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Maximizing Yield in Irrigated Groundnut through Increased Fertilizer Levels, Split Application along with Organic Sources

V. Vasuki*

Institute of Agriculture, AEC & RI, Tamil Nadu Agricultural University, Tiruchirapalli, India

**Corresponding author*

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A B S T R A C T

Field experiment was conducted at Coconut Research Station, Aliyarnagar during Rabi/Summer for three consecutive yearsto maximize yield of groundnut through integrated nutrient approach and rescheduling fertilizer levels along with farmyard manure and to study the impact of split application of fertilizers along with economic feasibility of integrated nutrient combinations. The experiment was laid out in Randomized Block Design with three replications and ten treatments,T_1: RDF (100%) as basal, T_2**:** RDF (100 %) as basal + FYM @ 7.5 t ha^{-1}, T_3**:** RDF (75 %) as basal + RDF (25 %) as top dressing at 30 DAS, T_4**:** RDF (75 %) as basal + RDF (25 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1}, T_5**:** RDF (150%) as basal, T_6**:** RDF (150 %) as basal + FYM @ 7.5 t ha^{-1}, T_7: RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS, T_8**:**RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1}, T_9:RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS, T_{10}**:** RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1}. Gypsum @ of 400 $kgha^{-1}$ was applied as basal. were applied to the recommended dose of fertilizers. Results revealed that application of recommended dose of fertilizers (RDF) (100%) as basal + RDF (50 %) as top dressing at 30 DAS + FYM @ 7.5 tha^{-1} recorded higher pod yield and net returns (2936 $kgha^{-1}$ and Rs. 91789ha^{-1}, respectively) and were comparable with RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS along with 7.5 tha^{-1} of FYM higher pod yield and net returns (2812 $kgha^{-1}$ and Rs. 86610ha^{-1}, respectively). Economic analysis registered that RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS along with 7.5 tha^{-1} of FYM recorded the maximum return of Rs. 91789 and BCR of 3.10 and was closely followed by RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS with a maximum return of Rs. 86610 but with a BCR of 3.05 the additional cost of FYM were not incurred in cost of cultivation.

Introduction

Groundnut is one of the most important sources of vegetable protein. Groundnut seeds contain high quality edible oil (50%), protein (25%) and carbohydrates (20 %). In India groundnut is an important legume crop grown in about 70 lakh hectares and ranks first in world for acreage and second in production (www.apeda.gov.in). The average productivity of groundnut in India is around 1300 kg/ha which used to be around 1000 kg/ha in the last decade. However, the demand of groundnut as oil seed and food

crop is increasing. The productivity of groundnut in India is also low mainly due to the fact that the crop is mostly grown on dry lands and in semi-arid regions with low soil fertility and input management (A.L. Singh, 2002). The balanced nutrient application will improve the productivity of groundnut when coupled with irrigation. Fertilizer to any crop acts as a growth promoter. A good soil health emphasizes the integration of biological with chemical and physical measures of soil quality (Puste *et al.,* 2001). Selvi *et al.,* (2005) reported that combined application of N P K and FYM resulted in significantly higher hydraulic conductivity, porosity, water holding capacity and aggregate stability as compared to either NPK alone or unmanured control in Finger Millet – Maize – Cowpea sequence on inceptisols. Mahapatra and Dixit (2010) has reported that in groundnut integrated use of FYM + 75 % RDF, Rhizobium, Gypsum and Boron recorded significantly higher pods /plant and higher pod yield of 2.66 t/ha. Response of groundnut to fertilizers was never high and often erratic, justifying the name "unpredictable legume". Rami Reddy *et al.,* (1983) reported that in rainfed conditions favorable rainfall during the crop period helped effective utilization of top-dressed fertilizers leading to maximum NPK uptake. In order to increase the yield in groundnut through nutrient management practices, the integrated approach of farmyard manure application along with inorganic fertilizers were experimented along with split application of fertilizers to assess the use efficiency this experiment was formulated.

Materials and Methods

The field experiment was conducted at Coconut Research Station, Aliyarnagar during Rabi/Summer 2009-10, 2010-11 and 2011-12. The soil was sandy loam with organic carbon content of 0.27 %. The nutrient status of the soil was medium in available nitrogen 297 kgha, high in available phosphorus 37.7 kg/ha and high in available potassium 331 $kgha^{-1}$ with soil pH of 7.18. The experiment was laid out in Randomized Block Design with three replications with ten treatments namely, T_1: RDF (100%) as basal, T_2**:** RDF (100 %) as basal + FYM @ 7.5 t ha^{-1}, T_3**:** RDF (75 %) as basal + RDF (25 %) as top dressing at 30 DAS, T_4**:** RDF (75 %) as basal + RDF (25 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1}, T_5**:** RDF (150%) as basal, T_6**:** RDF (150 %) as basal + FYM @ 7.5 t ha^{-1}, T_7: RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS, T_8**:** RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1}, T_9:RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS, T_{10}**:** RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1}. The net plot size was 20 m^{-2} (4 x 5 m^{-2}). The crop was irrigated 5 to 7 times during its period of growth at different seasons. For recommended dose of NPK 25:50:75 $kgha^{-1}$ was applied. For 100 % and 150 % RDF of NPK, split application in the ratio of 100 % as basal, 75 % as basal and 25 % as top dressing, 100 % as basal and 50 % as top dressing, 75 % as basal and 75 % as top dressing with or without Farm yard manure @ of 7.5 t/ha. Gypsum @ of 400 kg/ha was applied as basal. Groundnut variety VRI 2 was sown with spacing of 30 x 10 cm. All the growth and yield parameters were recorded at 20 DAS, 40 DAS and at harvest stage. Statistical analysis for the crop data were carried out using the method Gomez and Gomez (1984) wherever statistical significance was observed.

Results and Discussion

The pooled mean of three years rabi / summer (2009-10, 2010-11, 2011-12) data revealed that the plant height (cm) recorded at harvest registered no significant difference among treatments for different nutrient doses, sources and split application of fertilizers.

However, the highest plant height was recorded with RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS with 42.40 cm. The lowest plant height of 38.73 cm was recorded with RDF (100 %) as basal alone.

The yield attributing characters like Sound Matured Kernels (SMK), Shelling percentage recorded non significance for varied treatments. Application of recommended dose of fertilizers RDF (100%) as basal + RDF (50 %) as top dressing at 30 DAS + FYM @ 7.5 tha^{-1} recorded higher dry pod yield and kernel yield (2936 and 1892 kg ha^{-1}, respectively) and were comparable with RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS along with 7.5 tha^{-1} of FYM higher dry pod and kernel yield (2812 and 1748 kg ha^{-1}, respectively). This may be attributed due to higher dose of RDF along with split application which facilitates easy and timely availability of nutrients. Losses of nutrients due to leaching and volatilization were reduced (Laxminarayanan and Patiram, 2006).

Additional application of FYM improves mineralization of nitrogen and phosphorus along with ameliorating effect on soil physical, chemical and biological properties making it more available to crop plants facilitating to produce more yield (Behera *et al.,* 2017). Lowest dry pod yield and kernel yield were recorded with treatments RDF (100 %) as basal, RDF (100 %) basal + FYM @ 7.5 t ha^{-1} and RDF (75 %) as basal + RDF (25 %) as top dressing at 30 DAS with dry pod and kernel yield of 1405, 1619, 1363 and 843, 969, 818 $kgha^{-1}$, respectively and were comparable with each other. The haulm yield recorded highest with RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1} (4670 kg ha^{-1}) and was comparable with RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1} (4676 kg ha^{-1}). The higher haulm yield was attributed due to staggered and timely availability of nutrient and also the development of more branches and leaves producing more yield and similar results were recorded by Karunakaran *et al.,* (2011) and Gagare *et al.,* (2011). The lowest haulm yield was recorded with RDF (100 %) as basal and RDF (75 %) as basal + RDF (25 %) as top dressing at 30 DAS (2598 and 2555 kg ha^{-1}, respectively).

The harvest index was non-significant among treatments, however numerically highest harvest index of 0.41 was recorded with RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1} and lowest HI of 0.37 was recorded with RDF (100 %) as basal + FYM @ 7.5 t ha^{-1} and RDF (75 %) as basal + RDF (25 %) as top dressing at 30 DAS. The results are in accordance with Kathmale *et al.,* (2000), Sabale (2002), Singh *et al.,* (2013). Integrated nutrient management with judicious combination of inorganic fertilizers with organic manures improves improve the soil fertility status and facilitates higher yield and harvest index (Nambiar and Abrol, 1989).

The economic analysis also recorded that highest net returns of 91789 $Rsha^{-1}$ and B:C ratio of 3.10 was registered with application of RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1}. The above was closely followed by RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS with a maximum return of Rs. 86610 but with a BCR of 3.05.

The additional cost of FYM was not incurred in calculating cost of cultivation. The lowest net return (30626 Rs ha^{-1}) was registered with RDF (75 %) as basal + RDF (25 %) as top dressing at 30 DAS and lowest B:C ratio of 1.81 was recorded with RDF (100 %) as basal + FYM @ 7.5 t ha^{-1} (Table 1).

Table.1 Effect of nutrient treatments in irrigated groundnut on Plant height (cm), Total number of pods plant^{-1}, Dry pod weight plant^{-1}, 100 kernel weight (g), Shelling percentage, Sound matured kernels, Dry pod yield, kernel yield, dry haulm yield (kg ha^{-1}), harvest index and economics(Pooled data of 3 years)

Treatments		Plant height (cm)	100 kernel weight (g)	Shelling (%)	Sound Matured kernels (Nos.)	Dry pod yield (kg ha^{-1})	Kernel Yield (kg ha^{-1})	Dry haulm yield (kg ha^{-1})	Harvest Index	Net monetary returns (Rs. ha^{-1})	B:C Ratio
T_1	RDF (100%) as basal	38.73	25.22	59.91	81.03	1405	843	2598	0.38	32745	**1.99**
T_2	RDF (100 %) as basal + FYM @ 7.5 t ha^{-1}	40.13	26.62	60.26	84.29	1619	969	3123	0.37	34383	**1.81**
T_3	RDF (75 %) as basal + RDF (25 %) as top dressing at 30 DAS	39.61	24.92	60.25	82.82	1363	818	2555	0.37	30626	**1.91**
T_4	RDF (75 %) as basal + RDF (25 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1}	39.24	26.44	61.40	85.42	1751	1071	3161	0.38	39288	**1.92**
T_5	RDF (150%) as basal	40.92	26.46	60.24	85.00	1792	1071	3174	0.39	49654	**2.45**
T_6	RDF (150 %) as basal + FYM @ 7.5 t ha^{-1}	42.23	28.11	61.58	86.50	2174	1330	3772	0.39	61597	**2.55**
T_7	RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS	42.40	28.09	60.24	86.01	2232	1335	3850	0.39	65956	**2.74**
T_8	RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1}	41.63	29.90	64.52	88.33	2936	1892	4676	0.41	91789	**3.10**
T_9	RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS	41.82	27.45	61.90	86.57	2274	1401	3863	0.40	71098	**3.05**
T_{10}	RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS + FYM @ 7.5 t ha^{-1}	42.22	30.22	62.46	88.88	2812	1748	4670	0.40	86610	**2.98**
S.Em ±		1.406	1.92	1.40	2.02	131	94	181	0.02		
LSD (0.05)		**NS**	**NS**	**NS**	**4.24**	**276**	**198**	**381**	**NS**		

From the experimental results it can be concluded that, irrigated groundnut when applied with higher rates of nitrogen, phosphorus, and potassium (150 percent RDF) along with split application (top dressing at 30 DAS) recorded significant response. Application of RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS along with 7.5 tha^{-1} of FYM or RDF (75 %) as basal + RDF (75 %) as top dressing at 30 DAS along with 7.5 tha^{-1} of FYM recorded higher pod yield, kernel yield and harvest index. The B:C ratio was also higher with RDF (100 %) as basal + RDF (50 %) as top dressing at 30 DAS along with 7.5 $tha^{-1}$of FYM.

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