha^{-1} at sowing	1607	2820
T_5	RDF NK + foliar application of 1% P as DAP	1355	2152
T_6	RDF NK + foliar application of nanophos @1 ml l^{-1}	1408	2230
T_7	RDF NK + foliar application of nanophos @2 ml l^{-1}	1455	2351
T_8	RDF NK + foliar application of biophos @2 ml l^{-1}	1459	2419
T_9	RDF NK + foliar application of biophos @4 ml l^{-1}	1506	2545
	SE(m) ±	25	44
	CD (P=0.05)	51	126

Table.4.Effect of different sources and methods of application of phosphorus on oil content and oil yield (kg ha^{-1})

S. No.	Treatment	Oil content (%)	Oil yield (kg ha^{-1})
T_1	Control (no fertilizers were applied)	36.11	238.50
T_2	Recommended dose of N:P_20_5:K_2O @20:40:50 Kg ha^{-1}	38.21	476.09
T_3	RDF NK +Soil application of nanophos as impregnated granules@65 Kg ha^{-1} at sowing	40.34	637.52
T_4	RDF NK + Soil application of biophos @65 Kg ha^{-1} at sowing	40.46	650.19
T_5	RDF NK + foliar application of 1% P as DAP	39.72	508.42
T_6	RDF NK + foliar application of nanophos @1 ml l^{-1}	36.58	538.20
T_7	RDF NK + foliar application of nanophos @2 ml l^{-1}	38.28	556.97
T_8	RDF NK + foliar application of biophos @2 ml l^{-1}	40.11	585.29
T_9	RDF NK + foliar application of biophos @4 ml l^{-1}	40.27	606.46
	SE(m) ±	0.24	0.77
	CD (P=0.05)	0.68	2.33

fertilizers synchronised release of phosphorus with uptake by crop there by preventing losses into soil (De Rose *et al.*, 2010) and also observed that the application of nano and biophos could increase in dry matter production. The bio and nano phosphatic fertilizers caused increased chlorophyll content they have observed a positive correlation between phosphorus and chlorophyll content. In present study also the increase in dry matter production at various stages could be the resultant effect of slow and steady release of phosphorus from the bio and nano engineered particles. The use of nano and bio formulation and promote plant growth the foliar application of nano and bio formulations can be explained on basis that the nano composite particles may get observed through the stomata of the leaf and translocated in the plant. Phosphorus uptake leads to increased net CO_2 fixation with increased rate of photosynthesis and thereby more photosynthates to develop more number of pods per plants (Badsra and Chaudhary, 2001). The selective indicated by Dhoke *et al*., (2012) suggested that nano particles have high reactivity because of large surface area, more density of reactive area and increases reactivity of these area on the particles surface and there features simply their absorption in plants (Zheng *et al.,* 2005). The components of pod yield comprises of number of pods per plant, number of kernels per plant and hundred kernel weight, in all those characteristics application of phosphorus at 40kg ha^{-1}and application of bio and nano formulations increased the number of pods per plant, number of kernels per plant, hundred kernel weight by 8.4%, 16.3% and 19.4% over control. Similarly application of nanophos at 65 kg ha^{-1} resulted in increase in the number of pods per plant, number of kernels per plant, hundred kernel weights by 6.6%, 14.7% and 14.2% over control and this was followed by foliar application of biophos@4 ml l^{-1} and 2 ml l^{-1}. The improvement in these attributes could be ascribed to the overall improvement in vigour and crop growth since, an adequate supply of phosphorus during early stages of growth is considered important in promoting growth and branching by influencing cell division and cell elongation in meristematic cells thereby increasing the sink in terms of flowering and seed setting. The favourable effect of P fertilization on yield attributes like pods per plant, seeds per pod and test weight might be attributed to the fact that phosphorus is known for its role as “Energy currency” and plays a key role in energy transformation in various metabolic processes (Brady, 1983).Beneficial effect of phosphorus in the fruiting of plants and ascribed this beneficial effect to better translocation of desired metabolites uptake and translocation of nano particles as in the yield attributing parts of plants (Devi *et al.*, 2012). The increase in oil content was mainly due to increase in glucoside formation (allyisothiocynate) and also the oil content increased successively with increase in P level, probably because it is a constituent of phospholipids and is essential for its synthesis (Singh and Singh, 1988).The increasing in oil content with phosphorus application could be due to the fact that phosphorus helps in synthesis of fatty acids and their esterification by acceleration biochemical reaction in glyoxalate cycle (Dwivedi and Bapat, 1998). The results of investigation clearly suggest that the pod and haulm yield were significantly influenced by the sources and methods of phosphorus application significant response was seen with soil application of biophos @ 65 kg ha^{-1} and soil application of nanophos @ 65 kg ha^{-1} this was followed by foliar application of biophos @ 4ml l^{-1} and 2 ml l^{-1} and foliar application of nanophos @ 2ml l^{-1} and 1ml l^{-1}. Such response to applied phosphorus is possible since the soil was low in available phosphorus. Application of 65 kg ha^{-1} biophos significantly increased the pod and haulm yield by 8.62% and 17.18%respectively in comparison to control. The increasing in yield might be directly associated with concomitant increase in growth and yield attributes of plant because of improved nutritional environment in rhizosphere as well as in the plant system leading to higher plant metabolism and photosynthetic activity. The fact that excess assimilate stored in the leaves and later translocated into seeds at the time of senescence, ultimately led to higher yield(Ijgude and Kadam, 2008).

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