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

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Authors' contributions

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

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ABSTRACT

A Field experiment was conducted during *Zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) to find out the Effect of Date of Sowing and Integrated Nitrogen Management on Growth and Yield of Summer Groundnut (*Arachis hypogaea* L.) 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/m2/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%) were

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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 S1(1ST April) + 50% RDN (inorganic) + 50% RDN (Vermicompost).

Keywords: Date of sowing; Integrated Nitrogen Management (INM); Recommended Dose of Nitrogen (RDN); yield; yield attributes.

1. INTRODUCTION

Groundnut (Arachis hypogaea L.) is an important oilseed crop of India, popularly known as peanut, monkey-nut and locally called as “moongphali” “It is widely grown in the tropical and subtropical, being important to both small and large commercial producers. Groundnut seeds contain high quality oil (48%), easily digestible protein (26%) and carbohydrates (20%). It is classified as both a grain legume and due to its high oil content, an oil crop. Like most other legumes, peanuts harbour symbiotic nitrogen-fixing bacteria in root nodules containing fertilizer and also improve soil fertility, making them valuable in crop rotations. Total area of groundnut in Rajasthan is 3.46 lakh ha with total production of 6.81 lakh tons with productivity of 1963 Kg/ha” [1].

“Groundnut is an exhaustive crop and removes large amount of macro and micronutrient. No single source of nutrient is capable at supplying plant nutrients in adequate amount and balanced proportion. Therefore, to maintain soil fertility and to supply plant nutrients in balanced proportion for optimum growth, yield and quality of crop in an integrated manner in a specific agro ecological situation is to practice integrated nutrient supply through the combined use of biological and organic sources of plant nutrients” [2].

Growth and yield of a crop depend on a number of factors; however, climate plays the most important role. Among the climatic parameters role of solar radiation, temperature, humidity, rainfall is very crucial. The oilseed crops, particularly groundnut are very sensitive to climatic parameters such as radiation and temperature [3] reported that “the December and January sown crops showed greater efficiency of partitioning of recent assimilates to the pods”.

“The proper time of sowing exerts a distinguished effect on growth and eventually on the yield of summer groundnut. Sowing date is an important production component that can be manipulated to counter the adverse effects of environmental stress. Matching the phenology of the crop to the duration of favorable conditions by selecting the most appropriate sowing dates to avoid the periods of stress is crucial for obtaining maximum yield. Adjustment of sowing date is very important to optimize climatic environment in respect to growth and yield of groundnut crop. This is accomplished through shifting sowings, so that any stress caused by environment is avoided during the critical stages of plant growth, but it requires detailed investigation of the growth dynamics of the crops under different dates of sowings” (Jeevana *et al*., 2022).

2. MATERIALS AND METHODS

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^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the mean sea level (MSL). 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). The treatment consists of 5 levels of Integrated Nitrogen Management(INM) [100% recommended dose of nitrogen(RDN) through inorganic, 100% recommended dose of nitrogen through FYM, 100% recommended dose of nitrogen through Vermicompost, 50% recommended dose of nitrogen (inorganic) + 50% recommended dose of nitrogen (FYM), 50% recommended dose of nitrogen (inorganic) + 50% recommended dose of nitrogen (Vermicompost)] as basal application and 2 Dates of Sowing (S_1:1st and S_2:15th April), whose effect was observed on groundnut. The experiment was laid out in Randomized Block Design with ten treatments each replicated thrice. Groundnut variety Kadiri-6 was used for experiment. Recommended nutrient dose 20-40-40 kg ha^{-1} were 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. 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, test weight (g), kernel yield (t/ha), pod yield (t/ha), haulm yield (t/ha) and harvest index (%) were recorded. The data recorded for different characteristics were subjected to statistical analysis by adopting the method of analysis of variance (ANOVA) as described by Gomez (1984).

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

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

3.2 Plant Height (cm)

At 100 DAS, Higher plant height (72.00 cm) was recorded in S_1(1st April) + 50% RDN through inorganic + 50% RDN through Vermicompost. However, S_1(1st April) + 100% RDN through inorganic (69.52 cm), S_1(1st April) + 100% RDN through Vermicompost (66.85 cm), S_1(1st April) + 50% RDN through inorganic + 50% RDN through FYM (71.18 cm) was statistically at par with treatment no. 5.

The increase in plant height might be due to favorable climatic condition (temperature, relative humidity and bright sunshine hours etc.) for growth, especially optimum temperature in early growth stages available to the crop which were in confirmation with the results of [4], [5] and Sunil *et al.* (2021).

3.3 Dry Weight (g)

At 100 DAS, Maximum plant dry weight (41.54 g) was recorded in S_1(1st April) + 50% RDN through inorganic + 50% RDN through Vermicompost. However, S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through FYM (39.58 g) was statistically at par with treatment no. 5.

Dry matter production increased steadily with advancing growth stages and reached the maximum at harvest. The dry matter production (kg/ha) was found to be more with sowing date 1st April, which could be attributed to higher population and accumulation of nutrients /unit area compared to delayed sowing at 15th April. This might be because early sowing provides congenial condition for better vegetative growth as compared to delayed sowing which is in accordance with earlier findings of [6].

3.4 Crop Growth Rate (g/m^2/day)

At 80-100 DAS, maximum crop growth rate (15.05 g/m^2/day) was observed in S_1(1st April) + 50% RDN through inorganic + 50% RDN through Vermicompost, there was no significant difference among the treatments.

3.5 Relative Growth Rate (g/g/day)

Highest relative growth rate (0.014 g/g/day) was recorded non-significantly in the treatment no.6 [S_2(15TH April) + 100% RDN (inorganic)].

3.6 Yield Attributes

Tables 2 and 3 pertaining the details of Effect of Date of Sowing and Integrated Nitrogen Management on yield attributes of Summer Groundnut.

3.7 Seeds Per Pod

At 100 DAS, the data recorded more seeds/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.

Application of inorganic fertilizers combined with organic and biofertilizer might have showed better performance of yield attributing characters viz. number of seeds per pod than application of other organic and inorganic nutrients. [7] recorded “highest plant height, more number of branches, maximum plant dry weight, crop growth rate in the treatment in which phosphorus was applied at 40 kg/ha along with seed treatment with VAM, PSB along with application of FYM @ 10t/ha”. The yield attributes namely maximum no of pods/plants, kernels/pod and pod yield was also recorded in the.

3.8 Pods per Plant

At 100 DAS, the data recorded more 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.

"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" [8].

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

No.	Treatment combination	Plant height (cm)	Dry weight (g)	CGR ($g/m^2/day$)	RGR (g/g/day)
1.	S_1(1st April) + 100% RDN through inorganic	69.52	33.36	10.97	0.0107
2.	S_1 (1st April) + 100% RDN through FYM	64.99	22.63	4.60	0.0057
3.	S_1 (1st April) + 100% RDN through Vermicompost	66.85	25.79	2.20	0.0024
4.	S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through FYM	71.18	39.58	13.09	0.0111
5.	S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost	72.00	41.54	15.05	0.0123
6.	S_2(15th April) + 100% RDN through inorganic	62.46	26.41	11.39	0.0148
7.	S_2 (15th April) +100% RDN through FYM	57.43	18.69	7.52	0.0136
8.	S_2 (15th April) +100% RDN through Vermicompost	58.57	19.80	3.67	0.0056
9.	S_2 (15th April) +50% RDN (inorganic) + 50% RDN through FYM	70.77	30.00	6.59	0.0070
10.	S_2 (15th April) + 50% RDN (inorganic) + 50% RDN through Vermicompost	71.13	27.53	8.63	0.0087
	F Tab (5%)	S	S	NS	NS
	SEm (±)	2.23	1.29	3.10	0.003
	CD (p=0.05%)	6.23	3.60	3.65	0.01

Table 2. Effect of date of sowing and INM on yield attributes of summer groundnut

S.No.	Treatment combinations	Pods/plant	Seeds/pod	Seed index
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 3. Effect of Date of Sowing and INM on yield attributes 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

3.9 Seed Index (G)

At 100 DAS, the data recorded higher test weight (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.

"Early and plentiful availability of nitrogen to plants favourably influenced the kernel development and kernel size, which ultimately resulted in seed index" [9].

3.10 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" [10].

3.11 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.

Combined use of manures and fertilizers caused a significant effect on pod yield over their sole application and control [11].

3.12 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.

"The application of RDF -NPK + Rhizobium + VAM + PSB showed higher increased in content and uptake of NPK in kernel and haulm yield of the crop which might be due to improved inherent nutrient supplying capacity of nutrients material, complexing of nutrients, particularly of micronutrient" [12-18].

3.13 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.

4. CONCLUSION

From the observations, it was concluded that with the combination of S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through Vermicompost in treatment no. 5 significantly recorded higher in all the growth and yield attributes namely, plant height, dry weight, pods per plant, seeds per pod, seed index, seed yield, pod yield and haulm yield.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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