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Growth Characteristics, Yield Attributes and Quality of Groundnut (*Arachis hypogaea* L.) as Affected by Integrated Nutrient Management and Moisture Conservation Practice

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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

The experiment was conducted in the Department of Soil Conservation and Water Management at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh during the Zaid season of 2022 and 2023. In the experiment, five integrated nutrient management practices were tested- F_1: 100% RDF, F_2: 75% RDF + 2.5 ton/ha Press mud, F_3: 75% RDF + 2.5 ton FYM/ha, F_4: 50% RDF + 5 ton/ha Press mud + 5 kg Borax/ha, and F_5: 50% RDF + 5 ton FYM/ha + 5 kg Borax/ha. Three moisture conservation options were also tested- M_1: Farmer practices, M_2: Dust

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mulching, and M_3: Imazathapyr @ 1l/ha + Dust mulching to evaluate the Effect of Integrated Nutrient Management and moisture Conservation practice on Groundnut production (*Arachis hypogaea* L.). The result showed that INM protocol F_4 - 50% RDF + 5 t press mud/ha + 5 kg Borex/ha, Pooled data reveals that plant height (43.07 cm), fresh weight (96.95 g), dry weight (26.06 g), no. of pod/plant (36.45), 100 test weight (46.20 g), protein content (29.89 %) and oil content (43.89%) of groundnut were recorded as significantly higher to comparing other Integrated Nutrient Management practices. However, Moisture practices M_3 - M3-Imazathapyr @ 1L ha + Dust mulching, Pooled data reveals that plant height (42.28 cm), fresh weight (90.78 g), dry weight (25.07 g), no. of pod/plant (33.96), 100 test weight (43.16 g), protein content (28.59 %) and oil content (42.53%) of groundnut was recorded significantly higher values compared to other moisture practices.

Keywords: Growth characteristics; nutrient management; groundnut production.

1. INTRODUCTION

Groundnut, also known as peanut (*Arachis hypogaea* L.), is a legume crop that belongs to the Fabaceae family (also known as Leguminosae). It is commonly referred to by many names such as earthnuts, peanuts, goober peas, pindas, jack nuts, pinders, manila nuts, g-nuts and monkey nuts. Like most other legumes, peanuts harbor symbiotic nitrogen-fixing bacteria in root nodules. The capacity to fix nitrogen means peanuts require less nitrogen-containing fertilizer and improve soil fertility, making them valuable in crop rotations.

Groundnut is an important oilseed crop in India that ranks first in cultivation area and second in production after soyabean. China is the world's largest producer of groundnuts with 17.57 million tonnes, followed by India with 6.73 million tonnes, Nigeria with 4.45 lakh tonnes, Sudan with 2.83 million tonnes, and the United States of America with 2.49 million tonnes. These five countries account for 36.01%, 13.79%, 9.12%, 5.80%, and 5.11% of the total world production of 48.80 million tonnes in 2019-20 Anonymous [1]. According to the 1st advance estimates, groundnut production estimate (kharif) was 82.54 lakh tonnes for 2021-22, against 85.56 million tonnes in 2020-21 (kharif). Groundnut Outlook - March 2023.

Groundnuts are a great source of nutrition as they contain high-quality edible oil, which makes up around 48% of the seed. They also contain easily digestible protein, about 26%, and carbohydrates, about 20% of the seed. Groundnuts are mainly grown as a Kharif crop under rainfed conditions. They are now also grown in the summer due to increased irrigation facilities and higher yield production.

The combination of organic and inorganic sources for nutrient supply has been found to be the most effective in increasing productivity and maintaining sustainability. Therefore, there is potential to further increase productivity by using a combination of various nutrient sources. Groundnut is a major oilseed crop and an important food legume that provides oil and protein to ensure nutritional security for a population of over one billion in our country. Hence, it is necessary to improve the nutritional aspects of groundnut in order to achieve better productivity. However, to sustain the desired crop productivity, there is a need for an integrated application of alternative sources of nutrients [2]. In order to achieve optimum growth, yield and quality of crops, it is essential to maintain soil fertility and supply plant nutrients in a balanced proportion. This can be achieved by practicing an integrated nutrient supply system that involves the combined use of organic, biological and chemical sources of plant nutrients. It is important to tailor this approach to the specific agro-ecological situation in which it is being implemented.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted during Zaid season 2022 and 2023 in the Department of Soil Conservation and Water Management, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh.

2.2 Climatic Conditions

Kanpur is located in the Central Pain Zone of Uttar Pradesh and subtropical region of North India. It is situated between latitudes ranging from 25º 56’ to 28º 58’ North and longitude 79º

31' to 80º 34' East and is situated at an elevation of approximately 125.9 meters above mean sea level in the gangetic plain region. The region receives a seasonal rainfall of about 816 mm, which is mostly received from the second fortnight of June or the first fortnight of July to mid-October, with a few showers in the winter season.

2.3 Experimental Details

The experiment was laid out in Randomized Block Design (RBD) with 5 Treatments replicated thrice and assigned to 15 plots. The treatment comprised F_1 - 100% RDF, F_2 - 75% RDF + 2.5 t /ha Press mud, F_3 -75% RDF + 2.5 t FYM/ha, F_4 - 50% RDF + 5.0 t Press mud + 5 kg Borax /ha, F_5 - 50% RDF + 5 t FYM/ha + 5 kg Borax /ha, I_1– Farmer Practices, I_2 – Dust Mulching, I_3– Imazathapyr @ 1 ha + Dust mulching.

2.4 Fertilization

The experimental field was ploughed once with a soil-turning plough and two ploughings with cultivator followed by planking for uniform level field. Basal application are based on treatments 100% RDF, 75% RDF + 2.5 t /ha Press mud, 75% RDF + 2.5 t FYM/ha, 50% RDF + 5.0 t Press mud + 5 kg Borax /ha, 50% RDF + 5 t FYM/ha + 5 kg Borax /ha were applied uniformly in the form of urea, DAP and muriate of potash. The 100% recommended dose of fertilizer (20:40:20:20kg NPKS ha^{-1}) was applied according to treatment plot before sowing.

2.5 Seed and Sowing

The variety of Groundnut seed used in this study is Avtar 100 kg/ha, which was released by Chandra Shekhar Azad University of Agriculture & Technology (U.P.) Kanpur. It was sown in a well-manured field with a spacing of 30x10 cm and a depth of 5-7 cm. The plot size used for the study was 5 m x 3.6 m = 18 m2.

2.6 Observations Recorded

The observed parameters of growth, yield attribute and quality were characterized as plant height (cm) at maturity, fresh weight per plant at maturity dry weight per plant at maturity, No. of pod per plant, 100-seed weight (g), Protein content (%) and Oil content (%) had to be determined. Data obtained was exposed to the proper method for statistical analysis of variance difference among mean of different treatments as described by Gomez and Gomez. The treatment means were compared using the Least Significant Differences (LSD) test at a 5% level of probability by using the Randomized Block Design (RBD) model as obtained by SPSS (Statistical Product and Service Solutions) Version 10.0, SPSS, Chicago and IL software.

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

The growth attributes of groundnut as influenced by integrated nutrient management and moisture conservation practices. The data in Table 1 showed that growth parameters *viz*., plant height, number of branches $plant^{-1}$ and number of plant leaves were recorded significantly heights by the integrated nutrient management at F_4: - 50% RDF + 5.0 t Press mud + 5 kg Borax /ha followed by F_2- 75% RDF + 2.5 t /ha Press mud. Higher plant height (43.07 cm) in pooled basis. This was because of availability of nutrients under the treatment receiving organic sources supplemented with press mud at 50% RDF + 5.0 t Press mud + 5 kg Borax /ha which provided better nourishment and enhanced the metabolic process in the plant and promoted the cell division and cell expansion and thereby stem elongation which virtually increased the plant growth in terms of plant height Similar result was found by Kausale et al. [3] and Diaz [4]. Higher fresh weight per plant (96.95 g) on pooled basis, might be due to utilization of nutrients and better proliferation of roots resulting in better growth. These results were in conformity with the findings of Baishya et al. [5]. The higher number of plant dry weight (26.06 g) pooled basis is because the accelerated vegetative growth resulted in an extensive photosynthetic apparatus and relative increase was recorded in growth. Similar results were found by Pannu et al. [6].

The data given in Table 1 showed that highest plant height (42.28 cm), fresh weight per plant (90.78 g) dry weight per plant (25.07 g) in pooled basis recorded highest in M_3: – Imazathapyr @ 1 ha + Dust mulching as compared to M_2: Dust Mulching, and M_1: Farmer Practices. This might be due to hyper-suppressed weed growth which result in minimizing competition for moisture and nutrient thus creating favourable soil environment for better growth and development of groundnut crop. This is in conformity with the results of Choudhary et al. [7].

Table 1. Growth parameters with Integrated nutrient management

Treatments	Plant height (cm)			Fresh weight			Dry Weight g		
	At Maturity			At Maturity			At Maturity		
	2022	2023	Pooled	2022	2023	Pooled	2022	2023	Pooled
Integrated nutrient management									
F_1 - 100% RDF	34.50	38.61	36.56	75.03	79.60	79.31	21.47	22.79	22.13
F_2 - 75% RDF + 2.5 t Press mud/ ha.	38.85	44.06	41.55	88.21	93.16	90.68	23.97	25.25	24.61
F_3 .75% RDF + 2.5 t FYM/ ha.	35.51	38.45	36.98	78.62	82.23	80.42	21.72	22.76	22.24
F_4 . 50% RDF + 5 t press mud/ha + 5 kg Borex/ha	40.16	45.98	43.07	93.84	100.07	96.95	25.48	26.64	26.06
F_5 .50% RDF + 5 t FYM/ha + 5 kg Borex/ha	36.67	39.89	38.28	82.44	87.89	85.16	22.76	24.43	22.59
Se(d)	0.84	0.94	0.89	1.89	2.00	1.94	0.52	0.55	0.53
CD at 5%	1.72	1.93	1.82	3.89	4.13	4.01	1.07	1.13	1.1
Moisture conservation practice									
M_1-Farmer Practice	34.72	39.33	37.02	80.24	84.60	82.42	22.14	23.24	22.69
M_2–Dust mulching	36.28	40.71	38.49	82.83	87.45	85.14	22.79	24.06	23.42
M_3-Imazathapyr @ 1 ha + Dust mulching	40.41	44.16	42.28	87.84	93.72	90.78	24.32	25.83	25.07
Se(d)	0.65	0.73	0.69	1.46	1.55	1.50	0.40	0.42	0.41
CD at 5%	1.34	1.50	1.42	3.02	3.20	3.11	0.83	0.88	0.85

Table 2. Yield parameters with Integrated nutrient management

Treatments	Yield attributing character					
	no. of pod/plant			100 Test weight		
	2022	2023	Pooled	2022	2023	Pooled
Integrated nutrient management						
F_1 - 100% RDF	26.51	26.99	26.75	35.86	36.99	36.42
F_2 - 75% RDF + 2.5 t Press mud/ ha.	33.84	35.14	34.49	44.13	44.71	44.42
F_3 -75% RDF + 2.5 t FYM/ ha.	28.21	28.71	28.46	38.02	38.76	38.39
F_4 - 50% RDF + 5 t press mud/ha + 5 kg Borex/ha	36.29	36.61	36.45	45.81	46.59	46.20
F_5 -50% RDF + 5 t FYM/ha + 5 kg Borex/ha	31.52	31.96	31.74	39.52	40.53	40.02
Se(d)	0.71	0.72	0.71	0.92	0.94	0.93
CD at 5%	1.46	1.49	1.47	1.89	1.93	1.91
Moisture conservation practice						
M_1-Farmer Practice	28.99	30.11	29.55	39.23	39.81	39.52
M_2–Dust mulching	31.11	31.33	31.22	40.18	40.99	40.58
M_3-Imazathapyr @ 1 ha + Dust mulching	33.72	34.21	33.96	42.59	43.74	43.16
Se(d)	0.55	0.56	0.55	0.73	0.73	0.73
CD at 5%	1.13	1.15	1.14	1.47	1.50	1.48

Table 3. Quality parameters with Integrated nutrient management

Treatments	Protein content (%)			Oil content (%)		
	2022	2023	Pooled	2022	2023	Pooled
Integrated nutrient management						
F_1 - 100% RDF	26.79	26.90	26.84	41.05	41.21	41.13
F_2 - 75% RDF + 2.5 t Press mud/ ha.	28.31	30.12	29.21	42.97	43.03	43.00
F_3 -75% RDF + 2.5 t FYM/ ha.	26.99	27.44	27.21	41.32	41.58	41.45
F_4 . 50% RDF + 5 t press mud/ha + 5 kg Borex/ha	29.18	30.60	29.89	43.81	43.97	43.89
F_5 .50% RDF + 5 t FYM/ha + 5 kg Borex/ha	27.94	28.49	28.21	41.42	41.90	41.66
Se(d)	0.63	0.65	0.64	0.95	0.95	0.95
CD at 5%	1.29	1.33	1.31	1.95	1.96	1.95
Moisture conservation practice						
M_1-Farmer Practice	27.71	28.41	28.06	41.,84	42.03	41.93
M_2–Dust mulching	27.77	28.58	28.17	42.09	42.31	42.20
M_3-Imazathapyr @ 1 ha + Dust mulching	28.05	29.14	28.59	42.40	42.66	42.53
Se(d)	0.48	0.50	0.49	0.73	0.74	0.73
CD at 5%	NS	NS	NS	NS	NS	NS

3.2 Yield Components

The yield attributes of groundnut as influenced by integrated nutrient management and moisture conservation practices. The data in Table 2 showed that yield parameter *viz* number of pod per plant (36.45), 100 test weights (46.20 g) were significantly highest on the pooled basis by the integrated nutrient management at F_4: 50% RDF + 5.0 t Press mud + 5 kg Borax /ha followed by F2 - 75% RDF + 2.5 t /ha Press mud. This was because of availability of nutrients under the treatment receiving organic sources supplemented as well as availability of different nutrients, with press mud and FYM, helped to development leading to high water potential, stomatal conductance, higher photosynthesis, partitioning of photosynthates to sink consequently increasing pods per plant and the 100-test weight. This is in conformity with the result of Baishya et al. [5].

The data in Table 2 showed that the highest number of pod per plant (33.96) in pooled basis were recorded as significantly highest and 100 test weight (43.16 g) in pooled basis were recorded non-significantly in M_3: – Imazathapyr @ 1 ha + Dust mulching as compared to M_1: Farmer Practices, and M_2: Dust Mulching. This was because of better growth and development of groundnut under moisture conservation practices in M_3 treatment thus resulting in better yield component of groundnut. Similar results were found by Nithisha et al. [8] and Regar et al. [9].

3.3 Quality

The quality parameters of groundnut as influenced by integrated nutrient management and moisture conservation practices. The data in Table 3 showed that quality parameters viz., protein content (29.89%), and oil content (43.89%) were significantly highest by the integrated nutrient management at F4: 50% RDF + 5.0 t Press mud + 5 kg Borax /ha followed by F2 - 75% RDF + 2.5 t /ha Press mud. This might be due to the combination of organic sources and press mud enhanced nutrient availability, further boosting the quality of groundnut. This result also confirms the findings of Joshi et al. [10] and Haneena et al. [11].

The data in Table 3 showed that higher protein content (28.59 %), and oil content (42.53 %) in pooled basis recorded highest in M_3 Imazethapyr @ 1 ha + Dust mulching as compared to M_2: Dust Mulching and M_1: Farmer Practices. This was because of better development and more nutrient availability that resulted to better protein content and oil content. This is in conformity with the result of Kumari et al. [12-16].

4. CONCLUSION

After conducting a two-year experiment, it has been concluded and recommended that the best treatment for achieving maximum growth, yield attributes, and quality of groundnut (*Arachis hypogaea* L.) is a combination of F4 - 50% RDF + 5 t press mud/ha + 5 kg Borex/ha and M3-Imazathapyr @ 1 ha + Dust mulching. This treatment is also beneficial for maintaining soil sustainability.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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