PRECISION NUTRIENT MANAGEMENT FOR ENHANCING THE YIELD OF GROUNDNUT IN PENINSULAR INDIA

Mudalagiriyappa, T.Sheshadri, D.C. Hanumanthappa, M.A. Shankar, Sharanappa Jangandi, S.B.Salimath, T. Rudramuni, Nagaraju, N. Devakumar, G.B.Mallikarjuna, and M.T. Malagi

University of Agricultural Sciences, G.K.V.K, Bangalore-560 065
Karnataka state, India

ABSTRACT

Groundnut is an important oil seed crop grown in an area of 8 lakh hectares in Karnataka state of India under rainfed conditions. In these situations farmers applied inadequate fertilizer without knowing the initial nutrient status of the soil which resulted in low nutrient use efficiency that intern lead to low productivity of groundnut in these areas. Soil fertility deterioration due to excess removal of fertilizers and manures is one of the major causes of fatigue in crop production. At present incidence and expansion of multinutrient deficiencies in Indian soils owing to inadequate and unbalanced nutrient input through fertilizers is considered one of the major reasons for decline factor productivity of crops. Therefore efforts were made during 2012 and 2013 to understand the situation and find solutions through Precision nutrient management with mechanisation in groundnut of the central dry zone of Karnataka state, in peninsular India. The study was conducted at University of Agricultural Sciences Bangalore in farmers fields with 50 x 50 m grids have been delineated using geospatial technology and also DGPS locations have been used for each grid to map the field variability. After grid making soil samples from 0-15cm were collected and analysed for different major and micro nutrients in all the selected 139 grids. Farm yard manure 5 t/ha was applied uniformly before sowing of the crop. Zinc sulphate @ 15 kg/ha was also applied at the time of sowing of the crop. To meet the sulphur need of the crop gypsum @ 500kg/ha was applied at 35 days after sowing. The available nitrogen status of soil revealed that 8, 80, 12 per cent was low, medium and high respectively, while the available phosphorus level remained lower for 96 per cent of samples and 84 per cent of the samples found to be medium available sulphur and zinc status remained lower. The crop was sown on 27.7.2012 and18.7.2013 and harvested during last week and third week of November 2012 and 2013 respectively. The project is in its second year of implementation, assessment, quantification of spatial variability of the field and the crop parameters like fertility status for major and minor nutrients, P^H ,EC pest and yield are done through GIS mapping in order to supplement the right quantity of nutrients and pesticides on right time on right quantity and right method. The analysis of two years data showed that precision nutrient management with mechanized cultivation recorded 52.1 and 22.0 per cent higher pod yield of groundnut over farmer's method and by adopting university package of practices respectively. It was assessed for its variability spread in the field and

insecticides were given as per variability by which we saved in the cost on pesticides.

Key words: Precision nutrient management, Spatial, Yield, Groundnut

Groundnut (*Arachis hypogaea* L.), king of oilseeds belongs to the family Leguminoceae and is commonly called as poor man's almond. It is the world's fourth most important source of edible oil and third most important source of vegetable protein. Seed is valued both for its oil and protein content as it contains about 40-45 per cent oil, 25 per cent protein and 18 per cent carbohydrates in addition to minerals and vitamins (Desai *et al.,* 1999). India occupies the first place in acreage but stands second in production (18.42 %) after China (41.5 %). The area under groundnut in India was estimated to be 4886.3 thousand hectares with a production of 57.79 lakh tonnes in 2012-2013. Gujarat accounts for 36 per cent of the total production of groundnut and it's the largest producer in India followed by Tamil Nadu (20.78 %), Andhra Pradesh (15.23 %), Rajasthan (8.23 %), Maharashtra (8.23 %) and Karnataka (7.82 %) (Gracy *et al.,* 2013). In India groundnut crop is mainly grown under rainfed conditions and energy starved marginal lands which are prone to the vagaries of monsoon. Deficient rainfall in the key groundnut growing areas, imbalance nutrition, inadequate plant population and incidence of severe pests and diseases are the main causes for low productivity.

Traditionally groundnut is grown in the *kharif* season. The conventional method of groundnut cultivation leads to increased cost of cultivation that in turn leading to decreased profitability. The use of blanket nutrient management recommendations has led to low nutrient use efficiencies, lower profits and increased environmental problems (Pampolino et al., 2012a). Nutrient recommendations in India are based upon crop response data averaged over large geographical areas and do not take into account the spatial variability in indigenous nutrient supplying capacity of soils (Majumdar et al., 2013). Blanket fertilizer application, therefore, results into under-fertilization in some cases and over-fertilization in other. Surveys revealed that farmers often apply greater than recommended rates of fertilizer N and P, but ignore the sufficient application of potassium and other secondary and micro-nutrients. Such unbalanced and inadequate use of nutrient can decrease the nutrient use efficiency and profitability and may increase environmental risks associated with loss of unutilized nutrients through emission or leaching. Therefore, traditional practices of groundnut production need refinement to produce more food with less production costs and efficient use of land, labour, nutrient, water and other agro-chemicals. To increase food production in sustainable manner famers will need to use the right fertilizer at the right rate, right time and right place (Patil, 2009). Groundnut crop continues to be an unpredictable legume, showing inconsistency in pod and oil yields. With increase in cost of cultivation due to increased cost of input, labour and to increase the use efficiency of applied inputs there is need for a fresh look to exploit the precision nutrient approaches which minimises loss of

fertilizers by improving nutrient use efficiency. On- farm participatory research was conducted in central central dry zone of Karnataka, southern India to evaluate the feasibility of adoption of precision nutrient management with mechanized cultivation of groundnut would increase yield, improve nutrient use efficiency with enhanced profitability of groundnut.

MATERIALS AND METHODS

The research was conducted at the farmer's fields of Devarakotta village, Hiriyur Taluk, Chitradurga District, Karnataka, India by University of Agricultural Sciences, GKVK, Bangalore in 2012-13 and 2013-14 in a sandy loam soil.

Treatments and experimental details

Management zone concept

After selecting a field of 35 hectares in a contiguous block involving 23 farmers, a grid size of 50 x 50 m was made as one management zone. Soil samples were taken from the four equidistant places and at the centre of the grid in 0-15 cm depth, composited air dried crushed to pass through 2 mm sieve and stored at room temperature until analysed for macro, secondary and micronutrients. Soil samples of each grid were analysed and based on the soil test results,major nutrients (NPK) were applied to each grid. After words three management approaches have been identified for the study viz., precision farming techniques, adoption of recommended UAS package of practices (state recommendations) and farmer's practice was also maintained as check. In precision nutrient management based on the soil sample data (Table 1.) the following treatments combinations were made; low NK and medium P; high N medium P and low K; high N and medium PK; medium NP and low K and medium NK and low P. If the particular element is low + 25% of recommended dose, if medium the recommended dose of nutrient was applied, if high - 25% of the recommended dose of fertilizer dose was applied. Then the crop was sown with improved seed cum fertilizer drill with variable rates of nutrients. Before sowing, the seeds were treated with fungicides/bio fertilizers using seed dresser. At the end all the treatment combinations were pooled and averaged and taken as precision farming plot yield. In recommended practice, the recommended dose (25:50:25 kg NPK/ha) of nutrients was applied and the crop was sown with the help of bullock drawn seed drill and all other recommended practices were followed. But in case of farmer's practice, farmers applied only 20 kg of nitrogen and 60 kg of phosphorus per hectare. Secondary and micro-nutrients were applied as per the recommendations to precision farming and UAS-pop treatments.

Nutrient use efficiency

In order to determine the efficiency of applied N and P under various nutrient management strategies, partial factor productivity (PFP) was calculated. Partial factor productivity was calculated as yield of harvested product (pod yield) per unit of nutrient applied (Dobermann, 2007).

Data analysis

The experimental data obtained is subjected to statistical analysis adopting one way analysis of variance and procedure is followed as outlined by Rangaswamy (2010). Critical difference (CD) values are given at 5 per cent level of significance.

Table.1 Initial nutrient status of the study area.

Nutrients	No of samples	Range	No of samples	Range	No of samples	Range
	Low		Medium		High	
N (kg/ha)	11	250-275	112	301-539	16	561-603
P_2O_5 (kg/ha)	133	6.09-19.83	3	24.43-28.16	-	-
K_2O (kg/ha)	17	75-123	117	127-271	05	363-480

pH (1:2.5):5.89-7.55; OC (%):0.3-0.48

RESULTS AND DISCUSSION

Yield of groundnut varied significantly due to different practices. Precision nutrient management recorded significantly higher pod yield of groundnut during 2012-13 (10.07 q/ha) and 2013-14 (12.75 q/ha) (Table1.). Precision nutrient management recorded 20.16 and 54.9 and 23.54 and 50 per cent increase in yield over recommended practice and farmer' practice respectively. Similarly, precision nutrient management recorded higher haulm yield over rest of the nutrient management practices. The increase in haulm yield was 12.2 and 35 and 11.1 and 27.3 per cent over recommended practice and farmer' practice respectively during 2012-13 and 2013-14. Sapkota *et al.* (2014) reported that no tillage system along with site specific approaches for nutrient management increased the wheat grain yield and biomass yield. The yield attributing parameters of groundnut viz., no of pods per plant followed the similar trend as that of pod yield of groundnut. Precision nutrient management recorded significantly average higher number of pods (16.0/plant) over recommended package of practice (13.65/plant) and farmers practice (11.55/plant). Precision nutrient management recorded significantly higher pod weight compared to recommended practice and farmers practice (Table 2).

Smaller overall grain and biomass yield in 2012-13 than in 2013-14 was mainly due to scanty rainfall received and higher temperature during pod development period. Higher pod and haulm yield in precision nutrient management over farmers practice clearly indicated that benefit of judicious nutrient management in groundnut. This approach results in all limiting crop nutrients are applied. The results are in agreement with Pampolino *et al.* (2012b).

Table 2. Yield and yield attributes of groundnut as influenced by precision nutrient management practices.

Technology		Pod yield (q/ha)		Haulm yield (q/ha)		No. of pods/ plant		Pod weight/ Plant (g)	
		2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
Farmers Practice		6.50	8.50	8.53	11.84	8.5	14.6	6.47	10.12
UAS-Pop		8.38	10.32	10.27	13.56	9.9	17.4	7.83	11.50
Precision Farming techniques		10.07	12.75	11.52	15.07	11.6	20.2	8.70	13.29
POP and PF	S.Ed	0.57	0.41	0.59	0.37	0.44	0.90	0.41	0.82
	C.D. at 5%	1.17	0.80	1.20	0.73	0.89	1.77	0.85	1.61
POP and FP	S.Ed	0.91	0.62	0.94	0.56	0.70	1.36	0.66	1.24
	C.D. at 5%	1.86	1.21	1.91	1.10	1.42	2.67	1.34	2.43
PF and FP	S.Ed	0.88	0.54	0.90	0.50	0.67	1.20	0.64	1.09
	C.D. at 5%	1.79	1.06	1.84	0.97	1.37	2.35	1.30	2.14

Growth parameters

The plant height of groundnut varied significantly due to different nutrient management practices. Plant height (25 cm) was more in precision nutrient management compared to recommended practice and farmers practice. Number of branches followed similar trend as that of plant height. Higher leaf area per plant (909.8/plant) was noticed due to precision nutrient management over other nutrient management practices (Table 3). The increase in growth parameters was due to continuous constant availability of nutrients from precision nutrient management practices resulted in better translocation of photosynthates. The results are conformity with the findings of Sanju (2013).

Nutrient use efficiency

Average over two years, PFP of N & P was higher in precision nutrient management than the application based on state recommendation and farmer's practice (Fig I).Higher nutrient use efficiency of applied N and P was probably due to balanced application of nutrients which enhances higher growth rate of crop leading to higher rates of nutrient uptake. Better efficiency of nutrients applied in precision nutrient management over farmers practice and state recommendations indicates that site specific nutrient application results in enhanced efficiency of nutrient utilization. Similar results were reported by Sapkota *et al. (*2014).

Table 3.Growth parameters of groundnut as influenced by Precision nutrient management practices.

Technology		Plant height (cm)		No. of branches/ plant		Leaf area (cm^2 /plant)	
		2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
Farmers Practice		18.1	23.8	4.8	5.9	708.8	813.4
UAS-Pop		20.5	26.2	6.2	7.4	795.7	910.7
Precision Farming techniques		22.0	28.8	8.7	10.3	830.3	989.6
POP and PF	S.Ed	0.72	0.76	0.43	0.37	12.91	16.91
	C.D. at 5%	1.47	1.49	0.88	0.73	26.34	33.15
POP and FP	S.Ed	1.14	1.15	0.69	0.57	20.52	25.5
	C.D. at 5%	2.33	2.25	1.40	1.11	41.85	49.99
PF and FP	S.Ed	1.10	1.01	0.66	0.50	19.78	22.42
	C.D. at 5%	2.25	1.98	1.35	0.97	40.35	43.95

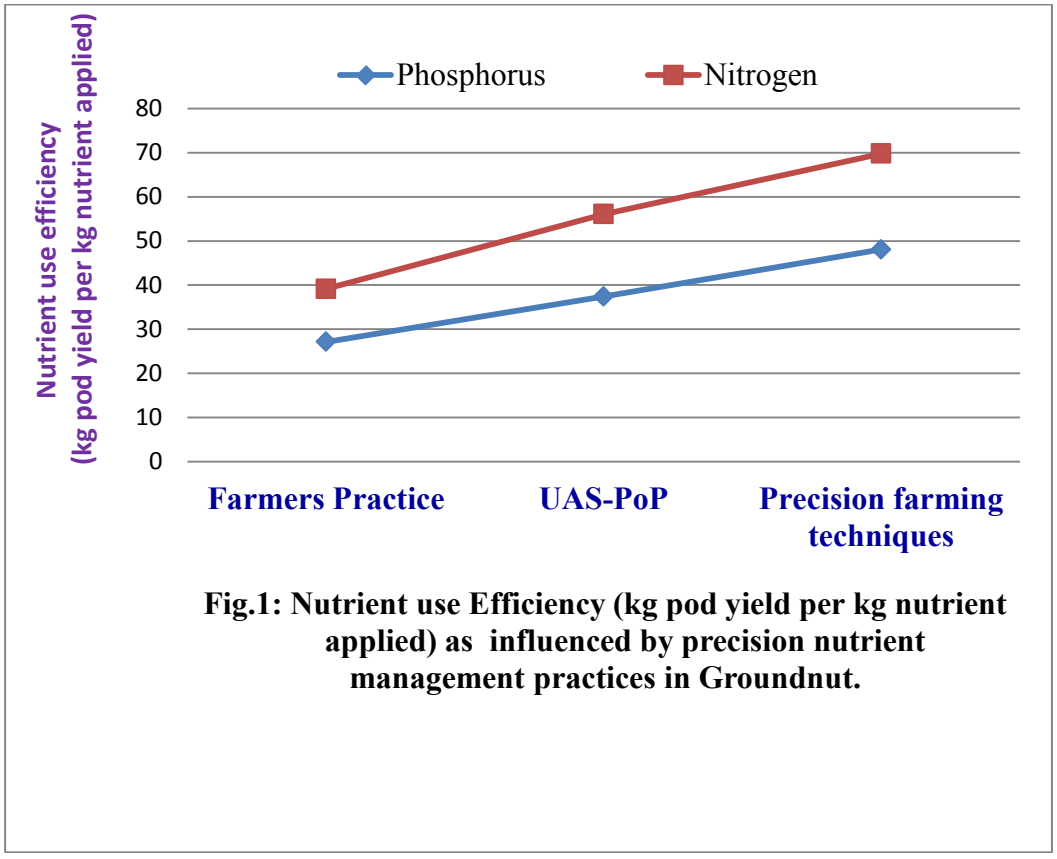

Fig.1: Nutrient use Efficiency (kg pod yield per kg nutrient applied) as influenced by precision nutrient management practices in Groundnut.

SUMMARY AND CONCLUSIONS

Precision nutrient management significantly increased pod yield, haulm yield, pod number and pod yield per plant of groundnut. Growth parameters of groundnut viz., plant height, number of branches and leaf area per plant followed the similar trend as that of yield and yield attributing characters. Partial factor productivity of nitrogen and phosphorus was higher in precision nutrient management than state recommendation and farmer's practice. So variable nutrient applications utilising site specific management zones found to be more economically feasible and profitable than conventional uniform application even in developing countries like India.

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