The Pharma Innovation Journal 2022; 11(3): 460-462

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(3): 460-462

www.thepharmajournal.com
Received: 03-01-2022
Accepted: 10-02-2022

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Effect of nitrogen and sulphur on yield and economics of summer groundnut (*Arachis hypogaea* L.)

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Abstract
A field experimental trial was conducted during *Zaid* season of 2021, at CRF (Crop Research Farm), Department of Agronomy, SHUATS, Prayagraj (U.P.) with the objective to evaluate the effect of nitrogen and sulphur on growth and yield of summer groundnut (*Arachis hypogaea* L.) under Randomized block design comprising of 9 treatments, with 3 different levels of nitrogen along with 3 different levels of sulphur that are replicated thrice. The treatment T_9 with 50 kg/ha nitrogen and 40 kg/ha sulphur has recorded maximum pod yield (2741.00 kg/ha), haulm yield (4371.00 kg/ha), gross returns (180980.75 INR/ha), net returns (134307.87 INR/ha) and B:C ratio (2.87).

Keywords: Nitrogen, sulphur, groundnut, gypsum, yield and economics

Introduction
Groundnut (*Arachis hypogaea* L.) is known to be a unique and important legume as well as oilseed crop and may be as grain legume and known as the "King of Oilseeds". It is otherwise called as peanut, monkey nut, earthnut, manila nut, goober and poor man's nut as it is less expensive wellspring of protein when practically identical to different nuts like cashew nut. It accounts biggest wellspring of consumable oil in world and positions thirteenth among the food crops as well as fourth most significant oilseed crops of the world. The groundnut origin began in South America from where it stretched to Asia, Africa, Nigeria, USA, Sudan and different regions of the planet. Groundnut was brought into India in nineteenth century on east bank of the South Aricot area in Tamilnadu. India positions first in groundnut region with 4.94 million hectares representing 17.32% of the world region and second in production with 6.70 million tonnes representing 14.55% of the world's production. In India, among oilseed crops, groundnut crop stands in first position in terms of area and 2nd case of production after soybean. It is a multipurpose crop contains 45% to 51% top notch hydrogenated consumable oil and 26% dietary proteins, 24.2% solvent starches and minerals. The kernels also rich in vitamin E, K and all B vitamins except B12. It is the richest plant source of thiamine and niacin, which is lowest in cereals. Haulm is utilized as animal feed. Groundnut oil contains blend of unsaturated fats *viz.*, oleic (50-65%) and linoleic acid (18-30%). Adjusted substenance is considered as one of the essential requirements to accomplish the expected yield (Yadav *et al.* 2017) [14]. Among all other management practices, plant nutrition is considered to be the important one. It is a thorough crop and assimilates tremendous amount of supplement from soil during various phrases of growth. Among the essential nutrients, nitrogen and sulphur are the most important nutrients. The nitrogen necessity of groundnut is a lot higher than cereals in a view of its high protein content. Nitrogen is fundamental for enthusiastic vegetative and reproductive development of plant, photosynthesis, nutrient absorption and generation of assimilates for pod filling. It is fundamental constituent of many compounds of plant, such as chlorophyll, proteins, nucleotides, alkaloids, enzymes, chemicals and vitamins (Sagvekar *et al.* 2017) [10]. It is the key element that stimulates root and shoot growth. Though it fixes atmospheric nitrogen, to meet the requirement of plant the nitrogen supply to groundnut crop is very crucial. The impact of nitrogen fertilizer addition on soil organic matter builds up and soil substantial properties is crucial to agrarian manageability and to procuring of crop yield. Besides, N fertilization influences dry matter generation as well as N accumulation and apportioning into different portions of yield plants for the development, advancement and other activities (Khaliq and Cheema, 2005) [5]. Besides NPK, Sulphur is one of the fundamental supplement which assumes a significant part in carbohydrate metabolism and genesis of chlorophyll, glycosides, oils and numerous different constituents that are

engaged in N-fixing process and photosynthesis of plants. Its nourishment to crop is important both according to quality and amount perspective. Sulphur is likewise progressively perceived as the fourth important plant supplement close to NPK (Tandon *et al.* 2002) [11]. Oil crops expect about the similar amount of S or more than, phosphorous for high return and quality of crop (Jamal *et al.* 2010) [3]. Sulphur is most popular for its job of oilseed crops in the blend of cysteine, methionine, chlorophyll and oil constituent. It is additionally liable for the union of specific oil development of seasoned compounds. The use of S nutrient on groundnut has been found tracked down compelled through expanding the number of pegs and pods/plant, portion to shell proportion and so forth (Bharadwaj and Pathak, 1987) [1]. The positive impact of sulphur nutrient application to groundnut has been accounted by (Ramdevputra *et al*. 2010) [9]. In the view of above consideration, the present investigation entitled "Effect of nitrogen and sulphur on yield and economics of summer groundnut (*Arachis hypogaea* L.)" was carried out.

Materials and Methods

The experimental trial was conducted during the *Zaid* season of 2021, at the CRF (Crop Research Farm), Department of Agronomy, SHUATS, Prayagraj (U.P.) under Randomized Block Design consisting of 9 treatments which are replicated thrice. Treatment combination consisted of two variables, one with 3 different levels of nitrogen *i.e.*, 30, 40 and 50 kg/ha and other with 3 different levels of sulphur *i.e.*, 0, 20 and 40 kg/ha. The treatment combinations are depicted in Table 1. The requirement of Nitrogen, Phosphorous, Potassium and Sulphur were supplied through Urea, Di ammonium phosphate, Muriate of potash and Gypsum sources. After the land preparation and making of plots, soil samples were taken and soil analysis was carried out. After the chemical analysis, the relatively available status of major nutrients are Nitrogen of 171.48 kg/ha, Phosphorous of 12.3 kg/ha and potassium of 235.7 kg/ha. The pH of 7.2, organic carbon of 0.22% and EC of 0.315 d/Sm. Certain plant protection measures were followed to control pests and diseases with regards to crop. Five plants were selected and tagged randomly in each plot for recording plant height at 20,40,60,80 days after sowing and at harvest stage of crop. To record plant dry weight and nodules three random plants were selected from border rows of each plot. On attaining of harvesting stage, the crop was harvested for $1m^2$ area of plot and after pods were weighed and pod yield was computed and expressed in kg/ha. Later post-harvest practices were carried out and the required readings were taken. Later on statistical analysis were carried out as per method of analysis of variance at 5% level of significance for F-test. The monetary parameters like cost of cultivation, gross returns, net returns and benefit: cost ratios were worked out as per the standard method.

Table 1: Details of treatment combination

S. No.	Treatment No.	Treatment combination
1	T_1	30 kg/ha Nitrogen + 0 kg/ha Sulphur
2	T_2	30 kg/ha Nitrogen + 20 kg/ha Sulphur
3	T_3	30 kg/ha Nitrogen + 40 kg/ha Sulphur
4	T_4	40 kg/ha Nitrogen + 0 kg/ha Sulphur
5	T_5	40 kg/ha Nitrogen + 20 kg/ha Sulphur
6	T_6	40 kg/ha Nitrogen + 40 kg/ha Sulphur
7	T_7	50 kg/ha Nitrogen + 0 kg/ha Sulphur
8	T_8	50 kg/ha Nitrogen + 20 kg/ha Sulphur
9	T_9	50 kg/ha Nitrogen + 40 kg/ha Sulphur

Result and Discussion

Table 2: Effect of nitrogen and sulphur on yield of summer groundnut

S. No.	T. No.	Pod yield (kg/ha)	Haulm yield (kg/ha)	Harvest Index (%)
1	T_1	2005.00	3739.00	31.84
2	T_2	2240.00	3915.00	34.52
3	T_3	2502.00	4126.00	36.19
4	T_4	2126.00	3832.00	31.30
5	T_5	2317.00	4024.00	35.50
6	T_6	2630.00	4288.00	36.74
7	T_7	2163.00	3930.00	31.76
8	T_8	2451.00	4142.00	34.31
9	T_9	2741.00	4371.00	34.84
	CD(P=0.05)	170.39	234.09	-
	S.Em±	56.83	78.08	1.51

Yield

The treatment T_9 has recorded maximum pod yield of 2741.00 kg/ha while the lowest of 2005.00 kg/ha was recorded with the treatment T_1. The treatment T6 was found statistically at par with the treatment T_9. Furthermore, Sulphur is engaged in the development of S consisted amino acids, vitamins and plays direct part in root development and formative activities (Jat and Ahlawat, 2009) [4]. Watering and Patrick [13], 1975 likewise detailed that increment in yields was credited to redirection of more worthy extent of assimilates to the emerging pods because of greater sink strength reversed through its greater interest of photosynthates. Addition of sulphur in sufficient amount likewise helps in the advancement of floral botany i.e., reproductive parts, which brings about the improvement in the formation of pods and kernels in crop plants. Similar findings have also been reported earlier by Patel *et al*. (2009) [8]. The treatment T_9 has recorded highest haulm yield of 4371.00 kg/ha while the lowest of 3739.00 kg/ha was recorded with the treatment T_1. The treatments T_6 and T_8 were found statistically at par with T_9. The treatment T_6 has recorded maximum harvest index and there was no significant difference among the treatments. The impact of nitrogen along with sulphur on the availability of all majorly nutrients further add in the enhancement of these yield parameters. Comparative discoveries have additionally been accounted on yield attributes and yield by Palsande *et al*. (2009) [7], Meena *et al*. (2011) [6] and Venkatesh *et al*. (2002) [12].

Economics

Cost of cultivation

Highest cost of cultivation was obtained with treatment T_9 of 46672.88 INR/ha, while the lowest of 44738.08 INR/ha with T_1.

Gross returns

Highest gross returns of 1809980.75 INR/ha was recorded with the treatment T_9, While the lowest was recorded with treatment T_1 of 126311.25 INR/ha. Similar discoveries were reported by Jat and Ahlawat (2009) [4].

Net returns

Highest net returns were recorded with the treatment T_9 of 134307.87 INR/ha, while the treatment T_1 has recorded the lowest of 81573.17 INR/ha.

Benefit-Cost ratio

Maximum B:C ratio was recorded with treatment T_9 of 2.87, while less of 1.82 with treatment T_1.

Higher B:C ratio was obtained with the higher level of sulphur. The less expensive of gypsum is one of the main justification behind higher farm profitability. The higher pod and biological yield further adds in getting higher farm productivity with the application of gypsum. Comparative discoveries were likewise reported by Das *et al*. (2013) [2].

Since, these findings are based on one season data; therefore, further trail may be required for further confirmation.

Table 3: Effect of nitrogen and sulphur on economics of summer groundnut

S. No.	Treatment No.	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	Benefit-cost ratio
1	T_1	44738.08	126311.25	81573.17	1.82
2	T_2	45488.08	150244.25	104756.17	2.30
3	T_3	46238.08	162979.00	116740.92	2.52
4	T_4	44955.48	141077.50	96122.02	2.13
5	T_5	45705.48	161621.00	115915.52	2.53
6	T_6	46455.48	175604.75	129149.27	2.78
7	T_7	45172.88	143524.25	98351.37	2.17
8	T_8	45922.88	165096.50	119732.62	2.59
9	T_9	46672.88	180980.75	134307.87	2.87

Acknowledgement

I express my gratitude to my advisor Dr. Rajesh Singh and all the faculty members of Department of Agronomy, SHUATS, Prayagraj, U.P., India for constant support and guidance to carry out the whole experiment research study.

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