Effect of Date of Sowing and INM (Integrated Nitrogen Management) on Growth and Yield 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 wassandyloamintexture,nearlyneutralinsoilreaction(pH7.4),lowinorganiccarbon(0.58 %), available N (225 kg/ha), available P (32.30 kg/ha) and available K (350 kg/ha). Thetreatment 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)] asbasalapplication and 2 Dates of Sowing (1st and 15th April),whoseeffectwasobservedongroundnut.Theexperiment was laid out in Randomized Block Design with ten treatments each replicatedthrice. The result showed that growth parameters of Groundnut *viz*., maximum plant height(72.00 cm), dry weight (41.54 g/plant), crop growthrate (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 significantlyhigher 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 withapplicationofS_1(1ST April) + 50% RDN (inorganic) + 50% RDN (Vermicompost).

Comment [A1]: kg.ha^{-1}

Comment [A2]: The sentence structure in the abstract needs to be rearranged: Aims, study design, place and duration of study, methodology, results, and conclusion

Keywords: Date of Sowing,INM, *Yield, Economics.*

INTRODUCTION

Groundnut (*Arachis hypogaea*), also known as earthnut, goober, pindar, monkey nut etc., is a legume mainly grown for its edible seeds Groundnut is importantforsustainableagricultureasitimprovesthephysio-chemical and biological properties of the soil. Its deep roots also open the soil, which ensure betteraeration and heavy leaf drop

increases the organic matter in the soil. 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. 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(**Nair *et al,* 1982**). 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**(*Prasad*, 2005)**. 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 **(Chakraborthi and Singh 2004)**.

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 **(Chaudhary *et al.,* 2015)**.

It 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.

Comment [A3]: the number of citations is very small, it is necessary to add citations from the latest recent research in this field

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 (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. Groundnut variety Kadiri-6 was used for experiment. Recommended nutrient dose 20-40-40 kg/ha wasappliedin 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 asnumber 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).

Comment [A4]: Material and Methods with subtitle : area study, experimental design, data collection methods/measurement of research results, data analysis

RESULTS AND DISCUSSIONS

Yield attributes

Table.1 and 2 Pertaining the details of Effect of Date of Sowing and Integrated Nitrogen Management ongrowthattributesofSummer Groundnut.

Seeds per pod

At 100 DAS, the data recorded highernumberofseed/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.

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Pods per plant

At 100 DAS, the data recorded higher number of pods/plant (48.00) in treatment no.5no.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 (**Akshaya *et al.* 2022**).

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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 (**Bala*et al.* 2011**).

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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)wasobserved 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**).

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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)**.

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Haulm yield (t/ha)

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

Comment [A10]: In the discussion it is necessary to compare with the results of research from other researchers.

Harvest index (%)

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

Economics

Table.3 Pertaining the details of Date of Sowing and Integrated Nitrogen Management ongrowthattributesofSummer Groundnut.

Gross return (INR/ha)

ThemaximumgrossreturnwasrecordedinS_1 (1^{st} April) + 50% RDN (inorganic) + 50% RDN through Vermicompost (129,200₹/ha) in treatment no. 5.

Net return (INR/ha)

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.

B C ratio

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.

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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.

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Table 1: EffectofDate of SowingandINM on yield attributes of Summer groundnut.

S.No.	Treatment combinations	Pods/plant	Seeds/pod	Seed index (g)
1.	S_1(1st April) + 100% RDNthrough 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 throughVermicompost	48.00	2.13	43.66
6.	S_2(15th April) + 100% RDNthrough 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:EffectofDate of SowingandINM onpost-harvest observationsof Summer Groundnut.

S.No.	Treatment combinations	Pod yield (t/ha)	Seed yield (t/ha)	Haulm yield (t/ha)	HarvestIndex (%)
1.	S_1(1st April) + 100% RDNthrough 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 throughVermicompost	3.23	3.14	7.03	30.62
6.	S_2(15th April) + 100% RDNthrough 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: EffectofDate of SowingandINM on economics of Summer Groundnut

S.No	Treatmentcombination	Cost ofcultivation (₹/ha)	Grossr eturn (₹/ha)	Netr eturn (₹/ha)	B:Cratio
1	S_1(1st April) + 100% RDNthrough inorganic	32,865	1,17,200	84,335	2.56
2	S_1 (1st April) + 100% RDN through FYM	33,549	97,200	63,351	1.89
3	S_1 (1st April) + 100% RDN through Vermicompost	52,116	1,00,000	47,884	0.91
4	S_1 (1st April) + 50% RDN (inorganic) + 50% RDN through FYM	33,207	1,24,000	90,793	2.73
5	S_1 (1st April) + 50% RDN (inorganic) + 50% RDN throughVermicompost	42,439	1,29,200	86,761	2.04
6	S_2(15th April) + 100% RDNthrough inorganic	32,865	1,05,200	72,335	2.20
7	S_2 (15th April) +100% RDN through FYM	33,549	88,000	54,451	1.62
8	S_2 (15th April) +100% RDN through Vermicompost	52,116	90,800	38,684	0.74
9	S_2 (15th April) +50% RDN (inorganic) + 50% RDN through FYM	33,207	1,12,000	78,793	2.37
10	S_2 (15th April) + 50% RDN (inorganic) + 50% RDN through Vermicompost	42,439	1,16,000	73,561	1.73