The Pharma Innovation Journal 2023; 12(7): 1685-1689

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(7): 1685-1689

www.thepharmajournal.com
Received: 20-04-2023
Accepted: 24-05-2023

TL Thentu
Scientist& Head, Agriculture Research Station, ANGRAU, Andhra Pradesh, India

D Nagarjuna
Scientist & Head, Agriculture Research Station, ANGRAU, Andhra Pradesh, India

Corresponding Author:
TL Thentu
Scientist& Head, Agriculture Research Station, ANGRAU, Andhra Pradesh, India

Impact of soil test-based fertilizer recommendation on groundnut (*Arachis hypogaea* L.) yield and economics in Nellore district, Andhra Pradesh

TL Thentu and D Nagarjuna

Abstract
Frontline demonstration was formulated to evaluate the Soil Test Based Fertilizer Recommendation in Groundnut at farmers' field level at Nellore district. The FLD was conducted with 30 demonstrations with 30 individual farmers during kharif season, 2018-19 to 2020-21 at Annagaripalem, Nadimpalli, Nagayagunta, Kothavangal villages of Nellore district. Soil Test Based Fertilizer application recorded higher plant growth and yield parameters hence there was a significant increase in yield from 3100 (check) to 3453 kg/ha encountered with treatment Soil Test Based Fertilizer application which was a rise of about 11.38%.in case of soil fertility status. An increase in net returns from Rs. 61,415/- to Rs. 87,126/- was recorded with farmers who followed Soil Test Based Fertilizer Recommendation over the farmers practices. High benefit cost ratio was recorded with Soil Test Based Fertilizer application i.e 2.17 over the existing local variety (1.79). The average technology gap and index were recordedas 797 kg/ha and 18.74 percent, respectively. Because of its judicious use of fertilisers, improved soil fertility status at harvest in the demonstration plot compared to farmer practise (local check) will save fertiliser doses.

Keywords: Soil test-based fertilizer recommendation, soil fertility, yield, net returns, benefit cost ratio (B: C ratio)

Introduction

Groundnut is a major cash crop in Andhra Pradesh, where it is grown on an area of 7.35 lakh hectares (Anonymous, 2018) [1] in a wide range of soil types, though it is most commonly cultivated in light textured soils. In SPSR Nellore dist. groundnut is majorly cultivated in coastal sandy soils and red loamy soils during both the season’s kharif and rabi. The district SPSR Nellore has been considered as productively potential region of groundnut due to assured irrigation facilities, precise irrigation management and favorable soil and climate conditions. However, there is a wide gap between the Potential and the actual production realized by the farmers due to imbalanced use of fertilizers by the growers.

The current challenge of crop nutrient management is to balance the nutrients required by the crop with the soil nutrient reserves and external application of nutrients. The soil test is an analysis of a soil sample to find out its nutrient content, composition, and other characteristics such as acidity or pH level. Analysing soil samples for nutrients and other properties like acidity or pH is done using soil tests. An accurate soil test will determine how much fertiliser should be applied to meet the crop's requirements while using the soil's inherent nutrients. Soil testing and soil test-based fertilizer recommendation plays an important role in supplying nutrients in proper amounts and in proper balance to the crops.

Considering the above points, frontline demonstrations were conducted to popularize the soil test-based fertilizer application among the farmers, feasibility of soil test-based fertilizer application was tested. The comparison was made between soil test-based fertilizer application treatment and farmers practice, where they apply high dosage of fertilizers which supply primary nutrient (NPK) alone in the form of straight and complex fertilizers. With an objective to reduce the cost of production of groundnut and subsequently improve the returns from unit in farmers’ fields.

Materials and Methods

Thirty frontline demonstrations were conducted to popularize benefits of soil test based fertilizer application on yield components, yield and economics of groundnut in five villages of Nellore district with an area of 24 hectares from 2018-19 to2020-21.

For each treatment, one-acre plots were selected to carryout frontline demonstration.
In each year of frontline demonstration, soil samples were collected initially from the farmer's fields and analyzed at soil testing lab, Krishi Vigyan Kendra, Nellore (Nellore district). The treatments consisted of

T_1: Farmers Practice – 40 N + 43 P_2O_5 + 36 K_2O kg/ac. (Phosphorous in the form of DAP)

T_2: Soil Test Based Fertilizer Recommendation (STBF){RDF:12 kg N + 16 kg P_2O_5 + 20 kg K_2O /ac (8 kg N as basal and 4 Kg N at 30 DAS, phosphorus in the form of SSP as basal, Zinc sulphate @ 20 kg/ac as basal, 4 kg/ac Borax as basal and 200 kg/ac Gypsum at peg formation stage)}.

A survey was conducted in groundnut-growing regions of SPSR Nellore Dist., and data was collected with the aid of a pre-tested personal interview schedule to quantify farmers' practises. Following the completion of the one-on-one interviews, 20 farmers with a combined 10+ years of experience growing groundnuts in the red loamy soils of Nellore district participated in Focus Group Discussions (FGD). A focus group discussion is a method in which a researcher gathers a small group of people to facilitate a moderated discussion around a predetermined topic. The goal is to learn more about the participants' beliefs, perceptions, and attitudes that aren't as obvious (Morgan, 1996, Kadiri Mohan *et al*. 2020) [10, 6]. Data collected with the individual interviews were cross checked with that of the conclusions drawn from the Focus Group Discussions (FGD) and later the main reason for this difference in yield was identified and that is imbalanced application of fertilizers, irrational use of Nitrogenous, Phosphorus and potassium fertilizers and Phosphorus is applied in the form of Diammonium phosphate (DAP). For fertilizer management, farmers are not implementing soil test results.
Upon validation of the summary of the individual interviews with the Focus Group Discussions (FGD) conclusions on fertilizer management in groundnut in red soils of Nellore Dist. was drawn. Majority of the farmers are applying 40 - 45 N + 40-45 P_2O_5 + 30-35 K_2O kg/ac. Hence this dosage was considered as farmer's practice.In soil test-based fertiliser recommendations treatment, treatments were enforced based on soil test results. As shown in Table 1, if the soil test results indicate a low nutrient status, 25% extra of the entire recommended dose of fertiliser is applied. If the nutrient status is medium, the recommended amount of fertiliser is applied and lastly, if the nutrient level is high, just 75% of the recommended fertiliser dose is applied.

Table 1: Nutrient levels of soil and fertilizer dosage formulated based on soil test base

Nutrients	Soil test values (kg/ha)	Dose to be applied (kg/ha)
Nitrogen (N)		
Low	< 240	37.5
Medium	240-480	30
High	> 480	22.5
Phosphorus (P_2O_5)		
Low	< 11	50
Medium	11-22	40
High	> 22	30
Potassium (K_2O)		
Low	< 110	62.5
Medium	110-280	50
High	> 280	37.5
Zinc	Soil test values (ppm/ha)	
Low	< 0.6	20
Medium	0.6-0.9	-
High	>0.9	-

Groundnut variety TAG-24 of 100-105 days duration was sown with spacing of 30 cm x 10 cm on flat beds. Weed management was done through manual weeding at 20 and 40 DAS twice. In all three years of the experiment, the crop was harvested 100 days after sowing (DAS). At harvest ten plants were randomly selected from each treatment for recording growth parameters such as plant height (cm), number of pods/plant, 100 pod weight and 100 seed weight. Pod and haulm yields were recorded in net plot (5 m x 5 m) during the harvest. Both treatments received uniform plant protection and agronomic management practices throughout the period of crop growth. Gross returns were calculated using local groundnut market prices, and net profits were estimated by subtracting cultivation costs from gross returns. As suggested by William Sealy Gosset, the t test was used to conduct a statistical analysis of the obtained information on the characteristics of groundnut crops (Fisher Box Joan, 1987) [4]. First, the growth and yield characteristics of groundnut crop were evaluated, followed by a three-year analysis of the results. The t-test for statistical significance was used to analyse the difference between two treatments as part of the statistical analysis. At a 5% probability level, the estimated 't' value was compared to the theoretical value from a 't' table.
The following formulas were used to calculate the extension gap, technology gap, technology index, and benefit cost ratio (Samui *et al*., 2000) [11]: The data so collected were classified, tabulated and analyzed to determine extension gap, technology gap, technology index as given below:

Technology gap = Potential yield-Demonstration yield
Extension gap= Demonstration yield- Farmers yield

$$\text{Technology index} = \frac{\text{Potential yield-Demonstration yield}}{\text{Potential yield}}$$

Results and Discussion

The results of the frontline demonstrations on response of groundnut to soil test-based fertilizer application in comparison with farmers practice were given Table 2. The soil test-based fertiliser application enhanced growth parameters such as plant height, number of pods per plant, hundred pod weight, and groundnut test weight compared to farmer's practise. Growth and yield attributes: Higher plant height of 19.2 cm was recorded with soil test-based fertilizer application compared to farmers practice (17.5 cm). There were more number of pods per plant (43) in soil test based fertilizer application as compared to 35 pods in farmers practice. Higher 100 pod weight of 60.5 g was recorded with soil test-based fertilizer application compared to farmers practice (54.6 g). Similarly higher 100 seed weight of 29.3 g was recorded with soil test-based fertilizer application compared to farmers practice (24.8 g). The application of fertiliser based on a soil test enhanced plant height, number of pods per plant, 100 pod weight, and 100 seed weight by 9.71, 22.85, 10.15, and 18.15 percent, respectively, over farmers' practises. As zinc is involved in multiple enzyme systems, enough zinc supply may have accelerated cell division and enlargement, resulting in an increase in growth hormone in the case of the fertiliser application treatment based on a soil test. Similar results were observed by Baraker *et al.* in 2017. Maximum haulm yield (4326 kg ha^{-1}) was recorded in soil test-based fertilizer application treatment which was in agreement with the findings of Ganesh *et al*. (2015) [5].

Table 2: Plant growth parameters, yield attributes, yield and economics influenced by soil test-based fertilizer application over farmers practice (Mean of 3 years data)

S. No.	Parameters	Check	Demo	Increase%	Std Deviation		CV%		CD at 5%
					Check	Demo	Check	Demo	
1	Plant height (cm)	17.5	19.2	9.71	1.86	2.24	10.06	11.09	**NS**
2	No. of Pods / plant	35	43	22.86	4.43	5.74	11.94	12.71	S
3	100 pod weight (g)	54.6	60.5	10.81	4.28	4.09	7.43	6.39	S
4	100 seed weight (g)	24.8	29.3	18.15	3.78	4.28	14.40	13.80	S
5	Pod yield (kg/ha)	3100	3453	11.39	103.9	133.5	2.86	4.09	S
6	Haulm yield (kg/ha)	3950	4326	9.52	524.7	366.2	11.5	8.8	S
7	Biological yield (kg/ha)	7050	7779	10.34	509.4	453.5	6.21	6.10	S
8	Harvest index (%)	43.97	44.38	0.93	3.32	1.95	7.07	4.19	NS

Pod yield

Soil test-based fertilizer application recorded higher pod yield (3453 kg ha-1) which was 11.38% higher over farmers practice (3101 kg ha-1) (table 3). Higher number of pods per plant, 100 pod weight and 100 seed weight might be the reason behind the yield increase in soil test-based fertilizer application treatment. Srinivasa *et al*. (2010) [14] claim that balanced fertilisation has a positive influence on groundnut yield. The co-efficient of variance in the case of farmers practice was 8.32 percent, which was higher than that of Soil test-based fertilizer application treatment.

Table 3: Extent of variation in groundnut yields (n=60)

Category of farmer	Mean	Standard Error	Standard Deviation	CV%	t value (5%)	P value
STBF	3453	32.87	103.95	7.54	2.88	0.000311
Farmers practice	3101	42.23	133.55	8.32		

Soil fertility status

The pH range of the soil was 6.68 to 6.85, and neither the soil test-based fertiliser application nor did farmer practise have a substantial impact on it. However, the treatment for applying fertiliser based on soil tests found a considerable increase in electrical conductivity over the FP. Similar observations were presented by Maneesh Kumar (2020) [8]. The organic carbon content was low in both treatments (0.50%), but when fertilisers were applied based on the results of a soil test, the organic carbon content increased 14% (Table 4) compared to FP (0.35%). This may be because fertiliser applications using soil tests are balanced. Similar findings were reported by Singh *et al*. (2016) [13] and Thakur *et al*. (2011) [15]. According to Kumar *et al*. (2013) [7], increased tillage and high soil temperatures accelerate the oxidation of organic matter, resulting in a decrease in the amount of organic carbon in the soil. The available N, P_2O_5, K_2O and Zn content of soil was the highest in soil test-based fertilizer application treatment (271 kg/ha, 13.2 kg/ha, 163 kg/ha, 0.66 ppm) which was 26%, 32%, 11% and 14% respectively over the FP (Farmer's Practice) (215 kg/ha, 9.98 kg/ha, 147 kg/ha and 0.52 ppm). The maximum amount of N, P, and K that was available in the final soil was reported under the soil test-based fertiliser recommendation. Similar to available P, available K was also significantly higher when fertiliser was applied based on a soil test. This was mostly caused by increased usage of fertilisers with phosphoric and potassium (Singh and Singh, 2017) [12].

Table 4: The influence of soil test-based fertilizer nutrition on the fertility status of the soil

Treatment	pH	EC (ds m^{-1})	OC (%)	N (kg/ha)	P_2O_5(kg/ha)	K_2O (kg/ha)	Zn (ppm)
Initial soil fertility status							
	6.85	0.124	0.34	234	11.5	139	0.41
Final soil fertility status							
FP	6.68	0.134	0.35	215	9.98	147	0.52
STBF	6.69	0.149	0.40	271	13.2	163	0.66

Economics

Soil test-based fertiliser application produced significantly higher gross and net returns per hectare (Rs. 1, 62, 905/- and Rs. 87,126/-) than farmers' practises (Rs. 1,49,394/- and Rs. 87,126/-) (Table 5). This was attributed to fertiliser treatment based on a soil test that increased pod production. Compared to soil test-based fertiliser application, farmers' farming practises were relatively more expensive. This might be due to application of fertilizers as per farmers choice without soil testing and high cost of DAP, and complex fertilizer. This cost was reduced in treatment soil test-based fertilizer application by applying limited quantity fertilizers as per soil test values. Simultaneously cost benefit ratio was higher with soil test-based fertilizer application (1:2.17) compared to farmers practice (1:1.76) because of lower cost of cultivation and improved yield with soil test-based fertilizer application. In soil test-based fertilizer application cost of cultivation was reduced by 9.76% whereas, gross returns and net returns were improved by 9.04 and 33.19%, respectively over farmers practice. Bhargavi *et al*. (2006) [3] reported comparable results for groundnut production with fertiliser application based on a soil test.

Table 5: Economics influenced by soil test-based fertilizer application over farmers practice (Mean of 3 years data)

S. No.	Parameters	Check	Demo	Increase %
1	Gross returns (Rs/ha)	1,49,394/-	1,62,905/-	9.04
2	Net returns (Rs/ha)	65,415/-	87,126/-	33.19
3	Cost of cultivation (Rs/ha)	83,980/-	75,780/-	-9.76
4	B:C Ratio	1.79	2.17	21.23

Groundnut under FLD: Technology Index (%), Extension Gap, and Technology Gap

The extension gap exhibited an upward trend. The extension gap between 244 and 356 kg/ha shown in table 6. The need of educating the farmer through a variety of media for the adoption of increased agricultural output is emphasised throughout the course of the study in order to reverse the enormous extension gap.

Table 6: Effect of FLD soil test-based fertilizer application on groundnut Productivity, technology gap, extension gap and technology index

Year	Pod yield (kg/ha)			% increase over control	Techno. gap (kg/ha)	Ext. Gap (kg/ha)	Techno. Index (%)	B:C ratio	
	Potential	Demo	Control					Demo	Control
2018-19	4250	3536	3180	11.19	714	356	16.81	2.11	1.72
2019-20	4250	3704	3252	7.05	546	244	12.85	2.24	1.85
2020-21	4250	3120	2870	8.71	1130	250	26.58	2.05	1.68
Average	4250	3453	3101	11.27	797	283	18.74	2.13	1.75

Agricultural demonstrations carried out in cooperation with farmers have resulted in a narrowing of the technological gap, as seen by the range of kg/ha produced (between 546-714 kg/ha). Dissimilarities in soil fertility and meteorological conditions may be too responsible for the technological gap. Mitra *et al*. also discovered something similar in 2010.

There was some volatility in the technology index (percent) due to differences in soil fertility, weather conditions, irrigation water shortages, and insect-pest attacks (which ranged from 12.85 to 16.81 during the study period).

Conclusion

Nutrient management for groundnuts using soil test-based fertiliser application demonstrated to be cost-effective given the current high fertiliser prices. Based on soil test results, it was determined that fertiliser application to rainfed groundnut might improve net returns for rainfed groundnut farmers as well as reduce cultivation costs.

References

1. Anonymous. Agricultural Statistics at a Glance - Andhra Pradesh. Directorate of Economics & Statistics Government of Andhra Pradesh; c2018.
2. Baraker B, Jha SK, Wani SP, Garg KK. Effect of balanced fertilizer management practices on factor of productivity on Groundnut (*Arachis hypogaea* L.) cultivation. Int. J Chemical Studies. 2017;5(4):1288-1291.
3. Bhargavi K, Padmalatha Y, Vijaya Sankara Babu M. Nutrient management of groundnut through farmers participatory approach. National Symposium on conservation Agriculture and Environment, October 26-28, 2006 BHU, Varanasi; c2006.
4. Fisher Box Joan. Guinness, Gosset, Fisher, and Small Samples. Stat Sci. 1987;2(1):45-52.
5. Ganesh SS, Sharma MK, Narwade AV, Neethu TM. Impact of bio-fertilizers and micro-nutrients on yield and yield contributing characters of groundnut (*Arachis hypogea* L.) Int. J Tropical Agriculture. 2015;33(2):931-934.
6. Kadiri Mohan, Vineetha U, Tulasi Lakshmi T, Rajasekhar P. Case Study on Groundnut Cultivation In Coastal Sandy Soils In SPS Nellore District Of Andhra Pradesh. J Res. ANGRAU. 2020;48(2):52-59.
7. Kumar R, Rathi AS, Laxmikant Tripathi NC, Kumar P. Soil fertility status of Rampur district of Uttar Pradesh. J Krishi Vigyan. 2013;2(1):55-58.
8. Maneesh Kumar. Soil Test Based Fertilizer's Recommendation on Yield, Soil Fertility Status and Economics of Rice Crop (*Oryza sativa* L.). J Krishi Vigyan. 2020;9(1):316-321.
9. Mitra B, Samajdar T. Yield gap analysis of rapeseed-mustard through Front Line Demonstration. Agric. Exten. Review. 2010 Apr-Jun, 16-17.
10. Morgan DL. Focus Groups. Annual Review of Sociology. 1996;22:129-152.
11. Samui SK, Maitra S, Roy DK, Mandal AK, Saha D. Evaluation of frontline demonstration on groundnut. J Indian Soc. Coastal Agric. Res. 2000;18(2):180-183.
12. Singh H, Singh J. Soil fertility status as influenced by cropping system in submountain zone of lower shiwalik hills in Punjab. J Krishi Vigyan. 2017;6(1):197-199.
13. Singh YV, Dey P, Meena R, Verma SK. Effect of soil test-based fertilizer application on yield and economics of chick pea in inceptisol. Ann. of Soil & Plant Res. 2016;18(4):409-412.
14. Srinivasa Rao CH, Vittal Kundu KPRS, Gajbhiye PN, Vijaya Sankar Babu M. Twenty years of continuous

cropping fertilization and organic manure application effects on forms of potassium and kinetics of Non exchangeable K release in the profile of an alfisol under arid conditions. Communi. Soil Sci. & Plant Analysis. 2010;41(6):783-796.

15. Thakur RSD, Vaishya UK, Singh M. Impact of continuous use of inorganic fertilizer and organic manure on soil properties and productivity under soybean-wheat intensive cropping of a vertisol. J Indian Soc Soil Sci. 2011;59:74-81.