

Original Research Article

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## Effect of Different Level of N P K and Gypsum on Soil Properties and Yield of Groundnut (*Arachis hypogaea* L.) var. Jyoti

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### ABSTRACT

A field experiment was conducted during kharif season (2016) to study the “Effect of different level of N P K and Gypsum on Soil properties and yield of Groundnut var. Jyoti (*Arachis hypogaea* L.)” at the research farm of department of Soil Science and Agricultural Chemistry Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Experiment laid out in randomized block design with three levels of N P K [0% N P K = No application of N P K, 50% N P K = (10:30:20kg ha<sup>-1</sup>), 100% N P K = (20:60:40kg ha<sup>-1</sup>)] and three levels of Gypsum [0% Gypsum = No application of Gypsum, 50% Gypsum = (250kg ha<sup>-1</sup>), 100% Gypsum = (500kg ha<sup>-1</sup>)]. The result shows that application of different levels combination of N P K fertilizers increased growth and yield of groundnut. It was recorded from the application of chemical fertilizers in treatment T7 [(@ 100% N P & K + 50% Gypsum)] increased pH 7.37, EC 0.714 dS m<sup>-1</sup>, Organic carbon 0.79%. Whereas available Nitrogen, Phosphorus, Potassium, Sulphur and Calcium were found more in T8 [(@ 100% N P K + 100% Gypsum)], followed by T7 [(@ 100% N P K + 50% Gypsum)] EC decreased. The physical parameters of soil such as bulk density g/cc, particle density g/cc and pore spaces % increased. It was also concluded from trail that the application of fertilizers in treatment T8 [(@ 100% N P K + 100% Gypsum)] was found in increasing Plant height, No. of leaves per plant, No. of branch, length of pod (cm), number of grain per pod, seed index (g.plot<sup>-1</sup>) and grain yield and as well as yield.

### Keywords

Soil Physical and Chemical properties, Soil amendment, N P K and Gypsum, Groundnut and yield.

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### Introduction

Groundnut or peanut (*Arachis hypogaea* L.) which is also known as a ‘King’ of oilseed (Sathya *et al.*, 2013) is a rainfed crop and grown in Kharif season Groundnut oil is edible oil and finds extensive use as a cooking medium both as refined oil and vegetable Ghee. Groundnut also has value as a rotation crop. Being a legume with root nodules, it can synthesize atmospheric nitrogen and therefore improve soil fertility. The residual oilcake contains 7-8% N, 1.5 % P<sub>2</sub>O<sub>5</sub> and 1.2% K<sub>2</sub>O and is used as an organic fertilizer and it is

also used for manufacturing artificial fibre. It is an important protein supplement in cattle and poultry rations. The haulms (plant stalks) are fed (green, dried or silage) to livestock. Groundnut shell is used as fuel for manufacturing coarse boards, cork substitutes etc. (Varghese, 2011). The optimization of the mineral nutrition is the key to optimize the production of groundnut, as it has very high nutrient requirement and the recently released high yielding groundnut varieties remove still more nutrients from the soil. On contrary

groundnut farmers, most part of the semi-arid region use very less nutrient fertilizer and sometime only one or two nutrients resulting in severe mineral nutrient deficiencies due to inadequate and imbalance use of nutrients is one of the major factors responsible for low yield in groundnut. India is the world's largest producer of groundnut where nutritional disorders cause yield reduction from 30 to 70% depending upon the soil types. Thus it is high time to look into the mineral nutrition aspects of groundnut for achieving high yield and advocate the suitable package of practices for optimization of yield (Singh, 2004). Significant increase in pod yield of groundnut was observed at a fertilizer level of 30: 60:30 kg N P K ha<sup>-1</sup> and increase in yield was 30% higher than lower level of fertilizer doses (Kumar *et al.*, 2000). In India, about 75% of the groundnut area lies in a low to moderate rainfall zone with a short period of distribution. It has been grown over an area of 5.31 million hectare and producing 6.93 million tones, of groundnut (DOAC, 2012) with productivity of 1305 kg ha<sup>-1</sup> in Indian context. Its cultivation is mostly confined to the states of Gujarat, Andhra Pradesh, Maharashtra, Tamil Nadu and Karnataka. The average area under groundnut cultivation in Junagad district during 2011 was 4.42 lakh hectares with production of 9.57 lakh tones and productivity of 2162 kg ha<sup>-1</sup> (DOAC, 2012).

Gypsum is widely used as a source of Ca for groundnut worldwide. Groundnut response to Gypsum as with any other fertilizer depends on the fertility status of the soil. The dissolution of Gypsum is fairly rapid and therefore readily adds Ca to the podding zone. However the major disadvantage of Gypsum is its vulnerability to leaching especially on light textured soils. Positive responses have been observed on sandy soils with pH less than 5.0 (0.01 M CaCl<sub>2</sub>). Survey data from the small holder farming sector has shown that the majority of the farmers do not apply

Gypsum or any other basal fertilizer to groundnut (Chikowo, 1998). The use of lime instead of Gypsum can provide not only Ca for the ground crop but also improves the availability of other plant nutrients. Proper incorporation of lime into the soil ensures the availability of Ca in the podding zone (Cox *et al.*, 1982).

## **Materials and Methods**

### **Soil sampling**

The soil of experimental area falls in order of Inceptisol and in experimental plots is alluvial soil in nature. The soil samples randomly collect from five different sites in the experiment plot prior to tillage operation from a depth of 0-15 cm. The size of the soil sample reduce by conning and quartering the composites soil sample is air dry and pass through a 2 mm sieve by way of preparing the sample for physical and chemical analysis. The experimental details are given below under different heading.

### **Design and treatment**

The experiment was carried out in 3×3 factorial randomized block design with three levels of N P K, three levels of Gypsum. The treatments were replicated three times and were allocated at random in each replication.

### **Experimental sites**

The experiment was conducted on the research farm of department of Soil Science and agricultural chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad which situated six km away from Allahabad city on the right bank of Yamuna river, the experimental site is located in the sub – tropical region with 25° N latitude 81.500° E longitude and 95 MS Laltitude.

## **Fertilizer application**

The fertilizers were applied in each plot according to treatment combinations. The nitrogen requirement meets with urea 46%. The nitrogen was applied with the three different levels i.e.levels of N P K [0% N P K = No application of N P and K, 50% N P K = (10:30:20 kg ha<sup>-1</sup>), 100% N P K = (20:60:40kg ha<sup>-1</sup>)] and three levels of Gypsum [0% Gypsum = No application of Gypsum, 50% Gypsum = (250kg ha<sup>-1</sup>), 100% Gypsum = (500kg ha<sup>-1</sup>)] was given in equal quantity to each plot which was calculated on the basis of general recommendation for maize as 0 kg, 80 kg, 100kg ha<sup>-1</sup> was supplied. On the basis of treatment combination the fertilizer used are described in table 1.

## **Results and Discussion**

### **Result of mechanical and chemical analysis of post-harvest composite soil samples**

Perusal of table reveals the maximum bulk density 1.18 was recorded with (N1G2) treatment combination followed by 1.13 with (N0G2) treatment whereas the minimum 1.02 bulk density was recorded with (N0G1) treatment. The statistical analysis of bulk density data indicates that there was significant difference in bulk density interaction between N P K and Gypsum. Similarly, the maximum Particle density 2.73 was recorded with (N1G2) treatment combination followed by 2.62 with (N0G2) treatment whereas the minimum 2.25 Particle density was recorded with control (N0G0) treatment. The statistical analysis of Particle density data indicates that there was significant difference in Particle density interaction between N P K and Gypsum. In the case of pore space the maximum pore space 50.98 was recorded with (N1G2) treatment combination followed by 50.00 with (N0G2) treatment combination whereas

the minimum 47.05 pore space was recorded with control (N0G0) treatment. The statistical analysis of pore space data indicates that there was significant difference in pore space interaction between N P K and Gypsum. The maximum pH 7.37 was recorded with (N1G2) treatment combination followed by 7.33 with (N2G0) treatment whereas the minimum 7.07 pH was recorded with control (N0G0) treatment. The statistical analysis of pH data indicates that there was non-significant difference in pH interaction between N P &K and gypsum. The trend of EC the maximum EC dS m<sup>-1</sup> 7.14 was recorded with (N2G1) treatment combination followed by 7.33 with (N2G0) treatment whereas the minimum 6.94 EC was recorded with control (N0G0) non difference in EC interaction between N P K and gypsum. The result of the data depicted that the maximum organic carbon 0.82 was recorded with (N2G1) treatment combination followed by 0.74 with (N2G0) treatment whereas the minimum 0.61 organic carbon was recorded with control (N0G0) treatment. The statistical analysis of organic carbon data indicates that there was non-significant difference in organic carbon interaction between N P K and Gypsum. In case of available nitrogen the maximum available nitrogen 286.87 was recorded with (N2G2) treatment combination followed by 25.20 with (N2G0) treatment combination whereas the minimum 236.57 available nitrogen was recorded with control (N0G0) treatment. The statistical analysis of available nitrogen data indicates that there was significant difference in available nitrogen interaction between N P K and Gypsum. The maximum available phosphorus 27.00 was recorded with (N2G2) treatment combination followed by 25.20 with (N2G0) treatment combination whereas the minimum 19.51 available phosphorus was recorded with control (N0G0) treatment. The statistical analysis of available phosphorus data indicates that there was significant difference in available phosphorus interaction

between N P &K and Gypsum. The maximum potassium 220.80 was recorded with (N2G2) treatment combination followed by 213.31with (N2G1) treatment combination

whereas the minimum 127.24 potassium was recorded with control (N0G0) treatment (Table 2-5; Figs 1-3).

**Table.1** Fertilizer and soil amendment treatment combination

S. NO.	Symbol	Treatment Combination
01	(T <sub>0</sub> =N <sub>0</sub> +G <sub>0</sub> )	(@ 0% N: P: K + 0%.GYPSUM)
02	(T <sub>1</sub> =N <sub>0</sub> +G <sub>1</sub> )	(@ 0%N: P: K + 50%.GYPSUM)
03	(T <sub>2</sub> =N <sub>0</sub> +G <sub>2</sub> )	(@ 0% N: P: K + 100%GYPSUM)
04	(T <sub>3</sub> =N <sub>1</sub> +G <sub>0</sub> )	(@50%N: P: K+0%GYPSUM)
05	(T <sub>4</sub> =N <sub>1</sub> +G <sub>1</sub> )	(@50%N: P: K+ 50%GYPSUM)
06	(T <sub>5</sub> =N <sub>1</sub> +G <sub>2</sub> )	(@50%N: P: K+100%GYPSUM)
07	(T <sub>6</sub> =N <sub>2</sub> +G <sub>0</sub> )	(@100%N: P: K+0%GYPSUM)
08	(T <sub>7</sub> =N <sub>2</sub> +G <sub>1</sub> )	(@100%N: P: K+50%GYPSUM)
09	(T <sub>8</sub> =N <sub>2</sub> +G <sub>2</sub> )	(@100%N: P: K+100%GYPSUM)

**Table.2** Soil physical parameters before sowing of groundnut

S. No.	Particular	Results	Methods
1.	Bulk density (Mg m <sup>-3</sup> )	1.07	(Black 1965)
2.	Particle density (Mg m <sup>-3</sup> )	2.24	(Black 1965)
3.	Soil texture (%) Sand- 55%, Silt- 30 %,Clay- 15 %, Sandy Loam		(Bouyoucos 1927)
4.	Soil colour 2.5 Y, 6/4 Light		Munshell Colour Chart
5.	Pore space (%)	47.05	(Black 1965)
6.	Water holding capacity (%)	76.67	(Black 1965)

**Table.3** Soil Chemical parameters before sowing of groundnut

S. No.	Particular	Methods	Results
1.	Soil pH (1:2)	(Jackson,1973)	7.32
2.	Soil EC (dS m <sup>-1</sup> )	(Wilcox, 1950)	0.610
3.	Organic Carbon (%)	Walkley and Black's method (1947)	0.61
4.	Available Nitrogen (Kg ha <sup>-1</sup> )	(Subbaih and Asija, 1956)	236.58
5.	Available Phosphorus (Kg ha <sup>-1</sup> )	(Olsen <i>et al.</i> , 1950)	19.51
6.	Available Potassium (Kg ha <sup>-1</sup> )	(Toth and Prince, 1949)	156.60
7.	Available Sulphur (kg ha <sup>-1</sup> )	Chesnin and Yien (1950)	19.89
7.	Available calcium (meq./100gm of soil)	EDTA method	1.41

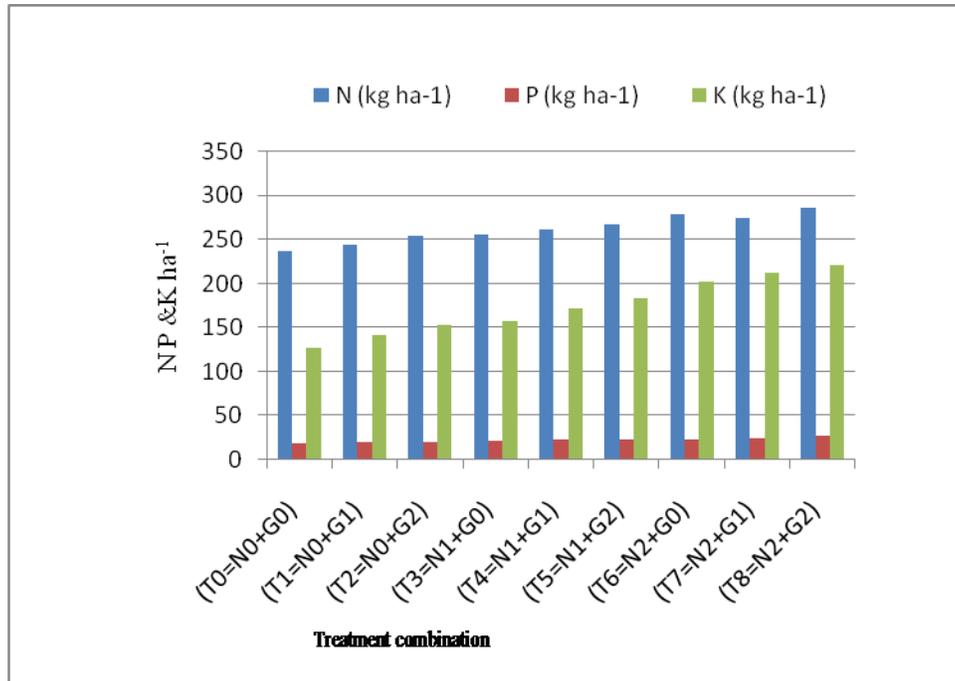
**Table.4** Interaction effect of different levels of N P K and Gypsum on Physico-chemical properties of Soil

<b>Treatments</b>	<b>Bulk density (g cc<sup>-1</sup>)</b>	<b>Particle density (g cc<sup>-1</sup>)</b>	<b>Pore space (%)</b>	<b>pH 1:2 (W/V)</b>	<b>EC (dS m<sup>-1</sup>)</b>	<b>Organic carbon (%)</b>
T <sub>0</sub> = (N <sub>0</sub> +G <sub>0</sub> )	1.07	2.24	47.05	7.13	0.634	0.61
T <sub>1</sub> =(N <sub>0</sub> +G <sub>1</sub> )	1.02	2.25	48.90	7.13	0.629	0.61
T <sub>2</sub> = (N <sub>0</sub> +G <sub>2</sub> )	1.13	2.62	50.00	7.23	0.619	0.64
T <sub>3</sub> = (N <sub>1</sub> +G <sub>0</sub> )	1.09	2.51	49.02	7.07	0.614	0.68
T <sub>4</sub> = (N <sub>1</sub> +G <sub>1</sub> )	1.05	2.52	50.00	7.17	0.694	0.69
T <sub>5</sub> = (N <sub>1</sub> +G <sub>2</sub> )	1.18	2.73	50.98	7.37	0.612	0.82
T <sub>6</sub> = (N <sub>2</sub> +G <sub>0</sub> )	1.07	2.41	48.03	7.33	0.610	0.74
T <sub>7</sub> = (N <sub>2</sub> +G <sub>1</sub> )	1.04	2.47	49.98	7.3	0.714	0.72
T <sub>8</sub> = (N <sub>2</sub> +G <sub>2</sub> )	1.03	2.34	49.17	7.27	0.614	0.79
F-test	S	S	S	NS	NS	NS
S. Em. (±)	0.020	0.019	0.557	0.213	0.054	0.027
C.D. at 5%	0.042	0.041	1.180	0.452	0.115	0.057

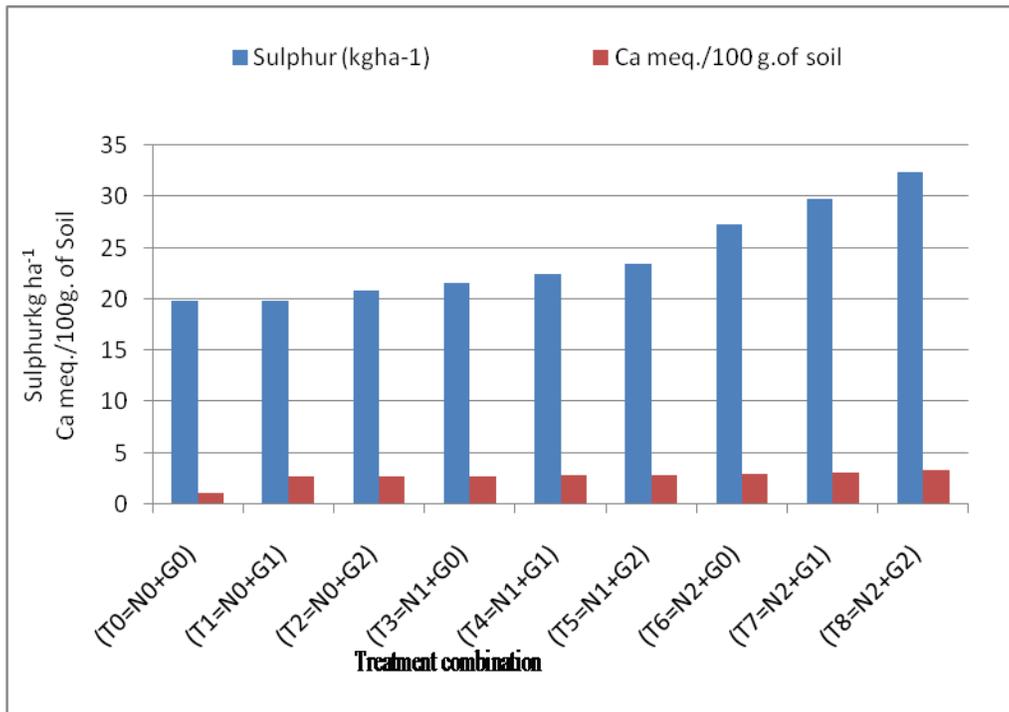
**Table.5** Interaction effect of different levels of N P K and Gypsum on Physico-chemical properties of Soil

<b>Treatments</b>	<b>Nitrogen (kg ha<sup>-1</sup>)</b>	<b>Phosphorus (kg ha<sup>-1</sup>)</b>	<b>Potassium (kgha<sup>-1</sup>)</b>	<b>Sulphur (kgha<sup>-1</sup>)</b>	<b>Calcium</b>
(T <sub>0</sub> =N <sub>0</sub> +G <sub>0</sub> )	236.57	19.51	127.24	19.89	1.06
(T <sub>1</sub> =N <sub>0</sub> +G <sub>1</sub> )	244.95	19.81	142.01	19.89	2.67
(T <sub>2</sub> =N <sub>0</sub> +G <sub>2</sub> )	254.38	20.41	153.43	20.88	2.73
(T <sub>3</sub> =N <sub>1</sub> +G <sub>0</sub> )	255.43	21.01	157.18	21.55	2.75
(T <sub>4</sub> =N <sub>1</sub> +G <sub>1</sub> )	261.72	22.58	172.14	22.46	2.83
(T <sub>5</sub> =N <sub>1</sub> +G <sub>2</sub> )	268.01	23.4	183.44	23.49	2.85
(T <sub>6</sub> =N <sub>2</sub> +G <sub>0</sub> )	278.72	23.7	202.63	27.28	2.92
(T <sub>7</sub> =N <sub>2</sub> +G <sub>1</sub> )	275.34	25.2	213.31	29.78	3.13
(T <sub>8</sub> =N <sub>2</sub> +G <sub>2</sub> )	286.87	27	220.8	32.44	3.31
F-test	S	S	NS	S	S
S. Em. (±)	0.923	0.054	5.598	0.722	0.047
C.D. at 5%	1.957	0.115	11.868	1.530	0.099

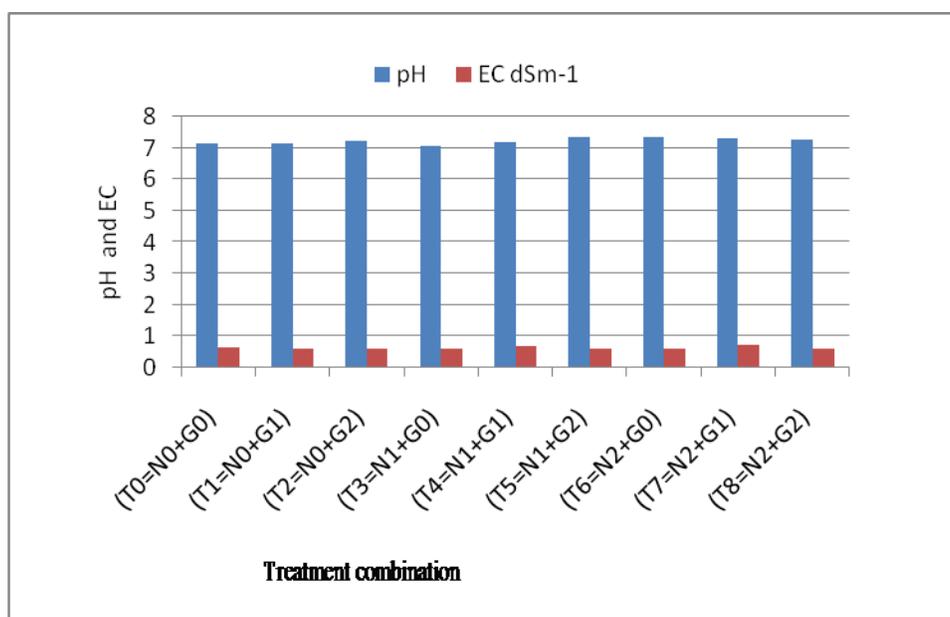
**Fig.1** Effect of different levels of N P K and gypsum on their interaction on N P K and of groundnut



**Fig.2** Effect of different levels of N P K and gypsum on their interaction on sulphur and calcium of groundnut



**Fig.3** Effect of different levels of N P K and gypsum on their interaction on pH and EC of groundnut



The statistical analysis of potassium data indicates that there was significant difference in potassium interaction between N P K and Gypsum. In case of sulphur the maximum sulphur 32.44 was recorded with (N2G2) treatment combination followed by 29.78 with (N2G1) treatment combination whereas the minimum 19.89 sulphur was recorded with control (N0G0) treatment. The statistical analysis of sulphur data indicates that there was significant difference in sulphur interaction between N P K and Gypsum. The maximum calcium 3.31 was recorded with (N2G2) treatment combination followed by 3.13 with (N2G2) treatment combination whereas the minimum 1.06 calcium was recorded with control (N0G0) treatment. The statistical analysis of calcium data indicates that there was a significant difference in calcium interaction between N P K and Gypsum.

In conclusion, it showed the best result on growth and yield of groundnut (*Arachis hypogaea* L.) in comparison to other treatment

combination. It was recorded from the application of chemical fertilizers in treatment T8 [(@ 100% N P K + 100% Gypsum)] was found to be the best treatment gave highest benefit of 52125 with highest cost benefit ratio 1:2.66 for Groundnut, it could be recommended for profitable production of Groundnut (*Arachis hypogaea* L.) var. Jyoti and treatment is good for soil physical and chemical properties. Effect of different levels of N P K and Gypsum is better for soil health and Groundnut production.

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