The Bioscan 9(4): 1561-1564, 2014
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

EFFECT OF NITROGEN AND PHOSPHORUS LEVELS AND RATIOS ON YIELD AND NUTRIENT UPTAKE BY GROUNDNUT IN NORTHERN TRANSITION ZONE OF KARNATAKA

L. SHIVA KUMAR*, B. M. RADDER, L. H. MALLIGAWAD AND V. MANASA
Department of Soil Science and Agricultural Chemistry,
College of Agriculture, UAS, Dharwad - 580 005, Karnataka
e-mail: shivalgowda@gmail.com

KEYWORDS
Groundnut
Fertilizer ratios
Shelling
Yield
Uptake

Received on :
24.08.2014

Accepted on :
13.10.2014

***Corresponding author**

ABSTRACT
A field experiment was conducted at Main Agricultural Research Station (MARS), Dharwad to know the effect of nitrogen and phosphorus levels and ratios on yield and nutrient uptake by groundnut in northern transition zone of Karnataka. Groundnut cultivar JL 24 was tried during 2012 with eleven ratios of nitrogen (N) and phosphorus (P_2O_5) fertilizers with potassium level as constant (25 kg K_2O ha^{-1}). The yield attributing characteristics, dry pod yield and nutrient uptake were increased due to increasing N/P fertilizer ratios from 0.00 to 1.00. The treatment receiving N/P fertilizer ratio of 0.50 (30 kg N, 60 kg P_2O_5, 25 kg K_2O ha^{-1}) produced significantly higher dry pod yield (3310 kg ha^{-1}), number of filled pods $plant^{-1}$ (17.47), total number of pods $plant^{-1}$ (18.80) and 100 kernel weight (38.50 g). Further, the same treatment recorded significantly higher uptake (147.04 kg N, 23.30 kg P_2O_5, 118.48 kg K_2O, 10.93 kg S ha^{-1}) as compared to all other N/P fertilizer ratios. The treatment receiving N/P fertilizer ratio of 0.50 (30 kg N, 60 kg P_2O_5, 25 kg K_2O ha^{-1}) produced higher kernel yield (2441 kg ha^{-1}). However, it was on par with the treatment receiving N/P fertilizer ratio of 0.33 (2344 kg ha^{-1}).

INTRODUCTION

Groundnut (*Arachis hypogaea* L) is an annual legume native to South America. It is now grown in most tropical, sub-tropical and warm temperate regions of the World between 40° N and 40° S latitudes. In the world the crop is grown in an area of 26.62 million with an production of 35.66 million tonnes with a productivity of 1348 kg ha^{-1}. In India, it is grown in an area of 5.3 million ha with a production of 6.93 million tonnes with the average productivity of 1305 kg ha^{-1}. In Karnataka, grown in an area of 0.70 million ha with a production of 0.50 million tonnes and a productivity of 705 kg ha^{-1} (Anon., 2012). The groundnut productivity in Karnataka is low which could be attributed to several production constraints, which include poor and imbalanced nutrition of crop and growing crop on marginal lands. Therefore, it is most essential to pay a great attention to the nutrition of the groundnut to enhance its productivity. Groundnut is called a self fertilizing crop, nevertheless, it is very exhaustive crop compared to other legumes because a very little portion of the plant residue is left in the soil after harvest (Varade and Urkude, 1982). An average crop of groundnut yielding 19 q ha^{-1} removes about 170 kg N, 30 kg P, 110 kg K, 39 kg Ca and 15 kg S from the soil (Aulakh *et al.* 1985).

Inadequate and/or imbalanced use of fertilizers has been identified as one of the critical constraints in groundnut production under rainfed farming situation. However, to meet the nitrogen requirement during early growth stages, it is applied as starter dose. Basal application of N (10 to 75 kg ha^{-1}) in the form of mineral nitrogen fertilizers has improved groundnut yield in some trials (Shimshi *et al.*, 1967). The positive response of a legume crop to fertilizer N indicates that N demand of the crop is not being fully met by N fixation therefore, symbiotic Nitrogen fixation could be limited. Also, phosphorus is necessary for the proper functioning of the nodules and root growth. Recommendations across the country revealed that groundnut showed response to the application of phosphorus @ 40 to 75 kg P_2O_5 ha^{-1}, particularly in P deficit soils. However, in soils with medium to high amount of available phosphorus, P fertilizer @ 40 to 50 kg ha^{-1} resulted in higher yields. Therefore, cultivation of groundnut depletes the soil fertility rapidly unless the crop is adequately fertilized. Nitrogen and phosphorus (rates and mode of application) determine plant reproductive efficiency and play a vital role in growth and development of groundnut crop. Thus, it is imperative to find out optimum N/P ratio (applied as basal) for maximum yield of groundnut crop under rainfed situations.

MATERIALS AND METHODS

A field experiment was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, during rainy season of 2012. Composite soil sample was collected from the site at a depth of 0 to 30 cm before laying out the experiment. The soil sample was analyzed for various chemical properties of soil. The soil is texturally clay, neutral

in pH (7.53), medium in available nitrogen (229 kg N ha^{-1}), phosphorus content (32.10 kg P_2O_5 ha^{-1}), high in available potassium (386 kg K_2O ha^{-1}) and medium in organic carbon (0.49 %) content, and normal in salt content (0.36 dSm^{-1}). A randomized complete block design with three replications and eleven treatments consisted of 11 N/P fertilizer levels and ratios *viz.*, 0.00 (control), 0.00 (0 kg N, 0 kg P_2O_5 and 25 kg K_2O ha^{-1}), 0.83 (25 kg N, 30 kg P_2O_5 and 25 kg K_2O ha^{-1}), 0.56 (25 kg N, 45 kg P_2O_5 and 25 kg K_2O ha^{-1}), 0.50 (25 kg N, 50 kg P_2O_5 and 25 kg K_2O ha^{-1}), 0.42 (25 kg N, 60 kg P_2O_5 and 25 kg K_2O ha^{-1}), 0.33 (25 kg N, 75 kg P_2O_5 and 25 kg K_2O ha^{-1}), 1.00 (30 kg N, 30 kg P_2O_5 and 25 kg K_2O ha^{-1}), 0.67 (30 kg N, 45 kg P_2O_5 and 25 kg K_2O ha^{-1}), 0.50 (30 kg N, 60 kg P_2O_5 and 25 kg K_2O ha^{-1}) and 0.40 (30 kg N, 75 kg P_2O_5 and 25 kg K_2O ha^{-1}). The groundnut cultivar JL 24 was used for sowing at 30 cm × 10 cm spacing.

After the harvest of previous crop sunnhemp grown during post rainy season 2011, the land was cultivated with tractor drawn rotavator and cultivator. The land was leveled and brought to fine tilth by repeated harrowings. Seeds were treated with Captan 50% WP at the rate of 3g kg^{-1} seeds before sowing. The seeds were sown at a distance of 10 cm in furrows places at 30 cm apart. The nitrogen, phosphorus and potassium were given in the form of urea, single super phosphate and muriate of potash, respectively. The entire quantity of fertilizer mixture containing entire dose of nitrogen, phosphorus and potassium were applied as per the treatments to each plot at the time of sowing. Fertilizers were mixed thoroughly and covered with the soil. Weeding and plant protection measures were undertaken as per need of the crop.

Collected soil samples were analyzed for (1:2.5 soil: water suspension), electrical conductivity by conductivity meter (Sparks, 1996), organic carbon by rapid titration method (Sparks,1996). Available N was estimated by alkaline permanganate method (Sharawat and Burford 1982), available P by Olsen's method, available K by ammonium acetate extraction method, and available S was estimated by turbidimetric method as described by (Sparks ,1996). The Available micronutrients was extracted with DTPA and determined by atomic absorption spectrophotometer as described by (Lindsay and Norvell, 1978). The analysis and interpretation of data were studied by using the Fischer's method of analysis of variance technique as described by Gomez and Gomez (1984). Wherever 'F' test were significant, treatments mean were compared by LSD.

RESULTS AND DISCUSSION

The effect of different levels and ratios of nitrogen and phosphorus fertilizers had significant effect on number of filled pods $plant^{-1}$ among the different treatments, the treatment receiving N/P fertilizer ratio of 0.50 (30/60) recorded more number of filled pods $plant^{-1}$ (17.47). Least number of filled pods $plant^{-1}$ was observed in control (11.26) and total number of pods $plant^{-1}$ of groundnut was differed significantly due to application of nitrogen and phosphorus fertilization, the treatment receiving N/P fertilizer ratio of 0.42 recorded significantly higher total number of pods $plant^{-1}$ (19.67), however it is on par with all other N/P fertilizer ratios from 18.53 to 18.80 except 0.50 (16.33) and control (16.13) (Table 1).

The differences observed in dry pod yield and yield components could be traced back to differences in dry matter production and its accumulation in different plant parts. The treatment receiving N/P fertilizer ratio of 0.50 (30 kg N, 60 kg P_2O_5, 25 kg K_2O ha^{-1}) produced higher total dry matter $plant^{-1}$ at harvest (36.00 g) as compared to other fertilizer ratios of 0.33 (34.92 g) and 0.50 (33.92 g). The shelling percentage of groundnut at harvest did not differ significantly due to nitrogen and phosphorus fertilization and in sound mature kernels results were observed in the treatment receiving N/P fertilizer ratio of 0.67 recorded significantly higher percentage of sound mature kernels (98.17) and in the N/P fertilizer ratio of 0.83 recording lowest sound mature kernels (93.92%) (Table 2).

Dry pod yield (3310 kg ha^{-1}) and kernel yield (2441 kg ha^{-1}) were significantly higher with the treatment involving N/P fertilizer ratio of 0.50 *i.e.*, basal application of 30 kg N, 60 kg P_2O_5, 25 kg K_2O ha^{-1} with 3177 kg ha^{-1} and when compared to recommended dose of fertilizer for assured rainfall situations *i.e.*, N/P fertilizer ratio of 0.33 (25 kg N, 75 kg P_2O_5 and 25 kg

Table 1: Number of filled pods $plant^{-1}$ and Total number of pods $plant^{-1}$ of groundnut as influenced by nitrogen and phosphorus levels and ratios of fertilizers

Treatments	Quantity of nutrients (kg/ha) Basal application			N/P Ratio	Number of filled pods/plant		Total number of pods/plant	
	N	P_2O_5	K_2O					
T_1	0	0	0	0.00	11.26	b	16.13	b
T_2	0	0	25	0.00	14.00	ab	18.53	ab
T_3	25	30	25	0.83	14.97	ab	16.93	ab
T_4	25	45	25	0.56	15.27	ab	17.13	ab
T_5	25	50	25	0.50	14.73	ab	16.33	b
T_6	25	60	25	0.42	16.07	a	19.67	a
T_7	25	75	25	0.33	16.47	a	18.20	ab
T_8	30	30	25	1.00	15.07	ab	16.67	ab
T_9	30	45	25	0.67	16.67	a	18.13	ab
T_{10}	30	60	25	0.50	17.47	a	18.80	ab
T_{11}	30	75	25	0.40	17.00	a	18.07	ab
Mean					15.39		17.72	
S. Em ±					0.95		0.91	

Note: In a column mean values followed by the common letter are not significantly different at p = 0.05 level (DMRT at 5 % level) DAS: Days after sowing

Table 2: Dry pod yield (kg/ha), kernel yield (kg/ha), haulm yield (kg/ha), 100 kernel weight (g), shelling percent and sound mature kernels (%) of groundnut as influenced by nitrogen and phosphorus levels and ratios of fertilizers

Treatments	Quantity of nutrients (kg/ha) Basal application			N/P Ratio	Dry pod yield (kg/ha)		Kernel yield(kg/ha)		Haulm yield (kg/ha)		100kernel weight (g)		Shellingper cent		Soundmature kernels (%)	
	N	P_2O_5	K_2O													
T_1	0	0	0	0.00	2194	c	1660	c	2932	b	39.49	a	75.69	a	97.93	a
T_2	0	0	25	0.00	2763	b	2045	b	3223	ab	39.26	a	74.11	a	97.30	a
T_3	25	30	25	0.83	3042	ab	2255	ab	3422	a	39.86	a	74.11	a	93.92	b
T_4	25	45	25	0.56	2851	ab	2091	b	3439	a	38.40	a	73.51	a	97.57	a
T_5	25	50	25	0.50	3019	ab	2213	ab	3401	a	39.53	a	74.10	a	96.33	ab
T_6	25	60	25	0.42	3079	ab	2264	ab	3614	a	38.43	a	73.55	a	96.77	a
T_7	25	75	25	0.33	3177	ab	2344	ab	3455	a	39.02	a	73.81	a	98.06	a
T_8	30	30	25	1.00	2690	b	2019	b	3418	a	39.29	a	75.08	a	97.97	a
T_9	30	45	25	0.67	3156	ab	2335	ab	3496	a	39.68	a	74.04	a	98.36	a
T_{10}	30	60	25	0.50	3310	a	2441	a	3651	a	38.50	a	73.50	a	98.17	a
T_{11}	30	75	25	0.40	3062	ab	2267	ab	3654	a	38.60	a	74.06	a	97.34	a
Mean					2940		2176		3428		38.98		74.14		97.55	
S. Em ±					154.65		102.36		145.87		1.14		0.78		0.99	

Note: In a column mean values followed by the common letter are not significantly different at p = 0.05 level (DMRT at 5 % level) DAS: Days after sowing

Table 3: Nitrogen, Phosphorus, Potassium and Sulphur uptake (kg/ha) at different growth stage of groundnut as influenced by nitrogen and phosphorus levels and ratios of fertilizers

Treatments	Quantity of nutrients Basal application			(kg/ha)	N/P Ratio		Nitrogen		Phosphorus		Potassium		Sulphur	
	N	P_2O_5	K_2O											
T_1	0	0	0	0.00	80.95	h	13.24	g	68.73	e			7.55	e
T_2	0	0	25	0.00	106.68	g	17.26	f	88.49	d			8.60	d
T_3	25	30	25	0.83	129.10	c-e	19.69	cd	101.42	b			9.61	bc
T_4	25	45	25	0.56	123.21	ef	18.95	de	92.76	cd			9.58	bc
T_5	25	50	25	0.50	127.30	de	21.05	bc	97.51	bc			9.75	bc
T_6	25	60	25	0.42	131.81	cd	20.14	cd	101.47	b			10.11	a-c
T_7	25	75	25	0.33	136.08	bc	22.26	ab	113.03	a			10.44	ab
T_8	30	30	25	1.00	119.16	f	18.92	de	88.56	d			9.34	cd
T_9	30	45	25	0.67	140.76	ab	22.49	ab	113.43	a			10.52	ab
T_{10}	30	60	25	0.50	147.04	a	23.30	a	118.48	a			10.93	a
T_{11}	30	75	25	0.40	130.31	c-e	20.09	cd	104.39	b			10.29	a-c
Mean					124.76		19.76		98.93				9.70	
S. Em ±					2.23		0.52		2.51				0.29	

Note: In a column mean values followed by the common letter are not significantly different at p = 0.05 level (DMRT at 5 % level) DAS: Days after sowing

K_2O ha^{-1}) with 2344 kg ha^{-1} and recommended dose of fertilizer for rainfed groundnut *i.e.*, N/P fertilizer ratio of 0.50 (25 kg N, 50 kg P_2O_5 and 25 kg K_2O ha^{-1}) (3019 and 2213 kg ha^{-1}, respectively). Haulm yield recording 2932 to 3654 kg ha^{-1} in different treatments differ significantly with respect to application of different levels and ratios of nitrogen and phosphorus fertilizers (Table 2). Similar results were obtained by Shinde *et al.* (2001) and Kandil *et al.* (2007) where in N/P fertilizer ratio of > 0.50 produced higher dry pod yield and kernel yield of groundnut.

The main factors which have direct bearing on dry pod yield are total number of pods plant^{-1}, dry pod weight plant^{-1}, 100 kernel weight and shelling percentage. Further growth attributes like dry matter production plant^{-1} and its distribution in to various plant parts had indirect influence on dry pod yield. Among the yield components, dry pod weight plant^{-1} was more closely associated with the dry pod yield ha^{-1}. The treatment receiving N/P fertilizer ratio of 0.56 (25 kg N, 45 kg P_2O_5, 25 kg K_2O ha^{-1}) produced higher dry pod weight plant^{-1} (15.82 g) as compared to N/P fertilizer ratio of 0.33 and 0.50 (13.61g and 13.12 g, respectively). Similar trend was reported earlier by Kandil *et al.* 2007. Total number of pods plant^{-1} (29.53), number of filled pods plant^{-1} (24.27), number of unfilled pods plant^{-1} (17.47), 100 kernel weight (38.50 g), shelling per cent (73.50) and per cent of sound mature kernels (98.17) were more in treatment which received N/P fertilizer ratio of 0.50 as compared to N/P fertilizer ratios of 0.33 and 0.50 (Table 1 and 2). Such differences with respect to yield components were reported earlier by Subrahmaniyan *et al.* (2000).

Nutrient uptake (147.04 kg N, 23.30 kg P_2O_5, 118.48 kg K_2O, 10.93 kg S ha^{-1}) was significantly higher with the treatment receiving N/P fertilizer ratio of 0.50 *i.e.,* basal application of 30 kg N, 60 kg P_2O_5, 25 kg K_2O ha^{-1}, when compared to recommended dose of fertilizer for assured rainfall situations *i.e.*, N/P fertilizer ratio of 0.33 (25 kg N, 75 kg P_2O_5 and 25 kg K_2O ha^{-1}) (136.08 kg N, 22.26 kg P_2O_5, 113.43 kg K_2O, 10.44 kg S ha^{-1}, respectively) and recommended dose of fertilizer for rainfed groundnut *i.e.*, N/P fertilizer ratio of 0.50 (25 kg N, 50 kg P_2O_5 and 25 kg K_2O ha^{-1}) (127.30 kg N, 21.05 kg P_2O_5,

97.51 kg K_2O, 9.75 kg S ha^{-1}, respectively) (Table 3). Similar results were reported by Vinod Kumar *et al*. (2000). Higher uptake of nutrients at higher N/P fertilizer ratio may be due to increased nitrogen availability to plants resulting higher biomass production.

REFERENCES

Arunima, P. and Singh, J. P. 2014. Response of mustard [*Brassica juncea* L.) Czernj. & Cosson] to potassium with other nutrients on yield and quality. The Bioscan., **9(2)**:649-652.

Aulakh, M. S., Sidhu, B. S., Arora, B. R. and Singh, B. 1985. Content and uptake of nutrients by pulses and oilseed crops. *Indian J. Ecol*. **12 (2):** 238-242.

Gomez, K. A. and Gomez, A. A. 1984. *Statistical Procedures for Agricultural Research,* An international Rice Research Institute Book, Wiley- Inter Science Publication, New York, USA. p. 680.

Kamdi, T. S., Sonkamble, P. and Joshi, S. 2014. Effect of organic manure and biofertilizers on seed quality of groundnut (*Arachis hypogaea* L.). *The Bioscan.*, **9(3)**:1011-1013.

Kandil, A. A., El-Haleem, A. K., Khalafallah, M. A., El-Habbasha, S.F., Abu-Hagaza, N. S. and Behairy, T.G. 2007. Effect of nitrogen levels and some bio-fertilizers on dry matter, yield and yield attributes of groundnut. Bulletin of the National Research Centre (Cairo). **32**: 341-359.

Sharawat, K. L. and Burford, J. R. 1982. Modification of alkaline permanganate method for assessing the availability of soil nitrogen in upland soils. *Soil Sci.* **133:** 53-57.

Shimshi, D., Schiffmann, J., Kost, Y., Bielorai, H. and Alper, Y. 1967. Effect of soil moisture regime on nodulation of inoculated peanuts. *Agron. J.* **59**:397-400.

Shinde, S.S., Kaushik, R.L. and Bhilare. 2001. Effect of plastic film mulch, levels of fertilizer and foliar sprays on yield and quality of summer groundnut. *J. Maharashtra Agric. Univ*. **25**:227-229.

Nayek, S.S.,Koushik Brahmachari, MD. And Chowdhury, R. 2014. Integrated approach in nutrient management of sesame with special reference to its yield, quality and nutrient uptake. *The Bioscan*. **9(1)**: 101-105.

Sparks. 1996. Methods of soil analysis part-2: Chemical methods. *Soil Sci. Soc. Amer.*, USA.

Subrahmaniyan, K. P., Kalaiselvan., Manickam, G. and Arulmozhi, N. 2000. Spacing and fertilizer requirement for confectionery groundnut varieties. *Crop Res*. **19:** 210-212.

Tandon, H. L. S. 1998. *Methods of Analysis of Soils, Plants, Water and Fertilizers.* Fertilizer Development and Consultation Organization, **31:**9-16.

Varade, P. A. and Urkude, D. K. 1982. Response of groundnut to sources and levels of potassium. *Ind. Potash J.* **7 (1):** 2-5.

Vinod kumar, B. C., Ghose, Ravibhat. and Karmakar, S. 2000. Effect of irrigation and fertilizer on yield, water- use efficiency and nutrient uptake of summer groundnut. *Ind. J. Agron*. **45** (4): 756-760.