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Performance of short duration groundnut (*Arachis hypogaea* L.) variety (TG 51) as influenced by nutrient management strategy under new alluvial zone of West Bengal

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ABSTRACT

To study the effect of nutrient management strategy on production potentiality of short duration high yielding summer irrigated groundnut variety TG 51, field experiments were conducted during summer seasons of 2011 and 2012 at Bidhan Chandra Krishi Viswavidyalaya, West Bengal. Results revealed that, application of 100 % RDF + 7.5 t/ha FYM as basal increased growth and yield attributes that led to significantly higher productivity (pod yield 3320 kg/ha) besides enrichment of soil available nutrients after harvest of the crop. Pod yield decreased with further increase in NPK fertilizer above 100% RDF. However, maximum haulm yield (3979kg/ha) was recorded with 150% RDF + 7.5t/ha FYM as basal. Maximum net return: cost ratio (3.43) was found with 100 % RDF which was closely followed by that of 100 % RDF + 7.5 t/ha FYM.

Key words: Economics, Fertilizer, FYM, Groundnut, Yield.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a major oilseed cum food legume crop in the world which is presently grown in about 90 countries over an area of 25 million hectares under different agro climatic regions and contributes major share to the India's edible oil production. As per Indian Council of Medical Research (ICMR) recommended consumption of 20 g edible oil /day/person, by 2020 A D, India requires around 20.3 million tonnes of edible oil. To meet this demand, it is essential to enhance the productivity of prominent oilseed crops of the country like groundnut through location specific nutrient management practices (Karunakaran *et al.,* 2010).

Groundnut, being an unpredictable legume, its response to nutrient application is always not optimistic (Veeramani *et al.,* 2012). Therefore, sustaining the yield of groundnut through blending organic and inorganic fertilizers has become necessary in the context of organic oil concept. Indiscriminate use of inorganic fertilizer application to groundnut is a common occurrence in West Bengal that results in wider variation of groundnut yield. In West Bengal, groundnut grown in three different seasons starting from *kharif* under rainfed situation, *rabi* with residual soil moisture after harvesting of *kharif* rice and in summer/spring irrigated condition. Spring groundnut cultivation is mainly confined to areas where potato is grown during winter followed by groundnut as successive crop. Integration of organic and inorganic fertilizer application of groundnut is very meager and due to shortage of time for land preparation, farm yard manure application is very less in these areas. Hence, the present investigation was undertaken to find out the optimum quantity and judicious combinations of farm yard manure (FYM) and NPK fertilizers for newly released high yielding groundnut variety (TG51) under New Alluvial Zone of West Bengal, India.

MATERIALS AND METHODS

The present investigation was undertaken at District Seed Farm, Kalyani under Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, during summer seasons of 2011 and 2012. The soil of the experimental field was sandy clay loam in texture with initial soil organic carbon 0.79%, available N 210.56 kg/ha, P_2O_5 24.65 kg/ha and K_2O 189.59 kg/ha and pH 6.81 on an average during the experimental period. The experimental individual plot size was 5m x 3m in a randomised block design with four replication having ten treatments. The treatments were T_1 = RDF 100% as basal; T_2 = RDF 100% as basal + FYM 7.5 tonnes/ha; T_3 = RDF 75% as basal + RDF 25% as top dressing at 30 days after emergence (DAE) ; T_4 = RDF 75% as basal + RDF 25% as top dressing at 30 DAE + FYM 7.5 tonnes/ha;

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T_5 = RDF 150% as basal; T_6 = RDF 150% as basal + FYM 7.5 tonnes/ha; T_7 = RDF 100% as basal + RDF 50% as top dressing at 30 DAE; T_8 = RDF 100% as basal + RDF 50% as top dressing at 30 DAE + FYM 7.5 tonnes/ha; T_9 = RDF 75% as basal + RDF 75% as top dressing at 30 DAE and T_{10} = RDF 75% as basal + RDF 75% as top dressing at 30 DAE + FYM 7.5 tonnes/ha. The recommended dose of inorganic fertilizer (RDF) was 20 kg N + 60 kg P_2O_5 + 40 kg K_2O per ha and the sources were urea, single super phosphate and muriate of potash respectively. Treatment wise FYM was applied during final land preparation of the experiment. Gypsum 400 kg/ha was applied uniformly in all the treatments. Newly released short duration (90 days) spanish bunch type hybrid groundnut variety TG51 was sown on 18th and 16th February during 2011 and 2012 respectively with the spacing of 30 cm x 10 cm. Available NPK status of the soil was also determined after harvest of the crop.

RESULTS AND DISCUSSION

Growth and yield attributes: Plant height of groundnut increased towards maturity with increasing levels of NPK fertilizers either as basal or split doses along with farm yard manure @ 7.5t/ha. At all the growth stages of the crop the dry matter production increased significantly with increasing levels of NPK fertilizer along with FYM. Split application of inorganic fertilizer did not vary the dry matter production significantly and maximum dry matter production at harvest (501.6 g/ m^2) was recorded at 100 % of RDF as basal along with 7.5 t/ha FYM which was superior to T_1 (100% RDF) (Table 1). Increase in the levels of nutrients through fertilizer and farm yard manure might have increased the plant height by the promotion of growth characteristics by rapid meristematic activities in plants. Similar findings were reported by Subrahmaniyan *et al*. (2000). FYM applications have increased the dry matter production significantly over inorganic fertilizer only, which might be due to increased release of macro and micronutrients. This is in accordance with the findings of Thorave and Dhonde (2007). Irrespective of the treatments growth rate of groundnut (CGR) was faster during 61-75 DAE thereafter growth rate became slower towards maturity of the crop. At all the growth stages the crop growth rate (CGR) was found maximum when 150% of RDF was applied either basal or split application along with FYM @ 7.5 t/ha. Beneficial effect of FYM in conjunction with recommended dose of fertilizers may be due to the effect of organic matter in improving physical, chemical and biological environment of soil conducive to better plant growth (Deshmukh *et al.,* 2005).

Number of pods /plant did not vary significantly due to application of different doses of inorganic fertilizers either basal or splits along with or without FYM. The highest pod dry weight was found with 100% of RDF along with FYM @7.5 t/ha as basal which varied significantly from the treatment receiving 100% RDF as basal only (Table 2). Inorganic fertilizer either 100% or 150% of RDF as basal significantly increased the shelling percentage. However, split application in either form of RDF (100% and 150% of RDF) along with or without FYM had no positive influence in increasing the shelling percentage. Similar observation was reported by Borse *et al.* (2008). The highest hundred kernel weight (46.09 g) was recorded with 100 % of RDF along with FYM @7.5 t/ha as basal. This finding is in agreement with Thomas and Thenua (2010) who reported that growth and yield attributes as well as yield improvement could be obtained by application of farm yard manures and fertilizers

TABLE 1: Effect of nutrient management strategy on growth attributes of groundnut (pooled over two years)

Treatments	Plant height (cm)					Dry matter (g/m^2)				Crop growth rate (g/m^2/day)		
	30 DAE	45 DAE	60 DAE	75 DAE	at harvest	45 DAE	60 DAE	75 DAE	at harvest	45 to 60 DAE	61 to 75 DAE	76 to harvest
T_1	9.1	17.0	25.7	39.7	51.2	67.1	171.5	359.5	467.5	6.96	12.54	7.14
T_2	9.5	17.6	27.8	40.8	52.6	68.2	188.9	381.5	501.6	8.04	12.83	8.21
T_3	9.5	16.9	28.0	40.6	52.7	67.7	179.2	368.1	497.1	7.42	12.60	9.09
T_4	10.7	18.2	27.7	43.2	50.6	73.1	188.1	374.2	491.1	7.66	12.41	8.29
T_5	9.1	16.1	29.5	42.0	53.7	70.9	165.9	360.8	495.2	6.33	12.99	8.95
T_6	9.2	17.0	27.9	43.0	53.0	71.5	206.4	356.7	497.7	8.99	10.02	9.19
T_7	9.3	17.8	28.9	41.9	49.7	68.8	200.1	405.4	485.5	8.75	13.68	5.33
T_8	9.5	18.0	29.9	43.5	47.1	71.8	207.4	389.5	476.5	9.09	12.14	5.79
T_9	9.9	17.0	27.4	38.8	46.3	69.3	178.5	349.9	471.1	7.32	11.42	8.07
T_{10}	9.7	17.1	28.8	46.8	46.8	69.0	188.4	371.2	479.7	7.95	12.19	7.23
S.Em (±)	0.321	0.288	0.337	0.877	0.4	1.073	3.486	4.688	4.726	0.232	0.300	0.51
CD (P=0.05)	0.924	0.827	0.972	2.520	1.149	3.082	10.010	13.459	13.569	0.666	0.863	1.466

S.Em (±): Standard error of mean, CD (0.05): critical difference at 5% level of significance, DAE: days after emergence

mainly through a significant improvement in 100 kernel weight.

Yield: The increase in pod yield was significant up to RDF only. Increase in RDF to 150% decreased pod yields; while the haulm yields continued to increase non significantly over RDF. The highest pod yield (3320 kg/ha) was recorded with 100 % of RDF as basal and farm yard manure 7.5 tonnes/ha. This might be because groundnut being a legume crop its fertilizer particularly nitrogen supply from soil is only 20-40 % and remaining is obtained from atmosphere by symbiotic association with *Rhizobium*. This finding confirms the finding of Mishra (2000). Split applications of inorganic fertilizer either 100% or 150% of RDF had no significant influence on pod yield. Maximum haulm yield (3979kg/ha) was recorded with 150% of RDF as basal along with farm yard manure @ 7.5 tonnes/ha, however, the difference was non-significant with that of the treatment receiving 100% RDF + FYM. Similar finding was also reported by Kausale *et al.* (2006). Kernel yield (2334 kg/ha) was found maximum with the application of 7.5 t/ha of FYM along with 100% of RDF (Table 2.). Higher pod yield with application of FYM, could be attributed to favourable changes in physical and chemical characteristics of the soil which enabled better pod formation. The positive influence of these treatments through immediate supply of nutrients from inorganic sources especially at the early stage of the crop and slow and steady supply of nutrients from FYM throughout the crop growth period improved adequate biomass production and improvement in yield parameters resulting in higher pod and haulm yield. Earlier reports also confirmed the significant increase in pod yield of groundnut due to organic manure application (Rao and Shaktawat, 2001).

Available N, P_2O_5 and K_2O in soil: The different levels of fertilizers and manures significantly influenced soil available nutrients (NPK) after harvest of groundnut crop during both the years of study. The maximum available soil nitrogen was found in 150 % of RDF along with FYM 7.5 tonnes/ha (T_6) which was significantly superior to the treatments received 100 % of RDF either basal or split applications. Split applications of nitrogen resulted in significant variation in the nitrogen content in soil as compared to basal application only. This might be due to reduced loss of nitrogen was experienced under split application, in terms of leaching, volatilization as well as various de-nitrification losses due to soil microbial activities. Available P_2O_5 content in soil exhibited similar trends as in case of nitrogen. Treatments receiving FYM along with inorganic fertilizer (100% or 150% RDF) either as split or basal application, showed increased availability of N and P_2O_5 in comparison to application of inorganic fertilizer only. This is because application of organic manure is one of the most important practical measures to improve soil fertility. FYM might have promoted the release of native soil P (Mohanty *et al.*, 2006) due to the fact that the organic anions compete with phosphate ions for the binding sites on the soil particles and the complex organic anions formed chelate with Al^{3+}, Fe^{3+} and Ca^{2+} etc. cations and thereby decreased the phosphate precipitating power of the cations, increasing the solubility and desorption of phosphorus.

In addition of providing necessary nutrients for crops and improving soil physico-chemical properties, organic manure is able to enhance microbial activity of soil, such as improving activity of soil enzymes and increasing soil microbial biomass (Ren *et al.* 1996 and Lv *et al.* 2005) which further helps in mobilization of different nutrient elements in soil such as nitrogen and thus can improve nutrient availability. Flaig, (1982) also reported that soil organic matter

TABLE 2: Effect of nutrient management strategy on yield attributes and yield (pooled over two years)

Treatments	No. of pods /plant	Pod dry weight (g) /plant	Shelling (%)	100 kernel weight (g)	Pod yield (kg/ha)	Haulm yield (kg/ha)	Kernel yield (kg/ha)
T_1	17.6	14.9	71.3	44.96	3166	3865	2258
T_2	18.7	17.5	71.9	46.09	3320	3895	2334
T_3	16.9	14.9	70.9	43.00	3121	3818	2214
T_4	16.9	16.1	71.5	44.23	2974	3854	2127
T_5	17.8	15.6	71.7	44.53	3247	3979	2329
T_6	17.3	14.3	71.3	44.36	3109	3913	2217
T_7	16.8	14.9	69.2	43.10	2863	3721	1981
T_8	16.5	13.4	69.8	43.68	2767	3541	1932
T_9	16.5	14.1	69.6	42.80	2864	3711	1992
T_{10}	16.1	14.4	69.3	44.18	2696	3562	1867
SEm (±)	0.391	0.402	0.463	0.448	44.816	58.065	37.603
CD (P=0.05)	NS	1.155	1.331	1.288	129.99	168.311	107.955

S.Em (±): Standard error of mean, CD (0.05): critical difference at 5% level of significance, DAE: days after emergence

TABLE 3: Effect of nutrient management strategy on available N, P_2O_5 and K_2O in soil (Kg/ha) and economics (pooled over two years)

Treatments	Available N, P_2O_5 and K_2O (kg / ha)			Economics		
	Nitrogen	P_2O_5	K_2O	Gross return (₹/ha)	Net return (₹/ha)	Net return : Cost ratio
T_1	462.1	39.22	80.2	126640	89396	3.43
T_2	487.1	43.9	97.5	132540	91546	3.26
T_3	473.3	45.6	94.3	124840	87352	3.36
T_4	478.7	51.1	116.8	118980	77742	2.91
T_5	492.3	46.2	138.2	129880	76179	2.43
T_6	512.5	60.4	109.5	124380	66929	2.18
T_7	484.0	57.6	93.0	114500	60546	2.14
T_8	511.7	54.0	104.2	110680	54553	1.99
T_9	479.8	45.8	85.6	114540	60595	2.14
T_{10}	491.2	46.8	95.2	107840	50145	1.88
SEm (±)	3.410	1.395	4.068	1796.3	1833.2	0.04
CD (P=0.05)	9.79	4.006	11.68	5154.5	5261.3	0.11

S.Em (±): Standard error of mean, CD (0.05): critical difference at 5% level of significance, DAE: days after emergence

and added organic materials not only act as a source of nutrient but also influence the availability of nutrients.

Available K_2O was found maximum with 150% RDF as basal. It was also found that irrespective of fertilizer doses entire quantity applied as basal recorded highest available K_2O as compared to split application of NPK fertilizers. Bhide and Motiramani (1964) also reported that muriate of potash with or without a basal dose of N and P increased the available potassium in all soils. (Table.3).

Economics: The highest gross return (₹ 132540) and net return (₹ 91546) was recorded with 100% of RDF along with 7.5 t/ha of FYM. However, the highest net return: Cost ratio (3.43) or, profit per rupee investment was recorded with the application of 100% of recommended dose of inorganic fertilizer as basal which was statistically at par with 75% of RDF as basal and 25% RDF at 30 DAE (3.36) and was closely followed (3.26) by 100% recommended dose of inorganic fertilizer NPK + 7.5 tonnes FYM / ha as basal. (Table 3). Combinations of various RDF levels with FYM was proved less profitable. However, if subsidies are available from state or central Government on FYM, the reduction in manuring share of cost of cultivation can make 100% RDF + FYM, the most profitable treatment.

It was concluded that in areas where organics are available at cheaper prices, recommended dose of inorganic fertilizer 20 kg N + 60 kg P_2O_5 + 40 kg K_2O/ha along with farm yard manure at the rate of 7.5 tonnes/ ha entire as a basal application could be beneficial for profitable cultivation of newly released short duration high yielding groundnut cultivar TG 51 during summer season in new alluvial zone of West Bengal.

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