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Effect of Integrated Nutrient Management Practices on Growth and Yield of Groundnut (*Arachis hypogaea* L.) in an Alfisols of Tamiraparani Tract

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ABSTRACT

Background: Groundnut, an important oilseed crop, has been losing its area on the cropping map of the state agriculture, owing to favourable production and marketing environment for other crops like maize. The trends in area, production and yield of groundnut, its relative profitability and factors affecting productivity in the state. The area under groundnut in Tamil Nadu and India has turned negative over the years although the productivity of the crop was constantly increasing. The current study aimed to evaluate the soil test crop response integrated nutrient management package on the growth and yield of groundnut.

Methods: A field experiment was conducted to study the effect of integrated nutrient management practices on growth and yield of groundnut (*Arachis hypogaea* L.) during *Rabi* (September to December) 2019 and 2020 at Agricultural College and Research Institute, Killikulam, Thoothukudi with the test crop of groundnut variety TMV (Gn) 13. The 10 treatments consisted of 2 levels of 75 and 100% Soil Test Crop Response (STCR) based recommended fertilizers *i.e.* 38 : 64 : 94 NPK kg ha^{-1}, 3 sources of organic manures (Poultry manure @ 3 t ha^{-1}, Humic acid @ 20 kg ha^{-1} and Rhizobium @ 3 kg ha^{-1}) along with absolute control receiving no organic or inorganic sources.

Result: The result revealed that application of 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_8) increased growth and yield attributes contributing significantly to higher productivity (2964 and 8975 kg ha^{-1} of mean pod and haulm yield, respectively) and nutrient uptake of groundnut besides enriching soil available nutrients after harvest of groundnut. Due to the cheap cost of manuring, that treatment also recorded the highest mean net returns (` 72,706 ha^{-1}) and B:C ratio (2.47).

Key words: Economics, Groundnut, Integrated nutrient management, Nutrient uptake, Organic manures, Yield.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) crop is native to South America. It is an excellent source of nutrition to both human and animal due to it's high nutritive values having 26 % protein, 12 % starch, 5% minerals and 9 % fibres. India holds head position in the worldwide oilseed scenario accounting 6.7 million hectares of total area (Anonymous, 2017) and production was 7.4 million tonnes with the productivity of about 1.46 tonnes per ha.

Groundnut is cultivated in Tamil Nadu in an area of 2,82,000 ha contributing 5,82,000 tonnes groundnut production, which is 12% of national production. The productivity of groundnut in Tamil Nadu is about 2.08 tonnes per ha compared to national average of 1.46 tonnes per ha (Anonymous, 2017). Hence, nutrient management strategies should be aimed at achieving the goals of productivity and sustainability with minimum cost of organic nutrients. Poultry manure, humic acid (HA) and *Rhizobium* spp. contain all the essential plant nutrients and it improves the soil fertility. Regular and imbalanced application of inorganic nutrient sources by omitting organic leads to reduction in soil health besides restricting groundnut productivity (Thulasiram *et al*., 2018). The lack of well-decomposed organic sources such as manure from poultry, manure from farms, rhizobium and humic acid contributes to low production. Though many studies have been carried out in groundnut crop, the soil

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test crop response (STCR) on integrated nutrient management for groundnut in an Alfisols of Tamiraparani tract is lacking. Therefore a study was undertaken to evaluate the soil test crop. response integrated nutrient management package on the growth and yield of groundnut.

MATERIALS AND METHODS

A field experiment was conducted to study the integrated nutrient management on growth and yield of groundnut (*Arachis hypogaea* L.) during *Rabi* season of (September to December) 2019 and 2020 at Agricultural College and Research Institute, Killikulam, Thoothukudi with the test crop of groundnut variety TMV (Gn) 13. The field was located at 80°46′ latitude and 77°51′ longitude. The elevation of the site was 40 m above sea level. Thoothukudi region coming under alluvial Tamiraparani river basin and semi arid condition received 750 and 785 mm, rainfall during 2019 and 2020, respectively. The daily mean maximum and minimum temperatures for the cropping period were 33.3 and 25.4°C during 2019 and 34.4 and 25.6°C during 2020, respectively. The experimental soil's texture was sandy clay loam (Scl). The soil was nearly neutral in reaction (pH 6.79 and 6.82), EC (0.13 and 0.16 dSm^{-1}), low in organic carbon (0.45 and 0.48%), low available N (212 and 218 kg ha^{-1}), medium available P (16.4 and 18.5 kg ha^{-1}) and available K (228 and 215 kg ha^{-1}). The 10 treatments consisted of combination 2 levels of soil test crop response (STCR) recommended fertilizers (STCR, 38 : 64 : 94 N-P_2O_5-K_2O kg ha^{-1}) *i.e,* 75 and 100% and three organic manures, poultry manure @ 3 t ha^{-1}, Humic acid @ 20 kg ha^{-1} and Rhizobium @ 3 kg ha^{-1} along with absolute control that received no manures or fertilizers. Ten treatments *viz*., T_1 - 100% STCR based NPK @ 38 : 64 : 94 kg ha^{-1}, T_2 - 75% STCR + Poultry manure @ 3 t ha^{-1}, T_3 - 75% STCR + Rhizobium @ 3 kg ha^{-1}, T_4 - 75% STCR + Humic acid @ 20 kg ha^{-1}, T_5 - 75% STCR + Humic acid @ 20 + Rhizobium @ 3 kg ha^{-1}, T_6 - 75% STCR + Rhizobium @ 3 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}, T_7 - 75% STCR + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}, T_8 - 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}, T_9 - Poultry manure @ 3 t ha^{-1}, T_{10} - Absolute control.

The STCR fertilizers (urea, single super phosphate and muriate of potash) and manures as per treatment was applied at sowing. The experiment was laid out in a randomized block design (RBD) with 3 replications. The observations on plant height, no. of branches plant^{-1} were recorded manually on five randomly selected representative plants from each plot of each replication separately as well as pod and haulm yield attributing character were recorded as per the standard method. The pod and haulm yield was recorded from net plot area of each treatment. Nutrient (NPK) concentration in plant samples, nutrient uptake and post harvest soil were determined as per standard procedures. The economics were worked out using market prices of output. The data obtained from various characters under study were analyzed by the method of analysis of variance as described by (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Growth attributes

Among treatments, 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_8) recorded the tallest plant (67.2 cm) and minimum days (31.1 days) required to 50% flowering during both years. This was followed by 75% STCR + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_7) and they were on par with each other. Integration of humic acid and poutry manure with 75% STCR fertilizers markedly enhanced the plant height and days to 50% flowering over 100% STCR fertilizers alone or poultry manure alone. The use of three organic sources as rhizobium, humic acid and poultry manure with 75% STCR fertilizer recorded significantly higher plant height and minimum days required to 50% flowering among all treatments, while unfertilized absolute control has the poor performance of these parameters. The growth attributes were similar trend in both years. The integrated sources of nutrients through fertilizers and organics might have increased plant height and minimum days required for 50% flowering. Similar findings were reported by Khaim *et al*., (2013) and Sarathi *et al*., (2014). The association of nutrients from inorganics and organics produced more number of leaves with height of plants. Particularly association of nitrogen nutrients with cell division and photosynthesis might have helped the plants to produce more leaves. This is in accordance with the findings of Choudhary *et al.* (2017) and Thakur *et al*., (2018). The increase in plant height and more leaves resulted in significant increase dry matter production (DMP). Rhizobium, humic acid and poultry manure with 75% STCR fertilizer recorded significantly higher DMP than all other treatments (8854 kg ha^{-1}, means of 2 years).

Yield attributes

The different organics with 75% STCR recommended fertilizers had significant influence on the pods plant^{-1}, 100 pods weight and 100 kernels weight (Table 1). Application of 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_8) recorded the maximum number of pods plant^{-1} (67.4), 100 pods weight (71.2 g) and100 kernels weight (36.4 g) and over rest of the treatments in both years while absolute control resulted in lowest values of pods plant^{-1} (26.4), 100 pods weight (27.8 g) and 100 kernels weight (31.4 g). Application of 75% STCR + Rhizobium + Humic acid + Poultry manure might have promoted higher growth rate from the early stage onwards in terms of plant height, pod weight, kernel weight as well as dry matter production. Thus the optimum growth of the plant due to favourable nutritional environment and higher uptake of nutrients might have favoured significant increase in number of pegs plant^{-1} and thus more number of pods plant^{-1}. This is in agreement with the findings of Falodun *et al*., (2015) and Aruna and Sagar (2018). 75% STCR + Rhizobium + Humic acid + Poultry and 75% STCR + Humic acid + Poultry are at on par with each other during both the years of study.

Yield

The nutrient management practices had significant influence on pod and haulm yield of groundnut during both the years (Table 2). The pod and haulm yield were significantly higher (2964 and 8975 kg ha^{-1}, respectively) at 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_8). This was followed by 75% STCR + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_7) and they were on par with each other. The absolute control recorded the lowest pod and haulm yields (1522 and 4849 kg ha^{-1}, respectively). Application of 75% STCR + Rhizobium + Humic acid + Poultry manure increased the pod and haulm yields significantly over all other treatments during both the years. However, the haulm yield of 75% STCR + Rhizobium + Humic acid + Poultry manure and 75% STCR + Humic acid + Poultry manure in both years were at on par. Higher pod yield could be attributed to favourable changes in physical and chemical characteristics of the soil which might have enable better pod formation. Moreover, the positive influence of these treatments through immediate supply of nutrients from inorganic sources especially at early stage of the crop and slow and steady supply of nutrients from poultry manures, rhizobium and humic acid throughout the crop growth period might have 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 ground nut due to integrated application of nutrients (Zalate and Padmani 2009 and Vala *et al*., 2018).

Quality

The oil and protein yield was also influenced by the application of STCR recommended NPK with different organic manures (Fig 1 and 2). Application of 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_8) recorded the highest oil and protein content (50.24 and 25.72, per cent, respectively) and yield (1014 and 536 kg ha^{-1}) followed by 75% STCR + 20 kg of humic acid ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_7) which registered the next best oil and protein content (49.10 and 25.21 per cent) and yield of 962 and 497 kg ha^{-1}. The absolute control (T_{10}) was recorded the lowest oil and protein yield (348 and 187 kg ha^{-1}). Application of 75% STCR +3 kg ha^{-1}of Rhizobium + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_8) provided the significant improvement in the oil and protein yield of groundnut seeds. Eisa., (2011) and Saini *et al*., (2017) reported that the humic acid influenced the oil and protein in groundnut. So, the humic acid can be contribute to increasing the yield and similarly improving the oil and protein yield.

Table 1: Effect of integrated nutrient management practices on growth and yield attributes of groundnut.

Treatment	Plant height (cm) (at harvest)		Days to 50% flowering		Dry matter yield (kg/ha)		Pods/plant		100 Pods weight/plant (g)		100 Kernel weight (g)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T_1 - 100% STCR @ 38 : 64 : 94 kg N-P_2O_5-K_2O ha^{-1}	53.2	55.4	35.6	35.2	7273	7321	45.7	46.8	49.7	47.7	31.3	31.8
T_2 - 75% STCR + Poultry manure @ 3 t ha^{-1}	54.4	56.8	36.6	35.7	6527	6585	36.6	35.4	38.6	39.6	32.8	33.1
T_3 - 75% STCR + Rhizobium @ 3 kg ha^{-1}	53.8	54.7	36.6	35.4	6828	6848	34.5	35.6	43.1	43.5	33.4	33.8
T_4 - 75% STCR + Humic acid @ 20 kg ha^{-1}	49.7	50.5	35.6	34.3	7317	7340	39.6	40.7	44.4	46.2	32.7	33.4
T_5 - 75% STCR + Humic acid @ 20 kg ha^{-1} + Rhizobium @ 3 kg ha^{-1}	58.0	60.3	34.6	34.0	8201	8254	51.8	52.3	59.5	60.5	34.3	35.0
T_6 - 75% STCR + Rhizobium @ 3 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	47.2	48.2	38.6	37.8	6373	6387	48.8	50.2	57.0	58.8	33.4	33.7
T_7 - 75% STCR + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	58.8	62.2	31.5	32.0	8678	6701	52.9	53.4	62.0	62.7	35.5	36.1
T_8 - 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	66.6	67.8	30.5	31.8	8821	8888	66.1	68.8	70.9	71.6	36.0	36.8
T_9 - Poultry manure @ 3 t ha^{-1}	54.5	55.5	34.6	34.2	5277	5271	40.7	40.2	56.0	55.1	33.4	33.3
T_{10}- Absolute control	44.6	45.5	39.6	38.7	4753	4706	25.4	27.3	27.0	28.6	31.3	31.5
SEd	0.50	0.51	0.31	0.32	148.67	146.52	0.72	0.77	0.79	0.81	0.074	0.078
CD (P=0.05)	1.06	1.07	0.65	0.64	312.35	315.32	1.51	1.53	1.67	1.69	0.156	0.157

Table 2: Effect of integrated nutrient management on haulm, pod yield and economics (` ha^{-1}) of groundnut.

Treatment	Haulm yield (Kg/ha)		Pod yield (Kg/ha)		Economics (` ha^{-1})					
	2019	2020	2019	2020	2019			2020		
					Cost of cultivation	Net returns	B:C ratio	Cost of cultivation	Net returns	B:C ratio
T_1 - 100% STCR @ 38 : 64 : 94 kg NPK ha^{-1}	7396	7405	2464	2505	45.167	57.107	2.26	45.368	56.905	2.28
T_2 - 75% STCR + Poultry manure @ 3 t ha^{-1}	6638	6685	2211	2243	47.567	44.182	1.93	47.895	44.765	1.95
T_3 - 75% STCR + Rhizobium @ 3 kg ha^{-1}	6943	6990	2299	2310	44.362	51.077	2.15	44.743	51.673	2.17
T_4 - 75% STCR + Humic acid @ 20 kg ha^{-1}	7441	7482	2464	2514	45.767	56.509	2.23	46.025	56.810	2.20
T_5 - 75% STCR + Humic acid @ 20 kg ha^{-1} + Rhizobium @ 3 kg ha^{-1}	8515	8575	2669	2655	46.062	64.945	2.41	46.545	65.121	2.38
T_6 - 75% STCR + Rhizobium @ 3 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	6481	6505	2148	2178	47.862	41.287	1.86	48.127	41.445	1.88
T_7 - 75% STCR + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	8825	8877	2775	2835	49.267	66.165	2.34	49.610	66.586	2.37
T_8 - 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	8936	9015	2938	2990	49.562	72,433	2.46	49.990	72.980	2.48
T_9 - Poultry manure @ 3 t ha^{-1}	5366	5385	1789	1756	43.509	30.727	1.71	43.712	31.065	1.73
T_{10} - Absolute control.	4834	4865	1530	1515	40.009	23.611	1.59	40.223	23.820	1.47
SEd	85.03	86.07	26.65	26.82						
CD (P=0.05)	178.65	179.01	56.01	56.07						

Table 3: Effect of integrated nutrient management on nutrient content (%) and uptake of groundnut and nutrient status (kg/ha) of soil after harvest.

Treatment	Nutrient content (%)						Nutrient uptake (kg/ha)					
	N		P		K		N		P		K	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T_1 - 100% STCR @ 38 : 64 : 94 kg NPK ha^{-1}	3.13	3.08	0.39	0.37	2.25	2.21	128	125	14.8	14.1	112	108
T_2 - 75% STCR + Poultry manure @ 3 t ha^{-1}	3.26	3.16	0.38	0.36	2.05	2.04	122	121	13.8	12.6	91	90
T_3 - 75% STCR + Rhizobium @ 3 kg ha^{-1}	3.05	3.01	0.38	0.36	2.25	2.22	118	120	13.3	12.4	96	96
T_4 - 75% STCR + Humic acid @ 20 kg ha^{-1}	3.35	3.34	0.39	0.38	1.99	1.98	133	131	14.9	13.2	99	97
T_5 - 75% STCR + Humic acid @ 20 kg ha^{-1} + Rhizobium @ 3 kg ha^{-1}	3.69	3.68	0.45	0.42	2.39	2.40	166	163	19.4	18.5	132	131
T_6 - 75% STCR + Rhizobium @ 3 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	2.94	2.90	0.37	0.35	2.23	2.25	109	108	12.4	10.8	97	94
T_7 - 75% STCR + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	3.76	3.72	0.47	0.44	2.52	2.56	178	175	21.3	18.6	148	145
T_8 - 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	3.93	3.88	0.51	0.49	2.80	2.78	198	193	24.1	21.7	168	164
T_9 - Poultry manure @ 3 t ha^{-1}	3.31	3.29	0.39	0.36	2.03	2.02	93	91	10.4	9.1	73	70
T_{10} - Absolute control	2.44	2.22	0.32	0.33	1.76	1.88	66	65	7.5	6.8	56	55
SEd	0.117	0.114	0.0098	0.0096	0.035	0.033	10.64	10.52	1.09	1.07	6.62	6.71
CD (P=0.05)	0.247	0.234	0.0205	0.0203	0.074	0.072	22.36	22.02	2.30	2.11	13.93	13.45

Nutrient content, uptake and soil nutrient status

Application of inorganic fertilizers in combination with organic manures had significantly influenced the N, P and K content and uptake by groundnut crop during both the years of study (Table 3). The highest N, P and K content (3.9, 0.5 and 2.79 per cent, respectively) was observed in the treatment with 75% STCR + Rhizobium 3 kg ha^{-1} + Humic acid 20 kg ha^{-1} + Poultry manure@ 3 t ha^{-1} (T_8) . The next highest N, P and K content (3.74,0.45 and 2.54, per cent respectively) was observed in the treatment received with 75% STCR + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_7). Among the treatments, application of 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_8) recorded significantly higher N, P and K uptake (195, 22.9 and 166 kg ha^{-1}, respectively) than rest of the treatments. This was followed by 75% STCR + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_7) (176, 19.9 and 146 kg ha^{-1}, respectively) and they were at on par. The uptake of major nutrients increased with 75% soil test crop responded recommended fertilizers and organic amendments application. Similar results were reported by Prasad *et al*., (2005) and Kara *et al*., (2006). Among the different treatments, the inorganic fertilizers alone or organic alone registered lower uptake of N, P and K. The application of 75% soil test crop response recommended fertilizers with organic sources favoured higher root and shoot development which might have also increased the uptake of N, P and K. The poultry manures, rhizobium and humic acid besides supplying major and minor plant nutrients, might have influenced the physical properties favourably resulting in better soil structure, greater water retention, more favourable environment for root and pod development ultimately registering increased nutrient uptake. This is evidenced from the reports of Chitdeswari *et al*., (2007) and Ravi *et al*., (2010).

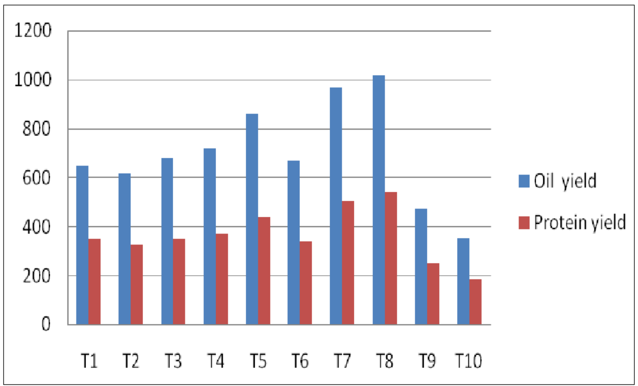

Fig 1: Effect of treatments on oil and protein yield (kg/ha) of groundnut.

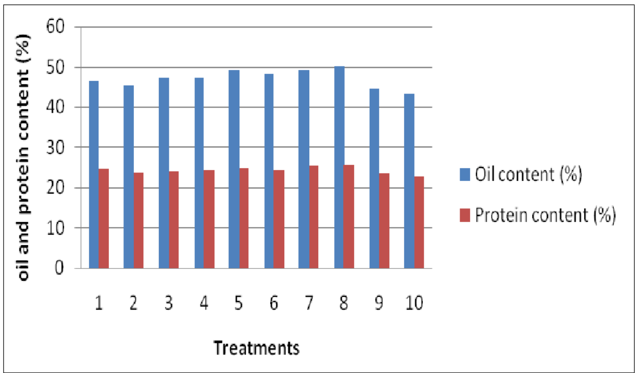

Fig 2: Effect of treatments on oil and protein content (%) of groundnut.

Similar trend was as that of uptake of nutrients, the available nutrients status after harvest of crop was observed. The two levels of fertilizers with different levels of organic manures significantly influenced the available nutrients (NPK) after harvest of groundnut crop during both the years

Table 4: Effect of integrated nutrient management on nutrient status (kg/ha) of soil after harvest.

Treatment	Soil available status					
	N		P		K	
	2019	2020	2019	2020	2019	2020
T_1 - 100% STCR @ 38 : 64 : 94 kg NPK ha^{-1}	237	231	12.4	10.3	241	236
T_2 - 75% STCR + Poultry manure @ 3 t ha^{-1}	231	228	14.1	11.8	230	226
T_3 - 75% STCR + Rhizobium @ 3 kg ha-^{1}	234	230	11.7	9.6	240	235
T_4 - 75% STCR + Humic acid @ 20 kg ha^{-1}	230	228	11.3	8.9	257	253
T_5 - 75% STCR + Humic acid @ 20 kg ha^{-1} + Rhizobium @ 3 kg ha^{-1}	254	248	13.5	10.7	273	266
T_6 - 75% STCR + Rhizobium @ 3 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	241	239	11.5	9.2	259	251
T_7 - 75% STCR + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	256	251	14.3	11.1	275	271
T_8 - 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1}	278	272	16.5	13.2	291	286
T_9 - Poultry manure @ 3 t ha^{-1}	228	222	11.8	10.2	255	251
T_{10}- Absolute control	183	178	8.8	8.4	183	177
SEd	9.46	9.33	0.19	0.18	3.34	3.22
CD (P=0.05)	19.88	19.54	0.41	0.40	7.02	7.01

of study (Table 4). The soil available N, P and K were maximum (275, 14.8 and 288 kg ha^{-1}, respectively) in 75% STCR + Rhizobium @ 3 kg ha^{-1} + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_8) and it was significantly superior to rest of the treatments. This was followed by 75% STCR + Humic acid @ 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_7) with the higher available N, P and K (253, 12.7 and 273 kg ha^{-1}, respectively). The lower status of available NPK was recorded in fertilizer alone or organic manure alone applied treatments. The absolute control registered lowest status of available N, P and K (180, 8.6 and 180 ka ha^{-1}, respectively). The rate of release of nutrients from organic manures may depend on initial chemical composition together with the stage of composting. The highest available N, P and K in soil due to combination of fertilizers with organic sources which increased the post harvest soil by mineralization. Similar finding were reported by Karunakaran *et al*., (2010) and Ramakrishna *et al*., (2017).

Economics

The economics (Table 2) data reveal that the application of STCR of fertilizer as 38:64:94 kg of NPK ha^{-1} with humic acid @ 20 kg ha^{-1} + rhizobium 3 kg ha^{-1} and poultry manure @ 3 t ha^{-1} (T_8) was the best treatment with net income of 72,706 ha^{-1} with benefit cost ratio of 2.47 followed by treatment of 75% STCR + Humic acid 20 kg ha^{-1} + Poultry manure @ 3 t ha^{-1} (T_7) with next best net income of (66,375) with the B:C ratio of 2.35. The poor net income and benefit: cost ratio was obtained from absolute control (T_{10}) (23,715 and 1.53). Due to the poultry manure is a very cheap source compared to all other inputs and it has an high nutrient content. So, it could be increasing the highest net income. The earlier findings of were also supported for this result Akbari *et al*., (2011) and Gurni and Nath (2012).

CONCLUSION

It is concluded that in areas where organics are available at cheaper prices, the application of STCR recommended fertilizer as 75% STCR + 3 kg of Rhizobium ha^{-1} + 20 kg of Humic acid ha^{-1}+ Poultry manure @ 3 t ha^{-1} (T_8) is effective to maximize the yield and income of groundnut farmers of Alfisols of the Tamiraparani tract.

Conflict of interest: None.

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