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Influence of various nutrient management practices on crop yield, nutrient concentration, uptake and economics of groundnut-groundnut cropping system

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Abstract

Field experiments were laid out in kharif and rabi seasons of 2018-2019 in Farm of S. V. Agricultural College, Experimental design followed was Randomized Block Design consisting of nine treatments which were replicated thrice. Experimental results shown the yield, yield attributes of groundnut like pod yield, haulm yield, 100 pod weight, 100 Kernel weight, Nutrient concentration, Nutrient uptake, Gross returns, Net returns and B:C ratio were significantly highest with the treatment of 75% RDN+25% N through FYM+ *Rhizobium* seed treatment +PSB soil application during *kharif* where as it was significantly highest with the treatment 50% RDN + 50% N through FYM+ *Rhizobium* seed treatment +PSB soil application during *rabi* and lowest values of above parameters was recorded in control in both the seasons.

Keywords: Groundnut, yield, concentration, uptake, Net returns and B:C ratio

Introduction

Groundnut is considered to be as major oilseed crop of India, 80% of its produce is used for oil extraction, 11% as seed, 8% as direct food and only 1% produce is exported. Groundnut seeds are the rich source of edible oil and protein content. In India groundnut is cultivated in an area of 49.14 lakh ha with a production of 82.54 lakh tones, although India ranks 1st in the world in respect of area and production, and ranks 8th in productivity. In Andhra Pradesh, groundnut is cultivated in an area of 8.70 lakh ha with a production of 7.74 lakh tones (Annual project Report, 2021) [2]. Groundnut-Groundnut cropping system is one of the predominant cropping systems in Chittoor district of Andhra Pradesh. Nutrient management practices involving organic manures particularly farm yard manure, bio-fertilizers, vermicompost and green leaf manures not only acts as a source of multiple nutrients with ability to increase physical, chemical and biological properties of soil and productivity of crop by maintaining soil health. Organic manures contain plant nutrients, growth hormones and enzymes in small quantities, but which are essential for improvement of soil fertility and productivity. In consideration of various agronomic management practices, use of organics is prime importance under rainfed farming situations (Nagaraj *et al.*, 2001) [9]. Groundnut as a legume crop, leaves residual fertility which helps in the growth and development of succeeding crop under rainfed farming situations. Integration and incorporation of organic manures (farmyard manure, vermicompost etc.) helps to improve soil physical properties like soil structure, soil moisture conservation and biological properties like soil microbial activity which in turn helps to sustain the production and productivity of the crops in rainfed farming situations (Lourduraj, 1999) [6]. Hence, various nutrient management practices like combined usage of inorganic fertilizers, organic manures and bio fertilizers is the best efficient way to supply plant nutrients for sustained crop productivity and improved soil fertility (Vala *et al* 2018) [16].

Material and Methods

The field experiment was conducted with groundnut crop (variety Dharani) at farm of S.V. Agricultural College, Tirupati, Andhra Pradesh during *kharif* 2018 and *rabi* 2018-19 respectively. Experimental field was geographically situated in the Southern Agro Climatic

Zone of Andhra Pradesh and it was classified as Semi-Arid Tropics (SAT) according to Trolls classification. The experimental design followed was randomized block design (RBD) with three replications and nine treatments. The treatments followed were as follows viz.; T₁: Control, T₂: 100% RDN, *Kharif*: FYM @ 5 t ha⁻¹+20: 40: 50 N: P₂O₅: K₂O kg ha⁻¹, *rabi*: 30: 40: 50 N: P₂O₅: K₂O kg ha⁻¹, T₃: 100% N through FYM, T₄: 75% N through RDN+25% N through FYM, T₅: 50% N through RDN+50% N through FYM, T₆: 100% RDN + *Rhizobium* seed treatment and PSB @ 5 kg ha⁻¹ soil application, T₇: 100% N through FYM + *Rhizobium* seed treatment and PSB @ 5 kg ha⁻¹ soil application, T₈: 75% N through RDN+ *Rhizobium* seed treatment and PSB @ 5 kg ha⁻¹ soil application, T₉: 50% N through RDN+ *Rhizobium* seed treatment and PSB @ 5 kg ha⁻¹ soil application. The soil of the experimental plot was sandy loam in texture, neutral in soil reaction, non-saline soils, low in organic carbon (0.39%), available N (248 kg ha⁻¹), high in available phosphorus (30.8 kg ha⁻¹) and medium in available potassium (208 kg ha⁻¹). Farmyard manure applied to the soil, contains 0.5% N, 0.2% P and 0.4% K. The inorganic source of fertilizers were given as urea, single super phosphate, and muriate of potash. Gypsum @ 250 kg ha⁻¹ was applied at peg initiation stage. Biofertilizers like PSB culture applied to soil @ 5 Kg ha⁻¹ before sowing and seeds were treated with *Rhizobium* culture @ 10g/ kg seed. Yield and yield attributing parameters were recorded during harvest. Yield components include pod and kernel yield per unit area was collected from data analysis after harvest of the crop. The weight Pod index (g) of 100- pod samples, drawn randomly and 100-index (g) kernel samples, drawn randomly from shelling of the pod samples were calculated by standard procedure.

Groundnut Plant samples were collected at harvest from different treatments and grinded it into fine powder, and it was analyzed for macro nutrients. Total Nitrogen (%) was estimated Kjeldahl digestion and distillation method, Total Phosphorus (%) was estimated by Diacid digestion and vanadomolybdate and spectrophotometry, Total Potassium (%) was estimated by Diacid digestion and Flame Photometry.

Nutrient uptake by crop was calculated for each treatment separately using the following formula,

$$\text{Nutrient uptake} = \frac{\text{Nutrient Concentration}(\%) \times \text{Dry Matter yield (kg ha}^{-1}\text{)}}{100}$$

Cost of cultivation (₹ ha⁻¹) was calculated for each treatment on the basis of input cost. Gross returns (₹ ha⁻¹) was computed by considering the prevailing market price of the output. Net returns (₹ ha⁻¹) was arrived by deducting the cost of cultivation from gross returns of corresponding treatments. Returns per rupee invested or Benefit cost ratio was worked out for each treatment by using the following formula.

$$\text{Returns per rupee invested} = \frac{\text{Gross returns (₹ ha}^{-1}\text{)}}{\text{Cost of cultivation (₹ ha}^{-1}\text{)}}$$

Results & Discussion

100 Pod Weight

The data related to 100 pod weight, 100 kernel weight, shelling percentage, pod yield and haulm yield of groundnut crop at was presented below in table 1

100 pod weight was significantly highest in treatment T₈ (75%

RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 93.60 g in *kharif* and 95.29 g during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest 100 pod weight 73.27% in *kharif* and 76.21% in *rabi* was recorded in control. The increase in 100 pod weight may be due to overall improvement in vegetative growth of the plant which is as a result of combined application of organic manure and inorganic fertilisers, which favorably influenced yield.

Naveen and Senthil (2020) reported that integrated application of 100% RDF + basal application *Phosphobacteria* @ 2 Kg ha⁻¹ seed treatment with *Rhizobium* recorded highest number of pods plant⁻¹ (20.96), pod yield (2576.4 kg ha⁻¹), haulm yield (3174.5 kg ha⁻¹) kernel yield (2044.46 kg ha⁻¹), 100 kernel weight (49.76 g) and shelling percentage (72.83).

100 Kernel Weight

100 kernel weight was significantly highest in treatment T₈ (75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 39.63 g in *kharif* and 34.12 g during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest 100 kernel weight 31.12% in *kharif* and 25.30% in *rabi* was recorded in T₁ (control). Integrated use of nutrients resulted in increase supply of plant nutrients which improved the 100 kernel weight.

Chaudhary *et al.* (2011) [4] in an experiment on growth, yield, yield attributes and economics of summer groundnut (*Arachis hypogaea* L.) as influenced by integrated nutrient management reported that 100 kernel weight was recorded highest (43.9 g) in treatment receiving FYM compared to 43.4 g in RDF and 41.2 gm in control.

Shelling Percentage

Shelling percentage was significantly highest in treatment T₈ (75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 74.23%, in *kharif* and 73.59% during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest Shelling percentage 62.54% in *kharif* and 65.95% in *rabi* was recorded in T₁ (control). Application of organics like FYM, PSB, *Rhizobium* increased shelling percent in groundnut.

Kamadi *et al.* (2014) [5] reported that maximum shelling percentage was (73.4%) recorded with FYM (72.1%), green manuring (71.2%), RDF (70.55%) and control (70.32%).

Pod yield

Pod yield was significantly highest in treatment T₈ (75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 1796 kg ha⁻¹ in *kharif* and 3763 kg ha⁻¹ during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest pod yield of 1579 kg ha⁻¹ in *kharif* and 3462 kg ha⁻¹ in *rabi* was recorded in T₁ (control). Recommended dose of fertilizers (RDF), organics has improved yield in groundnut.

Naga Madhuri *et al.* (2014) [7] reported that press mud cake applied treatment recorded highest pod yield of 1496 kg ha⁻¹ followed by RDF (1459 kg ha⁻¹) followed by FYM and pressmud cake and the lowest with vermicompost applied plot 1373 kg ha⁻¹

Haulm Yield

Haulm yield was significantly highest in treatment T₈ (75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 4335 kg ha⁻¹ in *kharif* and 3873 kg ha⁻¹

during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest haulm yield of 3377 kg ha⁻¹ in *kharif* and 3727 kg ha⁻¹ in *rabi* was recorded in T₁ (control).

Reddy *et al.*, (2005) [12] reported that combined application of inorganics and organics (FYM, poultry manure and compost) recorded highest pod and haulm yield of groundnut over use of inorganic chemical fertilizers.

Influence of Various Nutrient Management Practices on Plant Nutrient Concentration at Harvest

The data related to Nitrogen content, phosphorus content and potassium content was presented below in table 2

Nitrogen Content

Nitrogen content was significantly highest in treatment T₈ (75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 1.78% in *kharif* and 1.6% during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest haulm yield of 1.14 in *kharif* and 1.1% in *rabi* was recorded in T₁ (control).

Sheetal *et al.* (2014) reported that highest nutrient concentration and uptake was recorded in 150% RDF (37.5:75:37.5 kg ha⁻¹) and it is at par with 5t FYM ha⁻¹ +50% RDF + neem cake 500 kg ha⁻¹ + biofertilizers in groundnut.

Phosphorus Content

Phosphorus content was significantly highest in treatment T₈ (75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 0.56% in *kharif* and 0.55% during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest Phosphorus content of 0.23% in *kharif* and 0.24% in *rabi* was recorded in T₁ (control).

Aziz *et al.*, (2006) [3] reported that other organic manure applied treatments also showed more plant phosphorus content when compared to control and RDF. Root growth was more in plants receiving pressmud cake @ 10 tons ha⁻¹, it is the reason for increased P uptake (8.2 mg kg⁻¹) of plants compared to poultry manure (7.6 mg kg⁻¹) and FYM (6.9 mg kg⁻¹).

Potassium Content

Potassium content was significantly highest in treatment T₈ (75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 1.35% in *kharif* and 1.05% during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest Potassium content of 0.65% in *kharif* and 0.61% in *rabi* was recorded in T₁ (control).

Added organic matter may be attributed to increased K concentration and improved root growth. Better root growth resulted in increased nutrient uptake in plants. Maximum increase in shoot K concentration (62 mg kg⁻¹) in maize was recorded when pressmud cake was added at the rate of 10 tons ha⁻¹ followed by poultry manure (47 mg kg⁻¹) and FYM (33 mg kg⁻¹) (Aziz *et al.*, 2006) [3].

Influence of Various Nutrient Management Practices on Nutrient Uptake At Harvest

The data related to Nitrogen, phosphorus and potassium uptake was presented below in table 2

Nitrogen Uptake

Nitrogen uptake was significantly highest in treatment T₈ (75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 77.23 kg ha⁻¹ in *kharif* and 61.84 kg ha⁻¹ during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest Shelling percentage 38.5 kg ha⁻¹ in *kharif* and 41 kg ha⁻¹ in *rabi* was recorded in T₁ (control).

Akbari *et al.* (2011) [1] reported that in groundnut uptake of nutrients N, P, K, S, Zn, Fe and Mn was increased in soil treated with 50 per cent recommended dose of fertilizer through fertilizers + vermicompost @ 2 t ha⁻¹ or 100 per cent recommended dose of fertilizer (12.5-25.0 kg ha⁻¹) under rainfed condition.

Phosphorus Uptake

Phosphorus uptake was significantly highest in treatment T₈ (75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 23.7 kg ha⁻¹ in *kharif* and 21.17 kg ha⁻¹ during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest Phosphorus

Table 1: Influence of various nutrient management practices on yield attributes (g) after harvest of groundnut

Treatments	100 pod weight (g)		100 kernel weight (g)		Shelling percentage		Pod yield (kg ha ⁻¹)		Haulm yield (kg ha ⁻¹)	
	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>
T ₁ : Control	73.27	76.21	31.12	25.3	62.54	65.95	1579	3462	3377	3727
T ₂ : 100% RDF	90.27	90.55	37.61	31.25	71.88	70.31	1763	3657	4207	3827
T ₃ : 100% N through FYM	75.86	82.44	32.44	26.67	66.44	67.31	1617	3603	3573	3769
T ₄ : 75% RDN +25% N through FYM	88.41	87.29	36.07	30.56	71.27	68.58	1704	3721	3976	3826
T ₅ : 50% RDN+50% N through FYM	81.62	86.64	34.78	29.29	68.55	67.48	1673	3635	3837	3792
T ₆ : 100% RDF+ <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	92.37	91.32	38.08	31.35	72.14	71.17	1737	3674	4313	3843
T ₇ : 100% N through FYM + <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	76.84	84.6	33.29	28.72	67.24	67.46	1649	3622	3731	3784
T ₈ : 75% RDN+ 25% N through FYM + <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	93.60	94.24	39.63	32.75	74.23	72.38	1796	3590	4335	3804
T ₉ : 50% RDN+50% N through FYM+ <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	92.37	95.29	38.08	34.12	72.14	73.59	1683	3763	4012	3873
SEm ±	0.47	0.36	0.49	0.53	0.39	0.34	6.27	8.31	25.89	5.41

CD (P=0.05)	1.42	1.07	1.47	1.58	1.11	1.32	18.79	24.91	77.61	16.23
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in *kharif* and ₹ 74,966 ha⁻¹ during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest net returns of ₹ 30,680 ha⁻¹ in *kharif* and ₹ 57,340 ha⁻¹ in *rabi* was recorded in T₁ (control).

Benefit-Cost Ratio

Benefit-cost ratio was significantly highest in treatment T₈ (75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application) with 2.61 in *kharif* and 3.15 during *rabi* in treatment T₉ (50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application). Lowest benefit cost ratio of 1.95 in *kharif* and 2.07 in *rabi* was recorded in T₁ (control).

Ramesh *et al.* (2009)^[11] reported that the application of different combinations of organic manures resulted in higher yield of Indian mustard (1822 kg ha⁻¹) and resulted in highest gross return (30352 rupees), net return (21,552 rupees) and B:C ratio (3.44) for cattle dung manure+poultry manure.

Conclusions

Nutrient availability and uptake was highest with 75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application in *kharif* groundnut and 50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application in *rabi* groundnut. Significantly highest productivity and pod yield was obtained with 75% RDN+ 25% N through FYM+ *Rhizobium* seed treatment + PSB soil application during *kharif* and 50% RDN+ 50% N through FYM+ *Rhizobium* seed treatment + PSB soil application and during *rabi* indicating 25% and 50% of inorganic nitrogen can be saved in *kharif* and *rabi*, respectively in groundnut-groundnut cropping system. Gross returns, net returns and B:C ratio of the system were also high with the combined application of inorganic fertilizers, organic manure and biofertilisers.

Table 2: Influence of various nutrient management practices on content and uptake after harvest of groundnut

Treatments	N concentration		P concentration		K concentration		N uptake		P uptake		K uptake	
	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>
T ₁ : Control	1.14	1.1	0.23	0.24	0.65	0.61	38.5	41	7.76	9.07	21.84	22.73
T ₂ : 100% RDF	1.6	1.39	0.56	0.51	1.17	0.83	65.55	53.07	20.2	19.39	53.56	31.89
T ₃ : 100% N through FYM	1.22	1.17	0.24	0.29	0.74	0.68	43.6	44.22	8.57	10.81	26.44	25.5
T ₄ : 75% RDN +25% N through FYM	1.47	1.34	0.4	0.5	0.88	0.85	60.57	51.2	21.08	16.96	37.42	37.49
T ₅ : 50% RDN+50% N through FYM	1.45	1.29	0.3	0.4	0.83	0.79	55.78	49.04	11.65	15.04	31.97	29.83
T ₆ : 100% RDF+ <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	1.52	1.44	0.53	0.44	0.94	0.9	59.12	55.34	16.01	15.59	35.39	34.71
T ₇ : 100% N through FYM + <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	1.35	1.23	0.29	0.32	0.8	0.73	50.24	46.66	10.69	12.23	29.96	27.49
T ₈ : 75% RDN+ 25% N through FYM + <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	1.78	1.52	0.56	0.44	1.35	0.98	77.23	58.2	23.7	17.04	58.48	30.94
T ₉ : 50% RDN+50% N through FYM+ <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	1.68	1.6	0.55	0.55	1.27	1.05	68.56	61.84	21.7	21.17	51.28	40.67
SEm ±	0.02	0.02	0.02	0.02	0.04	0.02	0.83	0.72	0.82	0.81	1.5	0.86
CD (P=0.05)	0.06	0.06	0.06	0.06	0.12	0.07	2.48	2.17	2.47	2.43	4.49	2.58

Table 3: Effect of various nutrient management practices on gross returns, net returns and benefit cost ratio of the groundnut

Treatments	Gross returns		Net returns		B:C ratio	
	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>
T ₁ : Control	63065	89725	30680	57340	1.95	2.77
T ₂ : 100% RDF	95635	91472	55409	56132	2.38	2.59
T ₃ : 100% N through FYM	87029	108073	49027	68785	2.29	2.75
T ₄ : 75% RDN +25% N through FYM	92325	93136	56155	57530	2.55	2.62
T ₅ : 50% RDN+50% N through FYM	90289	109100	53874	71929	2.48	2.94
T ₆ : 100% RDF+ <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	90927	103993	53693	67567	2.44	2.85
T ₇ : 100% N through FYM + <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	88254	108573	50038	68465	2.29	2.71
T ₈ : 75% RDN+ 25% N through FYM + <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	96669	110197	59679	74037	2.61	3.05
T ₉ : 50% RDN+50% N through FYM+ <i>Rhizobium</i> seed treatment and PSB @ 5 kg ha ⁻¹ soil application	93676	112957	52630	74966	2.28	3.15
SEm ±	210	287	205	281	0.01	0.01
CD (P=0.05)	628	462	615	464	0.02	0.03

Reference

1. Akbari KN, Ramdevputra MV, Sutaria GS, Vora VD, Padmani DR. Effect of organics, bio and inorganic fertilizer on groundnut yield and its residue effect on succeeding wheat crop. *Legume Research*. 2011;34(1):45-47.
2. Annual Project Report. AICRP (All India Coordinated Research Project on Groundnut). Junagadh-362001. 2021.
3. Aziz T, Rahmatullah MA, Maqsood MA, Tahir I, Ahmad, Cheema MA. Phosphorus utilization by six *Brassica* cultivars (*Brassica juncea* L.) from tri-calcium phosphate; a relatively insoluble P compound. *Pakistan Journal of Botany*. 2006;38:1529-1538.
4. Chaudhary SK, Jat MK, Sharma SR, Singh P. Effect of INM on soil nutrient and yield in groundnut field of semi-arid area of Rajasthan. *Legume Research*. 2011;34(4):283-287.
5. Kamadi TS, Sonkamble P, Joshi S. Effect of organic manure and biofertilizers on seed quality of groundnut (*Arachis hypogaea* L.). *The Bioscan*. 2014;9(3):1011-1013.
6. Lourduraj AC. Nutrient management in groundnut (*Arachis hypogaea* L.) cultivation. A Review of Agriculture. 1999;20(1):14-20.
7. Naga Madhuri KV, Prasad TNVKV, Munaswamy V, Reddy PVRM, Giridhara Krishna T. Effect of organic manures on yield of groundnut and soil quality. 79th Annual Convention, National Seminar on Developments in Soil Science. 2014;24-27.
8. Nagamadhuri KV, Reddy PVRM, Lavanaya Kumari P, Murali G. Influence of 36 years of fertilizers and manures application on rainfed groundnut productivity. *Trends in Farm Mechanization and Engineering Intervention for Sustainable Agriculture*. 2017;79.
9. Nagaraj MV, Malligawad LH, Biradar DP. Productivity and economics of confectionery groundnut as influenced by plant density and fertilizer management. *Karnataka Journal of Agricultural Sciences*. 2001;14:932-937.
10. Naveen S, Senthil N. Effect of Integrated Nutrient Management on yield, yield attributes and quality of groundnut (G-7). *Indian Journal of Agricultural Research*. 2020;55(5):619-623.
11. Ramesh S, Dahia S, Rathe A, Singh D, Nandal JK, Malik RK. Effect of integrated nutrient management on growth, yield, economics and soil fertility in rice-wheat cropping system. *Journal of the Indian Society of Soil Science*. 2009;5(3):31-34.
12. Reddy SS, Shivaraj B, Reddy VC, Ananda MG. Direct effect of fertilizers and residual effect of organic manures on yield and economics of maize (*Zea mays* L.) in groundnut-maize cropping system. *Crop Research*. 2005;30(1):1-5.
13. Sheetal T, Gabhane VV, Pushpa B. Effect of integrated nutrient management on yield, quality, nutrient content and uptake of groundnut in shrink-swell soil. *International Journal of Agricultural Sciences*. 2014;10(1):291-293.
14. Sonawane BB, Nawalkar PS, Patil VD. Effect of micronutrients on growth and yield of groundnut. *Journal of Soils and Crops*. 2010;20(2):269-273.
15. Umesha R, Tiwari A, Sridhara CJ. Effect of enriched FYM and fertilizer levels on growth and yield components of aerobic rice (*Oryza sativa* L.). *Trends in Biosciences*. 2012;8(10):2479-2486.
16. Vala FG, Vaghasia PM, Zala KP, Akhatar N. Response of integrated nutrient management on nutrient uptake, economics and nutrient status of soil in bold seeded summer

groundnut. *International Journal of Current Microbiology and Applied Sciences*. 2018;7(1):174-180.