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Assessment of Organic, Inorganic and Integrated Nutrient Management Practices on Yield and Economics of Groundnut during the *Kharif* Season

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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

Achieving sustainable and balanced food production is a difficult task given the rising food demand brought on by the world's fastest population growth. Taking this into account, an On Farm Trial (OFT) on the effect of organic, inorganic and Integrated Nutrient Management (INM) practices on groundnut growth, yield attributes, yield and economics was conducted in 5 locations at Krishi Vigyan Kendra (KVK) operated mandals in Kalikiri during the *Kharif* seasons from 2021-2022 to

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2023-2024 on 2.0 ha of rainfed alfisols.
The study revealed that INM practice recorded higher yield attributes, pod yield, gross return, net return and return per rupee invested than organic and inorganic nutrient management practices. The improvement in pod yield in INM was 11.9% and 7.8% over organic and inorganic nutrient management practices, respectively. Similarly, INM recorded higher gross returns (63,637 Rs. /ha), net returns (22,983 Rs. /ha) and B:C ratio of 1.56 as compared to organic and inorganic nutrient management practices. Results of the study suggested the integrated use of organic and inorganic sources of nutrition for increasing groundnut productivity and economic stability of groundnut farmers of Chittoor district.

Keywords: Groundnut; production; nutrient management practices; groundnut economics.

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important food and oilseed crop farmed and consumed worldwide. Because of its high protein content, it is widely recognized as an excellent source of nutrition for people and animals. According to FAO, globally, groundnut covers 327 lakh hectares area with a production of 539 lakh tonnes with a productivity of 1648 kg per hectare [1]. The groundnut area, productivity and output over the last five years in the major Indian groundnut-growing states show that Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Rajasthan account for 87 percent of the groundnut area and 85 percent of the production [2]. Gujarat is the largest producer, accounting for 36% of total groundnut production, followed by Rajasthan (17%) and Tamil Nadu (7.5%). Andhra Pradesh and Telangana account for 5.13 and 3.23 percent of national groundnut production, respectively [3]. Groundnut production contributes around 82.3 percent of acreage and 18.7 percent of production to total oil seeds in Andhra Pradesh. In Andhra Pradesh, It is primarily grown in the Rayalaseema districts of Anantapur, Kadapa, Kurnool, and Chittoor, followed by coastal areas (Nellore, Guntur and Prakasam districts). Chittoor has the second-highest groundnut area and output in Andhra Pradesh, after Ananthapur [4,5,6,7,8]. Groundnut is grown on 1.33 lakh hectares in Chittoor, yielding 1.54 lakh tonnes with a productivity of 1160 kg per hectare, which is far below than country and global average [9]. The reasons for low productivity might be due to rainfed cultivation, monoculture, poor soil fertility and low input levels. Because groundnut has a high nutrient need, optimizing mineral nutrition is critical for optimizing yield. On the contrary, groundnut farmers use relatively little fertilizer, resulting in severe mineral nutrient deficits, which are one of the leading causes of low groundnut output [10]. Organic farming promotes nutrient balance in crops by nurturing soil health, supporting beneficial microbial communities and reducing environmental impacts. However, it is frequently criticized for producing lower yields [11]. As a result, yield generation is one of the key constraints in organic farming, implying a greater area should be cultivated organically to generate the same amount of yield as conventional farming to meet the food demands of the expanding population [12]. One of the important strategies towards increasing crop productivity includes improved nutrient management practices by integrating organic manures, inorganic fertilizers and biofertilizers for supplying plant nutrients in accordance with the crop demand [13]. In the Chittoor district, there is minimal information on the integrated use of organic and inorganic plant nutrients for groundnut. With this in mind, the current On Farm Testing (OFT) was conducted in the western mandals of Chittoor district to gain a better understanding of improved nutrient management in groundnut for better growth, increased productivity and higher profitability.

2. MATERIALS AND METHODS

OFTs on assessment of Integrated Nutrient Management (INM) in groundnut was conducted in 5 locations at KVK operated mandals of Krishi Vigyan Kendra (KVK), Kalikiri during the *Kharif* seasons from 2021-2022 to 2023-2024 in 2.0 ha area to assess the impact of organic, INM and inorganic nutrient management practices on growth, yield attributes, yield and economics of groundnut. A high-yielding groundnut variety Narayani released from the Regional Agricultural Research Station (RARS), Tirupati was used for the study. The recommended dose of fertilizer (RDF) was 20:40:50 kg N: P_2O_5: K_2O: ha^{-1}. A package of practices recommended for the region was followed. Treatment-wise source of nutrition, application, seed treatment chemical and plant protection measures followed were depreciated in Table 1.

Table 1. Treatment wise source of nutrition, seed treatment and plant protection measures followed

Treatments	Source of nutrition	Weed management	Seed treatment	Plant protection
Organic	-Apply FYM @ 10 t/ha at last ploughing -Trichoderma @ 5 kg/ha in 250 kgs FYM and apply at last Plough -PSB and KSB @ 1000ml in 100 kgs FYM and apply at the time of sowing	-Hand weeding/ Mechanical weeding	-Seed Treatment with Rhizobium @ 10 ml/kg seed	-Erection of bird perches -Need based plant protection with neem oil -Pheromone traps @ 20 No./ha & sticky traps @ 12 No./ha3 rows Bajra or Jowar as a border crop
INM	-Apply FYM @ 10 t/ha at last ploughing -Application of 100 % recommended dose of fertilizers (20-40-50 $N:P_2O_5:K_2O$ @ kgs/ha) based on soil test values.	-Pre emergence application of pendimethalin @2.5 kg/ha fb one hand weeding at 30 DAS	-Seed treatment with Imidachloprid 17.8 % SL @ 2 ml/ kg Seed fallowed by Mancozeb @ 3 g/ kg seed	-Need based chemical plant protection measures
Farmers Practice (Inorganic)	-Application of complex fertilizers without considering soil test values	-Herbicides	-No seed treatment	-Need based chemical plant protection measures

Table 2. Growth, yield attributes and yield of groundnut as influenced by INM practices

Year	Plant population (m^2)			No. of Pods/plant			100 Kernel weight (g)			Yield (Kg/ha)		
	Organic	INM	Inorganic	Organic	INM	Inorganic	Organic	INM	Inorganic	Organic	INM	Inorganic
2021-22	27	26	24	12	13	12	42.8	42.6	42.4	800	920	840
2022-23	26	27	25	9	12	10	44.2	45.2	45.0	964	1074	986
2023-24	25	28	29	5	6	6	39.6	40.3	39.8	480	517	502
Mean	**26**	**27**	**26**	**9**	**10**	**9**	**42.2**	**42.7**	**42.4**	**748**	**837**	**776**

Table 3. Economics of groundnut production as influenced by INM practices

Years	Cost of cultivation (Rs ha^{-1})			Gross return (Rs ha^{-1})			Net return (Rs ha^{-1})			Return Re^{-1} invested		
	Organic	INM	Inorganic	Organic	INM	Inorganic	Organic	INM	Inorganic	Organic	INM	Inorganic
2021-22	41260	40260	38470	60000	69000	63000	18740	28740	24530	1.45	1.71	1.64
2022-23	43838	41580	39688	72300	80550	73950	28462	38970	34262	1.65	1.94	1.86
2023-24	41214	40122	39118	38400	41360	40160	-2814	1238	1042	0.93	1.03	1.03
Mean	**42104**	**40654**	**39092**	**56900**	**63637**	**59037**	**14796**	**22983**	**19945**	**1.35**	**1.56**	**1.51**

**Sale price of groundnut at farmers field was Rs.75/- per kg during 2021-22 and 2022-23 and the price was Rs.80/- per kg in 2023-24*

The observation on plant population m^{-2} and number of pods/plant was recorded from 10 plants, which were randomly selected from each location at the time of harvest. At the time of maturity, the net plots (50 m^2) produced were harvested, threshed and sundried in the field. After threshing, cleaning and drying the pod yield was recorded and expressed in kg/ha. Data on the economics of groundnut production were calculated by keeping a record of operations performed, labour employed, power and inputs used. The authors calculated the costs of various cultural operations using fixed and variable costs. The costs of common cultural operations for all treatments, such as seeds, field preparation and irrigation are fixed, while those that vary with treatments, such as fertilizer and organic input costs, plant protection measures and their application and harvesting are variable. The cost of inputs on account of different treatments was added to the common cost of cultivation of groundnut crops to arrive at the total cost of cultivation. The gross return was computed using the selling price of farmers. Net return was estimated by subtracting total cultivation costs from gross return. The return per rupee invested was, thus, calculated by dividing gross return by the total cost of cultivation.

3. RESULTS AND DISCUSSION

The data pertaining to plant population, number of pods/plants, 100 kernel weight and pod yield were presented in Table 2. The effect of different nutrient management practices did not show any effect on plant population and the plant population stand in all the treatments are below the optimum population as recommended by the university (ANGRAU). Data pertaining to the number of pods on the plan (Table 2) showed considerable variation under different nutrient management practices. Among them, INM recorded greater number of pods/plant (11 pods/plant) over the other two nutrient management practices (Organic and inorganic). A good crop stands with a greater number of pods/plant is critical for good pod yield in groundnut. From the data (Table 2), kernel weight is a very stable varietal character and does not vary much among the nutrient management practices. The data on pod yield of groundnut (Table 2) shows that, the yield in INM (837 kg/ha) was higher than compared to organic (748 kg/ha) and inorganic (776 kg/ha) nutrient management practices. Tested INM practice recorded 11.9% and 7.8% increase in yield over organic and inorganic nutrient management practices, respectively. The greater number of pods/plant and higher pod yield associated to INM could be due to the fact that chemical fertilizers along with organics can promptly provide the appropriate quantity of nutrients in a balanced proportion that coincides with the crop's growth demand. Our results agreed with the study by Chouhan et al. [14] which showed that organic cultivation was less productive than conventional cultivation in terms of yield in rice-wheat cropping system. The study by Kumar et al. [15] also showed that yield in organic and inorganic nutrient management practices alone was lower when compared to INM.

The economics of groundnut cultivation grown under different nutrient management practices was calculated on the basis of prevailing market price of different inputs and outputs. The data on cost of cultivation, gross returns, net returns and return per rupee invested were analyzed and the means are presented in Table 3. The results on the cost of cultivation showed the very striking effect of added nutrients on the economics of groundnut cultivation. Among the treatments, farmers practices (inorganic nutrient management) has the lowest cultivation cost than organic and INM practice of groundnut production. Organic nutrient management practice had the highest cultivation cost (Rs. 42104 ha^{-1}), which recorded 7.7% higher cost of production than farmers practice (inorganic nutrient management). INM practice also recorded a higher cost of production (Rs. 40654 ha^{-1}) which is 4.0 % higher than inorganic nutrient management. The high cost of cultivation in organic and INM practices was due to addition of organic nutrient sources which are required in larger quantity to reach the same soil nutrient levels as a unit weight of chemical fertilizer and moreover the availability and its transport makes the organic nutrient sources more expensive. Similar observations of high production costs in nutrient management practices involving organic sources compared to the inorganic source of nutrition were also observed by Mondal et al. [16] and Mallikarjun et al. [10]. INM practice registered higher gross returns (Rs. 63637 ha^{-1}), net returns (Rs. 22983 ha^{-1}) and return per rupee invested (1.56) than other two nutrient management practices of organic and Inorganic nutrient management. The enhanced yield under INM practice had resulted in economic advantage. Higher gross returns were observed in inorganic nutrient management (Rs. 59037 ha^{-1}) than in organic farming practice (Rs. 56900 ha^{-1}), mainly due to higher pod yield and low cost

of production in inorganic farming practice over organic farming. Similar observation of higher net returns and B:C ratio in Inorganic nutrient management over organic sources of nutrition alone was also noticed by Karunakaran et al [17] and Verma et al. [18]. Under the various nutrient management practices analyzed, INM practice is more profitable than groundnut produced using inorganic and organic farming practices. Tashi et al. [19] made a similar conclusion about paying farmers higher premium prices as a trade-off cost for the output reductions of up to 3-5 years in the crops grown under organic farming.

4. CONCLUSION

According to the study's findings, groundnut performance under INM practice showed a bigger gap in yield characteristics and yield than in organic and inorganic nutrient management practices. Groundnut yield improvement with INM was achieved through the combination of inorganic and organic nutrient sources that worked systematically to deliver nutrients throughout the crop growth period, raising production, enhancing input utilization efficiency, and resulting in economic benefit. It is possible to conclude that, under current conditions, implementing INM methods in groundnut cultivation could result in a greater economic gain, encouraging more farmers to embrace INM practices not only in groundnut but also in other main rainfed crops in Andhra Pradesh's Chittoor district.

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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