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Influence of various organic sources on nodulation, yield attributes and yield of groundnut (*Arachis hypogaea* L.)

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Abstract

A field experiment was conducted at the Dryland farm of S.V. Agricultural College, Tirupati during *kharif*, 2015 to study the response of groundnut to various organic sources viz., farm yard manure, poultry manure, sheep manure and neem cake along with recommended dose of NPK through fertilizers. Application of recommended dose of nutrients through fertilizers (20-40-50 kg N, P₂O₅ & K₂O ha⁻¹) resulted in improved yield attributes and yield of groundnut. Among the various organic sources tested, supply of 100% N through FYM recorded significantly higher yield attributes and yield, which was in parity with 50% N through FYM + 50% N through sheep manure. Application of 50% N through poultry manure or sheep manure or neem cake in combination with 50% N through FYM recorded significantly higher pod yield compared to sole application of these manures.

Keywords: ground nut, organic manures, nodulation, yield attributes and yield

Introduction

Groundnut is a premier oil seed and an important food legume in the world. India is the leader in groundnut farming with 4.19 million hectares of area, 6.68 million tonnes of production and a productivity of 1591 kg/ha. Groundnut is an exhaustive crop and for every one tonne of pods and two tonnes of haulms, it removes about 63 kg N, 11 kg P₂O₅, 46 kg K₂O, 27 kg Ca and 14 kg Mg ha⁻¹. Groundnut depletes the soil nutrients rapidly unless the crop is adequately manured (Nair *et al*, 1982) [4]. Use of farmyard manure with other organic amendments like vermicompost, neem cake, poultry manure, sheep manure etc provide an economic and environmental friendly way of applying nutrients to groundnut (Prasad, 2005) [7]. Indiscriminate use of chemical fertilizers leads to development of several problems like decline in soil organic carbon, soil pollution and severe attack of pest and diseases (Chakraborti and Singh 2004) [1]. Due to these problems, organic farming is gaining popularity in recent years. Balanced use of nutrients through organic sources like farm yard manure, poultry manure, sheep manure and neem cake are the prerequisites to sustain soil fertility and to produce reasonably good crop yield with optimum level of input usage. Although, many attempts have been made to study the effect of fertilizers on groundnut crop, the information on response of groundnut to various organic sources of nutrients is meagre. Keeping these in view, the present experiment was taken up to study the organic nutrient supply systems on growth, yield attributes and yield of groundnut in order to achieve the maximum production.

Materials and Methods

A field experiment was carried out during *kharif*, 2015 at the dryland farm of S.V. Agricultural College, Tirupati. The experimental soil was sandy loam in texture, neutral in reaction (pH 6.9), low in organic carbon (0.43 per cent) and available nitrogen (138.0 kg ha⁻¹), high in available phosphorus (40.4 kg ha⁻¹) and medium in potassium (176.2 kg ha⁻¹). The experiment was laid out in a randomized block design with three replications. There were nine treatments viz., control (T1), 100% RDF i.e 20-40-50 kg N, P₂O₅ & K₂O ha⁻¹ (T2), 100% N through farm yard manure (FYM) (T3), 100% N through poultry manure (T4), 100% N through sheep manure (T5), 100% N through neem cake (T6), 50% N through FYM + 50% N through poultry manure (T7), 50% N through FYM + 50% N through sheep manure (T8), 50% N through FYM + 50% N through neem cake (T9). The well decomposed farm yard manure, poultry manure, sheep manure and neem cake with 0.5%, 1.1%, 1.2%, and 1.9% N, respectively were used as organic sources for nitrogen. Based on the equal nitrogen basis, the

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required quantities of organic manures were incorporated in the soil 15 days before sowing. The quantities of phosphorus and potassium supplied by these manures were considered and the remaining quantities were applied through other organic sources i.e. biophos and biopotash, respectively. The recommended doses of nitrogen, phosphorus and potassium in treatment (T₂) were applied in the form of urea, single super phosphate and muriate of potash at the time of sowing. It was maintained separately in the field to avoid leaching of nutrients to the organic treatments. All the plant protection measures were taken up by using organic sources only. The test variety of groundnut 'Kadiri-6' was used in the study by adopting spacing of 30 cm x 10 cm.

Results and Discussion

Growth attributes

Application of 100% recommended dose of nutrients through fertilizers produced the tallest plants with highest leaf area index and dry matter accumulation, significantly higher compared to organic manures. Better nutrient availability with 100% recommended dose of nutrients through fertilizers might have triggered the cell multiplication and cell elongation, which increased the plant height, produced more number of leaves with good expansion and resulted in the highest leaf area index. These findings are in support of Devi *et al.* (2003) [2]. The next higher values of leaf area index was noticed with application of 100% N through FYM followed by 50% N through FYM + 50% N through sheep manure, which might be due to the balanced and timely release of nutrients and their favourable effect on producing of more number of larger leaves. These results are in close conformity with the findings of Zalate and Padmani (2009) [9]. The highest dry matter accumulation observed with the application of 100% recommended dose of nutrients through fertilizers might be due to the immediate availability of adequate amounts of nutrients, which resulted in vigorous crop growth with effective interception of light coupled and higher rate of photosynthesis. These findings are in support of Devi *et al.* (2003) [2]. Among the organic manures tried, the higher dry matter accrual noticed with 100% N through FYM might be ascribed due to its better and timely release of macro and micro nutrients sufficiently as and when required by the groundnut crop. Similar results were also perceived by Dosani *et al.* (1999).

Total number of nodules as well as effective nodules plant⁻¹ with the treatments involving various sources of organic manures was significantly higher compared to 100% recommended dose of nutrients through fertilizers (T₂). Organic manures favour root development which might have resulted in increasing of root nodule number. This was in close agreement with the findings of Patel (1994) [6] and Kausale *et al.* (2009) [3].

Yield attributes: The highest number of pods plant⁻¹,

hundred pod weight, hundred kernel weight and shelling percentage in groundnut were recorded with 100% recommended dose of nutrients through fertilizers, which was significantly higher than rest of the treatments. Pod formation is the complex process, governed by complementary interaction between source and sink. Thus the favorable effect of readily available nutrients with 100% recommended dose of nutrients through fertilizers (T₂) is evident with higher dry matter accumulation and effective translocation of photosynthates to the sink which resulted in improved stature of yield attributes i.e. number of pods plant⁻¹, hundred pod weight, hundred kernel weight and shelling percentage. These results were found in conformity with the findings of Devi *et al.* (2003) [2]. Among the various organic sources tried, 100% N through FYM resulted in more number of pods plant⁻¹. The supremacy of FYM might be due to balanced and continuous supply of macro and micro nutrients required to enhance the enzymatic activity and physiological process of plant which in turn reflected through the inflated stature of all the yield attributes of groundnut. These results are in close conformity with the findings of Verma and Munshi (2003) [8] and Zalate and Padmani (2009) [9].

Yield: The highest pod, kernel and haulm yields were obtained with the application of 100% recommended dose of nutrients through fertilizers. Accordingly, the groundnut crop under comfortable nutrition might have produced the elevated stature of growth and yield attributes which in turn reflected in producing the highest pod yield. These results are in agreement with the findings of Devi *et al.* (2003) [2]. Under organic approach, 100% N through FYM resulted in 87.9 per cent of improvement in the pod yield over control. Application of 100% N through FYM recorded on an average of 39.4 per cent higher pod yield than 100% N through neem cake. Different organic manures, besides being slow in the release of nutrients, require different durations for release of nutrients. It appears that poultry manure, sheep manure and neem cake might be slower to release nutrients compared to FYM. Further, beneficial effect of FYM could be owing to better physical environment with improved aeration and root activity conducive for nutrient absorption. The complementary effect of these favourable conditions was reflected through higher level of biomass accrual coupled with its efficient translocation and accumulation in the pods, which consequently resulted in higher pod and haulm yields. The results are in close conformity with the findings of Zalate and Padmani (2009) [9].

Oil and protein content: Organic sources failed to exert any significant influence on the oil and protein content of groundnut kernels. Oil synthesis is a complex process and it is difficult to modulate its content through management practices during a single season. These findings are in agreement with the studies of Panwar and Munda (2007) [5].

Table 1: Growth attributes of groundnut as influenced by various organic sources

Treatments	Plant height (cm)	Leaf area index	Dry matter production (kg ha ⁻¹)
T ₁ : Control	36.0	1.45	3763
T ₂ : 100% RDF (20-40-50 kg N, P ₂ O ₅ and K ₂ O ha ⁻¹)	47.3	2.62	6917
T ₃ : 100% N through farm yard manure (FYM)	44.9	2.34	6337
T ₄ : 100% N through poultry manure	39.1	1.72	5193
T ₅ : 100% N through sheep manure	39.2	1.73	5194
T ₆ : 100% N through neem cake	39.0	1.70	5190
T ₇ : 50% N through FYM + 50% N through poultry manure	42.2	2.09	5733
T ₈ : 50% N through FYM + 50% N through sheep manure	44.7	2.29	6310

T ₉ : 50% N through FYM + 50% N through neem cake	42.0	1.99	5707
SEm±	0.49	0.05	153.0
CD (P=0.05)	1.4	0.14	458

Table 2: Effect of nodules in groundnut as influenced by various organic sources

Treatments	Total number of nodules plant ⁻¹			Effective nodules plant ⁻¹		
	25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS
T ₁ : Control	11.0	26.1	44.8	8.7	24.2	39.2
T ₂ : 100% RDF (20-40-50 kg N, P ₂ O ₅ and K ₂ O ha ⁻¹)	16.3	35.2	55.6	13.5	33.9	49.4
T ₃ : 100% N through farm yard manure (FYM)	25.6	52.4	72.1	20.4	46.4	65.7
T ₄ : 100% N through poultry manure	21.1	45.2	64.1	17.1	40.1	59.2
T ₅ : 100% N through sheep manure	20.2	44.3	63.0	16.9	39.7	58.1
T ₆ : 100% N through neem cake	19.5	41.1	62.1	15.8	38.5	56.3
T ₇ : 50% N through FYM + 50% N through poultry manure	24.8	51.6	70.3	19.5	45.1	64.5
T ₈ : 50% N through FYM + 50% N through sheep manure	26.5	54.0	74.2	22.4	48.2	67.9
T ₉ : 50% N through FYM + 50% N through neem cake	26.0	53.5	73.3	21.3	47.3	66.8
SEm±	0.59	1.35	1.65	0.49	1.15	1.45
CD (P=0.05)	1.8	4.1	4.9	1.5	3.4	4.3

Table 3: Yield attributes of groundnut as influenced by various organic sources

Treatments	Number of pods plant ⁻¹	Hundred pod weight(g)	Hundred kernel weight(g)	Shelling percentage
T ₁ : Control	14.7	80.3	28.5	65.3
T ₂ : 100% RDF (20-40-50 kg N, P ₂ O ₅ and K ₂ O ha ⁻¹)	26.7	97.4	41.0	73.3
T ₃ : 100% N through farm yard manure (FYM)	24.0	93.4	37.3	71.8
T ₄ : 100% N through poultry manure	17.3	84.5	31.4	67.6
T ₅ : 100% N through sheep manure	17.6	84.9	31.6	67.1
T ₆ : 100% N through neem cake	17.0	84.3	31.2	67.4
T ₇ : 50% N through FYM + 50% N through poultry manure	20.3	89.3	34.3	69.8
T ₈ : 50% N through FYM + 50% N through sheep manure	23.5	93.0	37.0	71.8
T ₉ : 50% N through FYM + 50% N through neem cake	20.0	89.0	34.0	69.8
SEm±	0.54	1.04	0.78	0.37
CD (P=0.05)	1.6	3.1	2.3	1.1

Table 4: Yield and quality of groundnut as influenced by various organic sources

Treatments	Pod yield (kg ha ⁻¹)	Kernel yield (kg ha ⁻¹)	Haulm yield (kg ha ⁻¹)	Oil content (%)	Protein content (%)
T ₁ : Control	1103	720	2049	46.7	24.3
T ₂ : 100% RDF (20-40-50 kg N, P ₂ O ₅ and K ₂ O ha ⁻¹)	2357	1731	3813	47.2	25.5
T ₃ : 100% N through farm yard manure (FYM)	2073	1490	3375	47.2	25.3
T ₄ : 100% N through poultry manure	1497	1005	2587	47.3	24.4
T ₅ : 100% N through sheep manure	1499	1006	2598	46.7	25.0
T ₆ : 100% N through neem cake	1487	1009	2557	47.4	25.4
T ₇ : 50% N through FYM + 50% N through poultry manure	1767	1233	2997	46.8	25.0
T ₈ : 50% N through FYM + 50% N through sheep manure	2070	1486	3351	47.1	25.2
T ₉ : 50% N through FYM + 50% N through neem cake	1750	1222	2993	47.4	25.0
SEm±	66.2	50.8	105.6	0.20	0.28
CD (P=0.05)	200	152	319	NS	NS

Conclusion

Among the various organic sources tried, 100% N through FYM as well as 50% N through FYM + 50% N through sheep manure were proved to be the promising organic manorial practices for higher yield of groundnut with maintenance of soil fertility under rainfed conditions. However the economic returns under organic approach could be enhanced with premium price for the organic produce in the market after certification.

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