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

ABSTRACT

A Field experiment was conducted during *Zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). 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), available P (32.30 kg/ha) and available K (350 kg/ha). 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 (1^{st} and 15^{th} April), whose effect was observed on groundnut. The experiment was laid out in Randomized Block Design with ten treatments each replicated thrice. 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(1^{ST} 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(1^{ST} April) + 50% RDN (inorganic) + 50% RDN (Vermicompost).

Keywords: Date of Sowing, INM, *Yield and yield attributes.*

INTRODUCTION

Groundnut (*Arachis hypogaea*), commonly known as earthnut or peanut, is a globally significant crop cultivated for its nutritious and oil-rich seeds. It plays a vital role in sustainable agriculture, contributing to food security and economic development, particularly in tropical and subtropical regions. To meet the increasing demand for groundnut products and address the challenges associated with nutrient management, comprehensive research is necessary to enhance its productivity.

Groundnut cultivation spans over 100 countries, with Asia and Africa being the primary production regions. Its adaptability to diverse agro-climatic conditions positions it as a major

oilseed crop worldwide. In India, 80 per cent of the total produce is used for oil extraction, 11 per cent as seed, 8 per cent as direct food and only 1 per cent produce is exported. India contributes about 20 per cent area and less than 10 per cent of oil seed production of world. Whereas, groundnut accounts 40 per cent of the area (8 million/ha) and 30 per cent of the production (6.25 million tonnes) of total oil seed grown in India (Agriculture Statistics at Glance, 2009-10).

The growth and yield of groundnut are greatly influenced by environmental conditions, particularly temperature and moisture availability.

Early sowing allows groundnut crops to take advantage of residual soil moisture from the previous season and longer growing seasons. This can result in improved vegetative growth, earlier flowering, and increased pod development. By establishing the crop earlier, groundnut plants have more time to mature, enhancing the chances of achieving higher yields.

Nitrogen (N) is a vital nutrient for plants and is particularly important for groundnut due to its high nutrient demands throughout its growth cycle.

Proper nitrogen management involves a combination of different approaches, including organic and inorganic sources, to provide a balanced supply of nitrogen to the crop. This integrated approach aims to enhance nitrogen use efficiency, minimize nutrient losses, and promote sustainable agriculture.

Integrating organic sources of nitrogen, such as farmyard manure, poultry manure, sheep manure, and neem cake, can provide a sustainable and environmentally friendly approach to nutrient management in groundnut cultivation. These organic amendments not only supply nitrogen but also contribute to improving soil fertility, enhancing soil structure, and promoting microbial activity.

By combining organic and inorganic nitrogen sources and applying them at appropriate times, farmers can enhance nitrogen use efficiency, improve crop performance, and contribute to sustainable groundnut production systems.

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

RESULTS AND DISCUSSIONS

Growth parameters

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

Plant height (cm)

At 100 DAS, Higher plant height (72.00 cm) was recorded in S_1(1^{st} April) + 50% RDN through inorganic + 50% RDN through Vermicompost. However, S_1(1^{st} April) + 100% RDN through inorganic (69.52 cm), S_1(1^{st} April) + 100% RDN through Vermicompost (66.85 cm), S_1(1^{st} 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 (**Janjilwad *et al.* (2015)**, **Rahevar *et al*. (2015)** and **Sunil *et al.* (2021)**.

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 DMP (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 **Patel *et al.* (2006)**.

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.

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)].

Yield attributes

Table. 2 and 3 Pertaining the details of Effect of Date of Sowing and Integrated Nitrogen

Management on yield attributes of Summer Groundnut.

Seeds per pod

At 100 DAS, the data recorded more seeds/pod (2.13) in treatment no.5 [S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through Vermicompost]. However, treatment no.4 [S_1 (1^{st} 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.

Pods per plant

At 100 DAS, the data recorded more pods/plant (48.00) in treatment no.5 [S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through Vermicompost]. However, treatment no.4 [S_1 (1^{st} 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 (**Akshaya *et al.* 2022**).

Seed index (g)

At 100 DAS, the data recorded higher test weight (43.66 g) in treatment no.5 [S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through Vermicompost]. However, treatment no.4 [S_1 (1^{st} 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 (**Bala *et al*. 2011**).

Seed yield (t/ha)

At 100, the data recorded higher seed yield (3.14 t/ha) in treatment no.5 [S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through Vermicompost]. The minimum seed yield (1.18 t/ha) was observed in S_2 (15^{th} 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 (**Anil *et al.* 2017**).

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 **(Chaudhari and Choudhary 2022**)

Haulm yield (t/ha)

At 100 DAS, the data recorded higher haulm yield (7.03 t/ha) in treatment no.5 S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through Vermicompost. However, treatment no.4 S_1 (1^{st} 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 (**Pandaya and Singh, 1988**).

Harvest index (%)

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

CONCLUSION

From the observations, it was concluded that with the combination of S_1 (1^{st} 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.

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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(1^{st} April) + 100% RDN through inorganic	69.52	33.36	10.97	0.0107
2.	S_1 (1^{st} April) + 100% RDN through FYM	64.99	22.63	4.60	0.0057
3.	S_1 (1^{st} April) + 100% RDN through Vermicompost	66.85	25.79	2.20	0.0024
4.	S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through FYM	71.18	39.58	13.09	0.0111
5.	S_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through Vermicompost	72.00	41.54	15.05	0.0123
6.	S_2(15^{th} April) + 100% RDN through inorganic	62.46	26.41	11.39	0.0148
7.	S_2 (15^{th} April) +100% RDN through FYM	57.43	18.69	7.52	0.0136
8.	S_2 (15^{th} April) +100% RDN through Vermicompost	58.57	19.80	3.67	0.0056
9.	S_2 (15^{th} April) +50% RDN (inorganic) + 50% RDN through FYM	70.77	30.00	6.59	0.0070
10.	S_2 (15^{th} 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