The Pharma Innovation Journal 2022; 11(3): 1277-1279

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(3): 1277-1279

www.thepharmajournal.com
Received: 09-01-2022
Accepted: 18-02-2022

Nangunoori Ajay Kumar
M.Sc. Scholar, Department of Agronomy, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Rajesh Singh
Assistant Professor, Department of Agronomy, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

RS Chauhan
Associate Professor and Head, Department of Agronomy, RSM (PG) Collage, Dhampur, Bijnor, Uttar Pradesh, India

Corresponding Author:
Nangunoori Ajay Kumar
M.Sc. Scholar, Department of Agronomy, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

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

Nangunoori Ajay Kumar, Rajesh Singh and RS Chauhan

DOI: https://doi.org/10.22271/tpi.2022.v11.i3q.11461

Abstract
A research trail was conducted in *zaid* 2021, at KVK farm, SHUATS, Prayagraj. To study the influence of nitrogen and spacing on yield and economics on groundnut. The treatments consist of three levels of nitrogen (20, 25 and 30 kg/ha) and three levels plant spacing (20cm × 10cm, 25cm × 10cm and 30cm × 10cm) are included. Experiment was laid out in randomized block design with nine treatments each replicated thrice. The result showed that *viz*: significantly higher number of pods per plant, seed yield, haulm yield, net returns and B:C ratio recorded in (T_6) nitrogen 30kg/ha + 25cm × 10cm.

Keywords: Nitrogen, spacing, yield attributes, Netreturn, B:C ratio

Introduction
Groundnut (*Arachis hypogaea* L.) is an oldest oil seed crop in India, which is called as 'King of oil seeds'. Groundnut is popularly known as unpredictable legume. Since the pods are borne ground positively geotropic we cannot predict its performance before harvest as in the case of other crops. Basal application of N (10 to 75 kg/ha) in the form of mineral nitrogen fertilizers has improved groundnut yield in some trials (Shimshi *et al.*, 1967) [9]. The positive response of a legume crop to fertilizer N indicates that N demand of the crop is not being fully met by N fixation therefore, symbiotic Nitrogen fixation could be limited. It is important to accommodate the most appropriate number of plants per unit area of land to obtain better yield. Proper spacing in line sowing is to be recommended to maintain required number of plant population and to undertake intercultural operations for harvesting a better yield. Improper spacing and plant density affect the normal physiological activities of the crop. In densely populated crop, the inter specific competition between the plants is high. Again, wider spacing leads to lower yield resulted from uneconomic utilization of space. (Awal and Aktar, 2015) [1]. Sustained groundnut production and higher profitability can be managed by utilizing the proper ground space with optimum external inputs. Keeping these points in view an experiment was conducted to achieve optimum yield with profitable investment by treatment combinations of different spacings and different nitrogen levels.

Materials and Methods
The field experiment was undertaken in KVK farm, SHUATS, Prayagraj during *Zaid* 2021. To study the impact of nitrogen and spacing on yield and economics of groundnut. The soil of the experimental field constituting a part of central Gangetic alluvium is neutral and deep. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.3), low in organic carbon (0.57%), available N (230kg/ha), available P (32.10kg/ha) and available K (235kg/ha). The treatments consist of three levels of nitrogen application and three levels plant spacing are included. The experiment was laid out in randomized block design with nine treatments each replicated thrice. T_1: N 20kg/ha + 20cm × 10cm, T_2 : N 25kg/ha + 20cm × 10cm, T_3 : N 30kg/ha + 20cm × 10cm, T_4 : N 20kg/ha + 25cm × 10cm, T_5 : N 25kg/ha + 25cm × 10cm, T_6 : N 30kg/ha + 25cm × 10cm, T_7 : N 20kg/ha + 30cm × 10cm, T_8 : N 25kg/ha + 30cm × 10cm, T_9 : N 30kg/ha + 30cm × 10cm. During the growing season, the mean weekly maximum and minimum temperature, relative humidity and rainfall were 39.24 ºC, 26.48 ºC, 64.18%, 42.86% and 8.64 mm respectively. Observations on yield and yield attributes of groundnut were recorded and their significance was tested by the variance ratio (F-value) at 5% level (Gomez and Gomez, 1984) [4]. Relative economics was calculated as per the prevailing market prices of the inputs and produced during *Zaid* season 2021.

Table 1: Details of treatment combinations

Sr. No	Treatment No	Treatment Combination
1.	T1	20 kg/ha Nitrogen + 20 cm × 10 cm
2.	T2	25 kg/ha Nitrogen + 20 cm × 10 cm
3.	T3	30 kg/ha Nitrogen + 20 cm × 10 cm
4.	T4	20 kg/ha Nitrogen + 25 cm × 10 cm
5.	T5	25 kg/ha Nitrogen + 25 cm × 10 cm
6.	T6	30 kg/ha Nitrogen + 25 cm × 10 cm
7.	T7	20 kg/ha Nitrogen + 30 cm × 10 cm
8.	T8	25 kg/ha Nitrogen + 30 cm × 10 cm
9.	T9	30 kg/ha Nitrogen + 30 cm × 10 cm

Results and Discussion

Yield and Yield attributes

Data pertaining that (Table 2) yield attributes of groundnut, number of pods per plant (No.), seed yield (kg/ha), haulm yield (kg/ha) and harvest index (%) were significantly influenced by the treatments. Significantly higher number of pods per plant (30.80), seed yield (2355.6 kg/ha) and haulm yield (3402.3 kg/ha) were obtained in (T_6) nitrogen 30kg/ha + 25cm × 10cm. In number of pods per plant (30.80) (T_6) which is statistically at par with the application of (T_5) 25 kg/ha nitrogen + 25 cm × 10 cm (30.53) and (T_4) 20 kg/ha nitrogen + 25 cm × 10 cm (30.56). Number of pods/plant was significantly higher with the spacing of 25 cm × 10 cm when compared to closer spacing. Decreased number of pods/plant under closer spacing was due to mortality caused by mutual shading during pre-flowering stage of the crop. Similar findings were also reported by Siddaraju *et al.* (2010) [10] and Joshi *et al.* (2018). Treatment (T_5) 25 kg/ha nitrogen + 25 cm × 10 cm and (T_4) 20 kg/ha nitrogen + 25 cm × 10 cm were recorded statistically at par with (T_6) 30 kg/ha nitrogen + 25 cm × 10 cm in both seed yield and haulm yield parameters.

The increase in these yield attributes at optimum spacing was due to better crop growth, more space available for plants, lesser competition for moisture and nutrients between plants. This result is corroborating with the findings of Chaniyara *et al.* (2002) [2] and Rajeshkumar *et al.* (2017) [8]. The positive response of various yield components to nitrogen fertilization could be ascribed to overall improvement in crop growth. Similar findings were reported by Sree *et al.* (2020) [11]. The significantly higher harvest index (42.32%) was observed in (T_1) 20 kg/ha nitrogen + 20 cm × 10 cm, which is statistically at par with application of 20 kg/ha nitrogen + 30 cm × 10 cm (41.89). This might be attributed to the rapid development of seed yield in high plant density by optimizing growth factors, once the reproductive phase started, the leads to harvestable crop while other weather conditions are good. Similar results reported by Gawas *et al.* (2020) [3].

Table 2: Impact of nitrogen and spacing on yield and yield attributes of groundnut.

Treatment	Number of pods/plant	Number of kernels/pod	seed index (g)	Seed yield (kg/ha)	Haulm yield (kg/ha)	Shelling percentage (%)	Harvest Index (%)
T_1	24.33	1.16	36.66	2050.3	2748.2	67.10	42.32
T_2	25.36	1.14	37.26	2131.0	3011.1	67.00	41.25
T_3	25.56	1.17	37.10	2164.0	3095.2	67.36	41.14
T_4	30.56	1.16	37.63	2328.1	3373.6	68.93	40.82
T_5	30.53	1.17	37.03	2353.6	3380.3	68.73	41.04
T_6	30.80	1.20	37.50	2355.6	3402.3	68.11	40.91
T_7	28.33	1.18	37.26	2087.3	3172.3	67.93	41.89
T_8	28.60	1.19	37.93	2118.0	3225.4	67.66	41.17
T_9	28.76	1.17	37.43	2121.2	3351.6	68.78	40.60
SEm (±)	0.23	0.02	0.58	20.03	13.81	0.48	0.23
CD (5%)	0.70	-	-	60.04	41.4	-	0.68

Table 3: Impact of nitrogen and spacing on economics of groundnut.

Treatment	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
T_1	50,616	1,08,155.1	57,539.08	1.13
T_2	50,682	1,12,410.3	61,728.25	1.21
T_3	50,748	1,14,151.0	63,403.00	1.24
T_4	46,916	1,22,802.0	75,886.00	1.61
T_5	46,982	1,24,155.9	77,173.92	1.62
T_6	47,048	1,24,261.4	77,213.42	1.64
T_7	43,216	1,10,106.8	66,890.83	1.54
T_8	43,282	1,11,724.5	68,442.50	1.58
T_9	43,348	1,11,882.8	68,534.75	1.58

Economics

Economic efficiency and viability of crop cultivation are mainly the outcome of crop yield with lesser production cost. The data pertaining that (Table 3) higher cost of cultivation (50,748 ₹/ha) recorded in (T_3) 30 kg/ha nitrogen + 20 cm × 10 cm, due to closer spacing the seed rate has increased. Maximum gross returns (1,24,261.4 ₹/ha), net returns (77,213.42 ₹/ha) and B:C ratio (1.64) were obtained with (T_6) 30 kg/ha nitrogen + 25 cm × 10 cm.

Conclusion

Based on one season study treatment (T_6) 30 kg/ha nitrogen + 25 cm × 10 cm recorded seed yield (2355.6 kg/ha), haulm yield (3402.3 kg/ha), maximum net return (77,213.42 ₹/ha) and B:C ratio (1.64). Further trail may be required for further confirmation.

Acknowledgment

I express my gratitude to my advisor Dr. Rajesh Singh for constant support, guidance and for his valuable suggestions for improving the quality of this Resarch work. And to all the faculty members of Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh (U.P), India for providing necessary facilities, for their cooperation, encouragement and support.

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