International Journal of Environment and Climate Change

Volume 13, Issue 8, Page 1262-1269, 2023; Article no.IJECC.100617
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Effect of Date of Sowing and INM (Integrated Nitrogen Management) on Growth and Yield of Summer Groundnut (*Arachis hypogaea* L.)

Ridhi Das Nayak [a++*], Rajesh Singh [a#], Akankhya Pradhan [a] and Indu Thakur [a]

[a] *Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i82068

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/100617

Original Research Article

Received: 26/03/2023
Accepted: 29/05/2023
Published: 10/06/2023

ABSTRACT

A Field experiment was conducted during *Zaid* 2022 with a goal to evaluate the effect of date of sowing and integrated nitrogen management on growth and yield of summer groundnut (*Arachis hypogaea*). The experiment was laid out in Randomized Block Design with ten treatments each replicated thrice at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj - 211007, (U.P.) which is located at 25.28^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the Mean Sea Level (MSL) for 100 days. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.4), low in organic carbon (0.58%), available N (225 kg.ha^{-1}), available

[++] *M. Sc. Scholar;*
[#] *Associate Professor;*
**Corresponding author: E-mail: ridhi.dasnayak@gmail.com;*

P (32.30 kg.ha^{-1}) and available K (350 kg.ha^{-1}). The treatment consists of 5 levels of INM [100% RDN through inorganic, 100% RDN through FYM, 100% RDN through Vermicompost, 50% RDN (inorganic) + 50% RDN (FYM), 50% RDN (inorganic) + 50% RDN (Vermicompost)] as basal application and 2 Dates of Sowing (1st and 15th April), whose effect was observed on groundnut. The result showed that growth parameters of Groundnut *viz*., maximum plant height (72.00 cm), dry weight (41.54 g/plant), crop growth rate (15.05 g/m**2**/day), relative growth rate (0.014 g/g/day) and yield and yield attributes *viz*., number of pods/plant (48.00), number of seeds/pod (2.13), seed index (43.66 g), seed yield (3.14 t/ha), haulm yield (7.03 t/ha) and harvest index (30.62%) was recorded significantly higher with application of treatment 5 S_1(1ST April) + 50% RDN (inorganic) + 50% RDN (Vermicompost). The maximum net returns (90,793 ₹/ha) and B:C ratio (2.73) was recorded with application of S_1(1ST April) + 50% RDN (inorganic) + 50% RDN (Vermicompost).

Keywords: Date of sowing; INM; yield; economics.

1. INTRODUCTION

Groundnut (*Arachis hypogaea*), also known as earthnut, goober, pindar, monkey nut etc., is a legume mainly grown for its edible seeds (Wikipedia). "Groundnut is important for sustainable agriculture as it improves the physiochemical and biological properties of the soil. Its deep roots also open the soil, which ensure better aeration and heavy leaf drop increases the organic matter in the soil" [1].

Groundnuts are grown in tropical and subtropical regions around the world, with the majority of production concentrated in Asia and Africa. With an estimated global production of 47 million tonnes in 2020 (FAO), groundnut is grown in more than 100 countries and is one of the world's major oilseeds crops, ranking fourth in terms of production (FAOSTAT, 2021). The sowing date is one of the most important factors that can significantly affect the growth and yield of groundnut. Groundnut is a crop that requires specific environmental conditions to grow and develop properly, and its response to sowing dates may vary according to the local climate, soil type, and other factors. Sowing dates determines days of emergence, days of flowering and it has effect on total dry matter production, pod setting and pod yield. Delay or late in the time of sowing results in reducing total yield of crop [2]. Early sowing can help groundnut crops take advantage of residual soil moisture and longer growing seasons, which can result in better vegetative growth, earlier flowering, and increased pod development. On the other hand, late sowing can result in reduced growth, lower yields, and an increased risk of pest and disease incidence. Among the several factors responsible for its low productivity, efficient nutrient management practices are also considered as major constraints. "Groundnut depletes the soil nutrients rapidly unless the crop is adequately manured" [3]. "Use of farmyard manure with other organic amendments like vermicompost, neem cake, poultry manure, sheep manure etc. provide an economic and environmentally friendly way of applying nutrients to groundnut" [4].

"The incorporation of organic manures improves the nutrient content and uptake. Although organic manures contain plant nutrients in small quantities as compared to the fertilizer, the presence of growth promoting principles like enzyme and hormones besides plant materials make them essential for improvement of soil fertility and productivity" [5].

"Indiscriminate use of chemical fertilizers leads to development of several problems like decline in soil organic carbon, soil pollution and severe attack of pest and diseases" [6].

"Due to these problems, organic farming is gaining popularity in recent years. Balanced use of nutrients through organic sources like farm yard manure, poultry manure, sheep manure and neem cake are the prerequisites to sustain soil fertility and to produce reasonably good crop yield with optimum level of input usage. Groundnut is highly responsive to fertilizer application, although groundnut being a legume is capable of fixing atmospheric nitrogen, it responds to small quantity of nitrogenous fertilizer applied as starter dose" [7].

Groundnut is an exhaustive crop and removes large amount of macro and micronutrients from soil. None of the sources of nutrient alone can meet the total plant nutrient need of crop adequately. Hence, to achieve the targeted yield, proper date of sowing and nitrogen management is essential. With this background, a field experiment was conducted to study growth and productivity of groundnut under different date of sowing and integrated nitrogen management practices.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted at during zaid 2022, at Crop Research Farm, Naini Agricultural Institute, SHUATS, Prayagraj. The experimental site of the study is geographically located at 25.28°N latitude, 81.54°E longitude and 98 m altitude above the mean sea level (MSL).

2.2 Soil

The soil of the experimental field constituting a part of central Gangetic alluvium is neutral and deep. The soil was sandy loam in texture, organic carbon (0.58%) and available nitrogen (225 kg/ha), phosphorous (32.30 kg/ha) and low in potassium (350 kg/ha).

2.3 Experimental Design

The experiment was laid out in randomized block design with three replications comprising ten treatment viz., S_1 (1st April) + R_1 100% RDN (inorganic), S_1 (1st April) + R_2 100% RDN through FYM, S_1 (1st April) + R_3 100% RDN through Vermicompost, S_1 (1st April) + R_4 50% RDN (inorganic) + 50% RDN (FYM), S_1 (1st April) + R_5 50% RDN (inorganic) + 50% RDN (Vermicompost), S_2 (15th April) + R_1 100% RDN through inorganic, S_2 (15th April) + R_2 100% RDN through FYM, S_2 (15th April) + R_3 100% RDN through Organic (Vermicompost), S_2 (15th April) + R_4 50% RDN (inorganic) + 50% RDN through FYM, S_2 (15th April) + R_5 50% RDN (inorganic) + 50% RDN through vermicompost.

2.4 Cultural Practices

Groundnut variety Kadiri-6 was used for experiment. Recommended nutrient dose 20-40-40 kg/ha was applied in the plot through urea, single super phosphate (SSP) and muriate of potash (MOP), respectively at the time of sowing. All other recommended agronomic practices were followed and plant protection measures were adopted as per need. The plots were prepared with dimension of 3m × 3m and seeds were sown with a spacing of 30cm × 10cm. Irrigations were given uniformly and regularly to all plots as per requirement so as to prevent the crop from water stress at any stage.

2.5 Statistics

"The crop was completely harvested at physiological maturity stage and their post-harvest observations such as number of pods per plant, number of kernels per pod, seed index (g), kernel yield (t/ha), pod yield (t/ha), haulm yield (t/ha) and harvest index (%) were recorded" [1]. The data recorded for different characteristics were subjected to statistical analysis by adopting the method of analysis of variance (ANOVA) as described by Gomez and Gomez (1984). The significance of comparison was tested. The significant difference computed for 5 percent probability of error. Wherever the variance ratio (F value) was found significant, critical difference (CD) values were computed for the comparison among the treatmentmeans.

3. RESULTS AND DISCUSSION

3.1 Yield Attributes

Tables 1 and 2 pertaining the details of Effect of Date of Sowing and Integrated Nitrogen Management on growth attributes of Summer Groundnut.

3.2 Seeds per Pod

At 100 DAS, the data recorded higher number of seed/pod (2.13) in treatment no.5 [S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost]. However, treatment no.4 [S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through FYM] (2.00) was statistically at par with treatment no.5.

Result is corroborated with those reported by Shendage et al. [8] who reported increased number of kernels per pod in early sowing dates.

Application of inorganic fertilizers combined with organic and biofertilizer also might have showed better performance of yield attributing characters viz. number of seeds per pod than application of other organic and inorganic nutrients.

3.3 Pods per Plant

At 100 DAS, the data recorded higher number of pods/plant (48.00) in treatment no.5 [S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost]. However, treatment no.4 [S_1 (1st

April) + 50% RDN (inorganic) + 50% RDN through FYM] (46.27) was statistically at par with treatment no.5. Similar results were observed by Sardana and Kandhola [9] on increased number of pods per plant (28.7) during early sowing.

“Growth and yield attributes viz., plant height, number of pods, 100 kernel weight, shelling percentage and oil content of groundnut were significantly influenced due to integrated nutrient application of organic sources along with the presence of beneficial microorganisms” [10].

3.4 Seed Index (g)

At 100 DAS, the data recorded higher seed index (43.66 g) in treatment no.5 [S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost]. However, treatment no.4 [S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through FYM] (41.93 g) was statistically at par with treatment no.5.

Similar results were reported by Yadav and Ombase [2] where higher test weight (53.0 g) was recorded in first date of sowing which was statistically at par with second date of sowing and significantly higher than third date of sowing during first and second year.

“Early and plentiful availability of nitrogen to plants favourably influenced the kernel development and kernel size, which ultimately resulted in higher seed index” [11].

3.5 Seed Yield (t/ha)

At 100, the data recorded higher seed yield (3.14 t/ha) in treatment no.5 [S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost]. The minimum seed yield (1.18 t/ha) was observed in S_2 (15th April) +100% RDN through FYM.

“Maximum seed yield was found with early sowing might be due to the effect of temperature and photoperiod at pod filling of the crop growing period. These results revealed that at vegetative stage only GDD i.e., temperature played a pivotal role. At grain filling stage, temperature, photoperiod and sunshine hours had positive influence” [12].

3.6 Pod Yield (t/ha)

At 100 DAS, the data recorded higher pod yield (3.23 t/ha) was observed in S1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost. However, S1(1st April) + 100% RDN through inorganic (2.93 t/ha) and S2 (15th April) + 50% RDN (inorganic) + 50% RDN through Vermicompost (2.90 t/ha) was statistically at par with S1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost.

These results are in close agreement with the findings of an experiment conducted during kharif season of 2009 and 2010 at Agronomy Research Farm, College of Agriculture, Bikaner (Rajasthan) to evaluate the temperature use efficiency and yield of groundnut varieties in response sowing dates and fertility levels. The results revealed HNG 10 variety was recorded higher and almost similar pod yield (3773, 3743 and 3738 kg.ha^{-1}), and kernel yields under the first three sowing dates beginning from 20 April to 9 June, respectively [13].

3.7 Haulm Yield (t/ha)

At 100 DAS, the data recorded higher haulm yield (7.03 t/ha) in treatment no.5 S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost. However, treatment no.4 S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through FYM (6.68 t/ha) was statistically at par with treatment no. 5.

Similar results were reported by Kumar et al., [14] where “among the sowing windows, the crop sown during I fortnight of July recorded significantly higher haulm yield (2219 kg.ha^{-1})”. “This might be due to the proper distribution of rainfall during critical growth period of the crop and long day conditions exposed the crop to better sunlight for longer duration which produces more photosynthates for growth and development of the plant, during early sown conditions” [14].

3.8 Harvest Index (%)

At harvest, the data recorded maximum harvest index (30.62%) in treatment no.5 S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost and the minimum harvest index (16.51%) was observed in S_2 (15th April) +100% RDN through FYM.

This result confirms the finding of Jeevana et al. [15] who reported higher HI (37.78%) with early date of sowing. This difference brought out in growth characters by yield attributing characters and ultimately haulm and pod yields.

Table 1. Effect of date of sowing and INM on yield attributes of summer groundnut

S. No.	Treatment combinations	Pods/plant	Seeds/pod	Seed index (g)
1.	S_1(1st April) + 100% RDN through inorganic	44.20	1.83	39.86
2.	S_1 (1st April) + 100% RDN through FYM	41.23	1.33	36.89
3.	S_1 (1st April) + 100% RDN through Vermicompost	41.47	1.40	37.13
4.	S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through FYM	46.27	2.00	41.93
5.	S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost	48.00	2.13	43.66
6.	S_2(15th April) + 100% RDN through inorganic	40.67	1.53	36.33
7.	S_2 (15th April) +100% RDN through FYM	38.03	1.10	33.70
8.	S_2 (15th April) +100% RDN through Vermicompost	38.20	1.17	33.86
9.	S_2 (15th April) +50% RDN (inorganic) + 50% RDN through FYM	41.13	1.70	36.80
10.	S_2 (15th April) + 50% RDN (inorganic) + 50% RDN through Vermicompost	41.33	1.80	37.00
	F-Test	S	S	S
	SEm (±)	0.74	0.11	0.97
	CD (p = 0.05)	2.07	0.33	2.71

Table 2. Effect of date of sowing and INM on post-harvest observations of summer groundnut

S. No.	Treatment combinations	Pod yield (t/ha)	Seed yield (t/ha)	Haulm yield (t/ha)	Harvest Index (%)
1.	S_1(1st April) + 100% RDN through inorganic	2.93	2.09	5.77	24.02
2.	S_1 (1st April) + 100% RDN through FYM	2.43	1.73	4.93	19.02
3.	S_1 (1st April) + 100% RDN through Vermicompost	2.50	2.04	5.37	21.75
4.	S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through FYM	3.10	2.16	6.68	22.13
5.	S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost	3.23	3.14	7.03	30.62
6.	S_2(15th April) + 100% RDN through inorganic	2.63	1.41	5.90	16.56
7.	S_2 (15th April) +100% RDN through FYM	2.20	1.18	4.97	16.51
8.	S_2 (15th April) +100% RDN through Vermicompost	2.27	1.41	5.50	18.21
9.	S_2 (15th April) +50% RDN (inorganic) + 50% RDN through FYM	2.80	1.85	6.10	20.80
10.	S_2 (15th April) + 50% RDN (inorganic) + 50% RDN through Vermicompost	2.90	1.98	6.47	21.14
	F-Test	S	S	S	S
	SEm (±)	0.11	0.11	0.13	1.36
	CD (p = 0.05)	0.33	0.31	0.37	3.80

Table 3. Effect of date of sowing and INM on economics of summer groundnut

S. No	Treatment combination	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
1	t April) + 100% RDN through inorganic	32,865	1,17,200	84,335	2.56
2	st April) + 100% RDN through FYM	33,549	97,200	63,351	1.89
3	st April) + 100% RDN through Vermicompost	52,116	1,00,000	47,884	0.91
4	st April) + 50% RDN (inorganic) + 50% RDN through FYM	33,207	1,24,000	90,793	2.73
5	st April) + 50% RDN (inorganic) + 50% RDN throughVermicompost	42,439	1,29,200	86,761	2.04
6	th April) + 100% RDN through inorganic	32,865	1,05,200	72,335	2.20
7	5th April) +100% RDN through FYM	33,549	88,000	54,451	1.62
8	5th April) +100% RDN through Vermicompost	52,116	90,800	38,684	0.74
9	5th April) +50% RDN (inorganic) + 50% RDN through FYM	33,207	1,12,000	78,793	2.37
10	5th April) + 50% RDN (inorganic) + 50% RDN through Vermicompost	42,439	1,16,000	73,561	1.73

3.9 Economics

Table 3 pertaining the details of Date of Sowing and Integrated Nitrogen Management on growth attributes of Summer Groundnut.

The maximum gross return was recorded in S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through Vermicompost (129,200 ₹/ha) in treatment no. 5.

The maximum net return was recorded in S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through FYM (90,793 ₹/ha) in treatment no. 4. These results are in close agreement with the findings of an experiment conducted by Singh et al. [16] and Maurya et al. [17].

Maximum B C ratio (2.73) was recorded in S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through FYM in treatment no. 4 [18-22].

4. CONCLUSION

From the observations, it was concluded that with the combination of S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through FYM in treatment no. 4 recorded higher net return and B.C ratio and therefore is a fitting practice for augmenting higher Summer Groundnut yields for farmer.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Venkatagiri Sireesha and Joy Dawson. Effect of potassium and magnesium on growth and yield of groundnut (*Arachis hypogaea* L.). The Pharma Innovation Journal. 2022;11(5):591-594.
2. Yadav ST, Ombase KC. Effect of sowing dates on dry matter production and yield of kharif groundnut. Journal of Agriculture Research and Technology. 2021;46(3): 268-272.
3. Nair P, Sadanandan N, Kunju UM, Nair KPM. Potash fertilization and higher yields of bunch groundnut in Kerala. Indian Potash Journal. 1982;7:15-21.
4. Prasad R. Modern agriculture vis-à-vis Organic farming. Current Science. 2005; 89:252-254.
5. Vidyavathi Dasog GS, Babalad HB, Hebsur NS, Gali SK, Patil SG, Alagawadi AR. Nutrient status of soil under different nutrient and crop management practices. Karnataka Journal of Agricultural Sciences. 2012;25(2):193-198.
6. Chakraborthi M, Singh NP. Bio-compost: A novel input to organic farming. Agrobios Newsletter. 2004;2(8):14- 15.
7. Chaudhary JH, Ramdev Sutaliya, Desai LJ. Growth, yield, yield attributes and economics of summer groundnut (*Arachis hypogaea* L.) as influenced by integrated nutrient management. Journal of Applied and Natural Science. 2015;7(1):369 – 372.
8. Shendage RC, Mohite AB Sathe RK. Effect of sowing times and varieties on growth and yield of summer groundnut (*Arachis hypogaea* L.). Journal of Pharmacognosy and Phytochemistry. 2018;7(1):720-722.
9. Sardana V, Kandhola SS. Productivity of semi-spreading and bunch type varieties of groundnut as influenced by sowing dates. An Open Access Journal published by ICRISAT. 2007;5(1):1-3.
10. Akshaya A, Kumarimanimuthuveeral D, Kumar KPS. Integrated nutrient management practices on the physiological and yield traits of irrigated groundnut (*Arachis hypogaea* L.). The Pharma Innovation Journal. 2022;11(9): 1940-1942.
11. Bala HMB, Ogunlela VB, Kuchinda NC, Tanimu B. Responce of two groundnut (*Arachis hypogaea*) varieties to sowing date and NPK fertilizer rate in a semi-arid environment: yield and yield attributes. Asian Journal of Crop Science. 2011; 3(3):130-134.
12. Anil A, Sudhakar P, Umamahesh V, Prathima T. Effect of agroclimatic indices and yield in Groundnut (*Arachis hypogaea* L.) at different dates of sowing. Andhra Pradesh Journal of Agricultural Science. 2017;3(4):261-264.
13. Meena RS, Yadav RS. Phenological performance of groundnut varieties under sowing environments in hyper arid zone of Rajasthan, India. Journal of Applied and Natural Science. 2014; 6(2):344-348.
14. Kumar DS, Ankitha D, Pratyusha C. Effect of dates of sowings on growth and productivity of different cultivars of groundnut (*Arachis hypogaea* L.). Journal of Pharmacognosy and Phytochemistry. 2020;1(1):9-12.
15. Jeevana S, Singh S, Kumari S. Effect of sowing dates on performance of groundnut (*Arachis hypogaea* L.) cultivars in Kharif

season under Prayagraj condition. The Pharma Innovation Journal. 2022;11(4): 546-549.
16. Singh GP, Singh PL, Panwar AS. Seed yield, quality and nutrient uptake of Groundnut (*Arachis hypogaea*) as affected by integrated nutrient management in mid hill altitude of Meghalaya, India. Legume Research. 2013;36(2): 147-152.
17. Maurya AC, Verma SK, Kumar S, Lakra K. Nutrient concentration and their uptake and available nutrients in soil influenced by irrigation, mulching and integrated nutrient management in summer groundnut. International Journal of Current Microbiology and Applied Sciences. 2017; 6(11):2405-2415.
18. Chaudhari R, Choudhary R. Yield trends changes in groundnut under different sources of nutrients management. The Pharma Innovation Journal. 2022;11(2): 1088-1090.
19. Domonoske, Camila (April 20, 2014). A Legume with many names: The story of goober. NPR. National Public Radio. Archived from the original; 2020. fao.org
20. Pandaya SB, Singh AK. Influence of chelating legends on the uptake of Fe by maize plant. J. Indian Soc. Soil Sci. 1998;46:80-85.
21. USDA GRIN Taxonomy, retrieved June 29; 2016.
22. Verma JP, Verma SK, Meena RS, Yadav RS, Reager ML, De N, Meena VS, Kansotia BC. Temperature use efficiency and yield of groundnut varieties in response to sowing dates and fertility levels in western dry zone of India. American Journal of Experimental Agriculture. 2010;7(3):170-177.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/100617