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Response of groundnut (*Arachis hypogaea*) cultivars to integrated nutrient management on productivity, profitability and nutrient uptake in NEH Region

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ABSTRACT

A field experiment was conducted at Nagaland during 2009 and 2010 to study the response of groundnut (*Arachis hypogaea* L.) cultivars to integrated nutrient management on productivity, profitability and nutrient uptake in NEH Region on a sandy loam soil. Among the cultivars, FeSEG 10 recorded significantly higher growth, yield attributes and pod yield as compared to JL 24 and FeSEG 8. Nutrients uptake (N, P and K) and nutrients use efficiency was significantly higher under ICGS 76 followed by FeSEG 10 and FeSEG 8. The highest net returns, B: C ratio and crop profitability were recorded with FeSEG 10 followed by ICGS 76. The results showed significant increase in all yield attributes, yield, nutrient uptake and economics due to the application of 75% N through inorganic fertilizers + 25% N through FYM followed by 100% N through inorganic fertilizers.

Key words: Crop profitability, Economics, FYM, Groundnut cultivars, Growth and yield attributes, Nutrient uptake

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop and foodgrain legume. It contains about 40-45% oil, 20-25% protein, 20.5% carbohydrate, 5% fibre and ash and makes a sustainable contribution to human nutrition. This crop occupied an area of 6.2 million ha in 2010-11 with a production of 7.30 million tonnes and productivity of 1 180 kg/ha (Meena *et al*. 2011). Recently the crop has been given greater attention from Government as well as from the scientific institutes due to its suitability for growth in new areas. In North Eastern Region this crop is cultivated in an area of about four thousand hectare with a productivity of 1 000 kg/ha, which is higher than national average (924 kg/ha). It performs extremely well up to mid altitude of the region (Patel *et al.* 2005). The lower productivity of groundnut is mainly attributed to poor soil fertility, unscientific irrigation, cultivation of local cultivars and improper nutrient management. In view of the above situation a field experiment was conducted to find out the better performing cultivars and suitable nutrient management practices to maximize the groundnut productivity and profitability under rainfed condition of NEH region.

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MATERIALS AND METHODS

A field experiment was conducted at Research Farm of ICAR Research Complex for NEH Region, Nagaland Centre, Medziphema during *kharif* 2009 and 2010. Objectives were to study the response of groundnut (*Arachis hypogaea* L.) cultivars to integrated nutrient management on productivity, profitability and nutrient uptake in NEH Region on a sandy loam soil. The experimental site was located between 25.45°N latitude 93.53°E longitudes with a mean altitude of 295 m above mean sea level. The experimental site comes under sub humid region where monsoon normally starts by the middle of April and extends up to September. The annual rainfall during crop growing season from 5th June to 20th September was 694.7 mm in 2009 and 1235.1 mm during 2010 which was less than annual average rainfall 1570 mm. Temperature and relative humidity during the experimental period ranged from 18°C to 35°C and 78.5% to 92%, respectively. The experiment was conducted in split plot design with three replications in 16 treatment combinations. The main plot consists of four cultivars of groundnut FeSEG 8, FeSEG 10, JL 24 and ICGS 76 and in the sub plots different combinations of organic manure and inorganic fertilizers, viz. control (no nutrient), 50% N through FYM (0.50% N, 0.08% P and 0.41% K) and 50% N through inorganic fertilizers, 75% N through inorganic fertilizers and 25% N through FYM, 100% N through inorganic fertilizer (20 kg N/ha) and 100 % N through FYM. P_2O_5 @ 60 kg/ha and K_2O@ 40 kg/ha applied through inorganic fertilizers at the time of final land preparation as

per recommended dose. The recommended dose of groundnut is 20-60-40 N, P_2O_5 and K_2O, respectively. The soil fertility dynamics under various treatments were estimated by soil analysis of composite soil sample from each plot before sowing and after harvesting of crops. The soil of the experimental site was sandy loam in texture, acidic in reaction with pH 5.4, high in organic carbon 0.80%, low in N 188 kg/ha, moderate in phosphorous 20 kg/ha and low in K 48 kg/ha. The crop was sown when sufficient rain was received (1st fortnight of June). The crop was harvested in the month of October.

Crop profitability was computed using the formula (Singh *et al*. 2011).

Crop profitability (₹/ha/day) = Net returns (₹/ha) ÷ Number of days field occupied

RESULTS AND DISCUSSION

Growth, yield attributes and yield

The result showed that groundnut variety FeSEG 10 produced taller shoot and root growth than other cultivars. However, groundnut cultivars FeSEG 10 and ICGS 76 recorded statistically at par shoot and root growth (Table 1). The number of branches was found to be the highest in the FeSEG 8 which was statistically at par with ICGS 76 and superior over FeSEG 10 and JL 24. However, the groundnut variety JL 24 recorded the significantly higher number of nodules/plant over other cultivars. This might be due to genetic composition and suitability of the groundnut cultivars in this specific location, acidic soil of the region (Patel *et al*. 2005). Significantly greater number of pods/plant and kernels/pod were recorded in FeSEG 10 followed by ICGS 76 than other cultivars. However, pod weight/plant and 100-kernel weight was found to be higher in ICGS 76 (14.22 g/plant, 62.33 g, respectively) followed by FeSEG 8 (12.96 and 60.44, respectively) over other cultivars. This might be due to the bigger size and weight of individual kernels which were observed at the time of harvesting (Patel *et al.* 2005). The cumulative effect of more number of pods/plant and number of kernels/pod in FeSEG 10 and FeSEG 8 cultivars led to its higher productivity when compared to other cultivars. The grain yield of FeSEG 10 was higher by 3%, 10% and 14.5% over ICGS 76, FeSEG 8 and JL 24, respectively.

The nutrient management system showed a positive response on shoot length, root length and number of branches in groundnut plant. Application of 75% N through inorganic fertilizers + 25% N through FYM produced maximum shoot length, root length and higher number of branches/ plant and pods/plant as compared to other nutrient management treatment (Meena *et al.* 2011). The number of nodules/plant were found to be highest in the treatment 100% N through FYM (4 tonnes/ha) followed by 50% N through inorganic fertilisers (10 kg N/ha) + 50% N through FYM (2 tonnnes/ha).

The total number of nodules differed in groundnut under different fertility treatments and all the inorganic N levels produced lesser number of nodules as compared to organic sources. This might be due to the fact that legumes formed an effective symbiosis with *Rhizobia* when the plants need for N is not met by the soil. These findings are in line with those of Ghosh *et al.* (2009).

The number of pods/plant was decreased steadily as the crop receiving higher proportion of N through FYM. Accordingly, higher rate of substitution of recommended dose of N by FYM resulted in production of less number of pods/plant, pod weight/plant. Because of slow mineralization of organic matter might affect the nutrient supply at right

Table 1 Effect of cultivars and nutrient management practices on growth and yield attributing characters of groundnut (mean of two years)

Treatment	Shoot length (cm)	Root length (cm)	No. of nodules/ plant	No. of branches/ plant	No. of pods/ plant	No. of kernels/ pod	Weight of pods/ plant (g)	100 kernel weight (g)
Cultivars								
FeSEG 8	94.0	12.9	88.3	15.2	16.5	2.0	12.9	60.4
FeSEG 10	114.7	15.0	91.1	11.6	18.7	2.7	12.8	42.2
JL 24	103.8	12.8	97.4	10.9	16.0	2.0	10.8	46.0
ICGS 76	113.2	14.1	92.0	13.8	18.6	2.3	14.2	62.3
SEm ±	2.9	0.2	0.9	0.5	0.7	0.1	0.6	0.6
CD (P=0.05)	8.6	0.6	2.9	1.7	2.2	0.3	1.8	1.9
Nutrient management (% N inorganic + % N FYM)								
Control	102.7	11.7	55.8	12.0	14.9	2.2	9.6	49.1
50 + 50	108.2	13.7	115.7	13.0	16.2	2.2	11.7	51.8
75 + 25	113.6	14.8	107.5	13.6	19.4	2.4	16.2	55.1
100 + 0	118.0	15.5	61.0	14.1	20.5	2.4	14.7	52.7
0 + 100	93.3	12.9	121.0	11.6	16.1	2.1	9.9	45.0
SEm ±	4.0	0.2	1.1	0.5	0.8	0.1	0.7	0.6
CD (P=0.05)	12.0	0.6	3.3	1.7	2.5	NS	2.0	1.7

Table 2 Effect of cultivars and nutrient management practices on protein content, nutrient uptake and nutrient use efficiency in groundnut (mean of two years)

Treatment	Protein content (%)	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	Nutrient use efficiency (kg grain/kg nutrient uptake)
Cultivars					
FeSEG 8	22.1	93.6	8.2	73.7	28.0
FeSEG 10	22.3	101.5	9.0	74.1	30.3
JL 24	22.6	92.9	7.6	74.3	27.1
ICGS 76	22.0	102.6	9.0	77.3	30.7
SEm ±	0.3	1.7	0.3	1.7	1.2
CD (P=0.05)	NS	5.0	0.8	5.2	3.5
Nutrient management (% N inorganic + % N FYM)					
Control	20.0	66.7	5.9	55.9	0.0
50 + 50	23.0	94.5	8.0	61.7	27.6
75 + 25	24.5	127.7	10.7	82.5	29.4
100 + 0	25.0	129.5	11.1	98.3	25.5
0 + 100	19.0	69.6	6.1	77.2	35.3
SEm ±	0.3	2.0	0.3	2.0	1.2
CD (P=0.05)	0.9	6.1	0.9	5.9	3.5

time to the crop (Bala *et al.* 2010). The crop receiving 100% recommended dose of N through inorganic fertilizer followed by 75% N through inorganic fertilizers + 25% N through FYM produced significantly higher number of pods/plant, weight of 100 kernel/plant and ultimately yield over control (Table 2 and 3). Significantly higher number of pods/plant, weight of 100 kernel/plant and yield/ha were recorded under 75% N through inorganic fertilizers + 25% N through FYM over rest of the treatments. However, the yield under 75% N through inorganic fertilizers + 25% N through FYM was statistically at par with 100% N through inorganic fertilizers.

Nutrient uptake

The groundnut cultivar ICGS 76 followed by FeSEG 10 recorded significantly higher uptake of N, P and K as well as nutrients use efficiency than other two cultivars (Table 3). The lowest N, P and K uptake and nutrients use efficiency were observed in JL 24. This might be due to low productivity and duration of cultivars in comparison to those of ICGS 76 and FeSEG 10. The finding is also supported by Bala *et al.* 2011. The protein content among the tested cultivars was statistically at par. Application of 100% N through inorganic fertilizers recorded significantly higher total N, P and K uptake followed by 75% N through

Table 3 Effect of cultivars and nutrient management practices on yield, economics and crop profitability of groundnut (mean of two years)

Treatment	Pod yield (tonnes/ha)	Haulms yield (q/ha)	Harvest Index (%)	Cost of cultivation (₹ × 10^3/ha)	Gross returns (₹ × 10^3/ha)	Net returns (₹ × 10^3/ha)	B: C ratio	Crop profitability (₹/ha/day)
Cultivars								
FeSEG 8	2.26	49.8	50.1	22.5	67.9	45.4	3.0	453.4
FeSEG 10	2.50	50.2	46.8	22.5	74.9	52.4	3.3	475.7
JL 24	2.18	46.2	44.9	22.5	65.4	42.9	2.9	357.2
ICGS 76	2.43	52.4	53.3	22.5	72.8	50.3	3.2	386.7
SEm ±	0.06	1.28	2.60					
CD (P=0.05)	0.18	NS	7.85					
Nutrient management (% N inorganic + % N FYM)								
Control	1.9	45.4	44.3	19.0	55.9	36.9	2.9	337.1
50 + 50	2.2	45.7	49.9	22.8	67.5	44.7	3.0	405.1
75 + 25	2.7	53.0	54.3	25.2	80.9	55.7	3.2	500.7
100 + 0	2.6	51.9	55.0	25.2	79.3	54.0	3.1	485.8
0 + 100	2.0	46.0	40.5	20.5	60.2	39.7	2.9	361.6
SEm ±	0.1	1.4	2.8					
CD (P=0.05)	0.2	4.2	8.3					

inorganic fertilizers + 25% N through FYM than other nutrient management treatments. 100 % N through inorganic fertilizers improved the N, P and K uptake over control by 94, 88 and 76%, respectively (Table 3). This could be attributed to higher N concentration in grain where groundnut was grown with sufficient nutrients. Phosphorus is known to be responsible for synthesis of RNA and an ingredient of phospho-proteins, plays a central role in synthesis of protein. Nitrogen and phosphorus content in grain and haulms of groundnut and their uptake increased with the nutrient availability. The higher yields (grain and haulms) of groundnut coupled with higher nutrient (N, P and K) content resulted in higher uptake of nutrients due to application of nutrients through different sources (Ghosh *et al.* 2009). The beneficial effect of the fertilizers application on N, P and K uptake on pulses has also been reported by Myaka *et al*. (2006). 100% N through FYM enhanced the nutrients use efficiency over 50% N through FYM and 50% N through inorganic fertilizers, 75% N through inorganic fertilizers and 25% N through FYM, 100% N through inorganic fertilizers by 28, 20 and 36%, respectively. This might be due to slow release of nutrients and more nodulation and additional N_2 fixation in organic fertilizers which ultimately gave more N available to the plant for uptake and thus there was more nutrients use efficiency (Singh *et al*. 2010). Higher protein content was recorded in the 100% recommended dose of N followed by 75% N through inorganic fertilizers and 25% N through FYM than other treatments. Phosphorus being responsible for synthesis of DNA and RNA and as an ingredient of phospho-proteins plays a central role in synthesis of protein (Dastur 1959). It is evident from the results that N interacted positively with P and hence improved the nutrient uptake in crops. These results are in close agreement with the findings of Ghosh *et al.* (2009).

Economics and crop profitability

On an average fetched ₹ 6.99×10^3, 9.47×10^3 and 2.06×10^3/ha more net returns than FeSEG 10, JL 24 and ICGS 76, respectively (Table 4). Thus FeSEG 10 has recorded more B: C ratio over other cultivars. The higher pod yield coupled with the corresponding stover yield and with minimal increases in cost of cultivation has resulted in higher net returns and B: C ratio in FeSEG 10 cultivars. Bala *et al.* (2011) reported similar results. FeSEG 10 increased groundnut profitability by 5%, 33% and 23% over FeSEG 8, JL 24 and ICGS 76, respectively. Application of 75% N through inorganic fertilizers and 25% N through FYM enhanced mean net returns by ₹ 18.81×10^3/ha over control. Further, application of 100% RDN through inorganic fertilizers enhanced net returns by ₹ 17.1×10^3/ha over control. Inclusion of organic fertilizers (25%) with 75% RDF enhanced the net returns by ₹ 1.71×10^3/ha over 100% fertilizers through inorganic sources. The highest B: C ratio was observed with 75% N through inorganic fertilizers and 25% N through FYM (3.21) followed by 100 % RDN through inorganic fertilizers (3.14). The higher net returns with combined fertilizer source were due to higher pod yield. Significant increase in yield with application of fertilizers through organic and inorganic sources over control was due to enhancement of yield resulting in higher net returns. Similar findings were reported by Ghosh *et al.* (2006). 75% N through inorganic fertilizers and 25% N through FYM (500.7 ₹/ha/days) recorded the highest crop profitability followed by 100 % RDN through inorganic fertilizers (485.8 ₹/ha/day) than other nutrient management treatments.

It was concluded that FeSEG 10 can be grown to achieve for higher yield, nutrient use efficiency and profitability. Application of 75% N through inorganic fertilizers and 25% N through FYM was found more productive over other nutrient management treatments.

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