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Impact of Different Sources of Nutrients on Growth and Yield Attributes of Groundnut (*Arachis hypogaea* L.)

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Abstract

Field experiment was conducted during *kharif* seasons of 2011 and 2012 at S.K.N. College of Agriculture, Jobner to study the effect of integrated nutrient management levels on growth parameters and yield of groundnut (*Arachis hypogaea* L.). Treatments consisted of the eight levels of organic manures and fertilizers in main plots [control, RDF (25 kg N+45 kg P_2O_5 kg ha^{-1}), FYM 15 t ha^{-1}, FYM 7.5 t ha^{-1}+½ RDF, poultry manure 6 t ha^{-1}, poultry manure 3 t ha^{-1}+½ RDF, vermicompost 5 t ha^{-1}, and vermicompost 2.5 t ha^{-1}+½ RDF] and four levels of iron in sub plots [0.0, 5.0, 10.0 and 15.0 kg ha^{-1}] were compared. Poultry manure 3 t+½ RDF produced significant higher dry matter accumulation (65 g plant^{-1}), branches plant^{-1} (20.45), dry weight of nodules (109 g), leaf area index (5.62), no.of pods plant^{-1} (24.37), no. of kernels pod^{-1} (1.88), pod yield (2863 kg ha^{-1}) and stover yield (4365 kg ha^{-1}) of groundnut at harvest over rest of the treatments during both the years of study. Iron levels up to 10 kg ha^{-1} also significantly increased the dry matter accumulation (59.8 g plant^{-1}), branches plant^{-1} (19.08), dry weight of nodules (104.9 g), leaf area index (5.74), no. of pods plant^{-1} (21.30), no. of kernels pod^{-1} (1.61), pod yield (2461 kg ha^{-1}) and stover yield (3868 kg ha^{-1}) of groundnut over control and 5.0 kg Fe ha^{-1} but was found at par with 15 kg Fe $^{-1}$ during both the years of study on pooled basis. However, poultry manure 3 t+½ RDF proved significantly superior over other treatments in respect growth and yield attributes of groundnut.

Keywords: Groundnut, FYM, poultry manure, vermicompost, iron, yield

1. Introduction

Groundnut or peanut (*Arachis hypogaea* L.) is also known as a 'King' of oilseed (Priya et al., 2013) belongs to family Fabaceae. Groundnut (*Arachis hypogaea* L.) is an important oilseed crop and foodgrain legume crop of India. In 2011−12, it was cultivated in an area of 5.26 mha with production of 6.96 mt (DAC, 2013).. It contains about 40−45% oil, 20−25% protein, 20.5% carbohydrate, 5% fibre and ash and makes a sustainable contribution to human nutrition. Now a days, use of chemical fertilizer is increasing to boost up crop production to meet the need for ever increasing population of the nation. Simultaneously cost of chemical fertilizer has been increasing constantly, besides these; use of inorganic fertilizer alone is injurious to soil and environmental health. Thus combined use of inorganic fertilizer with organic fertilizers enhances crop production and sustains soil fertility (Gupta et al., 2003).

Groundnut is highly responsive to fertilizer application, although groundnut being a legume is capable of fixing atmospheric nitrogen. Application of higher dose of nitrogen may reduce nodule number and nodule growth and thus adversely affects the nitrogen fixation capacity (Veeramani et al., 2012). The optimization of the mineral nutrition has key role in optimizing the production of groundnut because it has very high nutrient requirement. On contrary groundnut farmers use very less fertilizer resulting in severe mineral nutrient deficiencies due to inadequate and imbalance use of nutrients is one of the major factors responsible for low yield in groundnut (Veermani & Subrahmaniyan, 2011). Thus it is high time to look into the mineral nutrition aspects of groundnut for achieving high yield and advocate the suitable package of practices for optimization of yield (Singh, 2004). Keeping in view the above facts, the present investigation was aimed to maximize the yield in groundnut through different nutrient management practices.

2. Materials and Methods

The field experiment was conducted during *kharif* seasons of 2011 and 2012 at S.K.N. College of Agriculture, Jobner. In this, spreading type groundnut 'M-13' was sown at 45×10

cm^2 spacing using a seed rate of 80 kg ha^{-1} on 8th July, 2011 and 9th July, 2012 and was harvested on 3rd November, 2011 and 4th November, 2012, respectively. The site was situated at latitude of 26° 05′ N, longitude of 75° 28′ E and at an altitude of 427 m amsl. This region falls under agro-climatic zone III-A (Semi-Arid Eastern Plain Zone) of Rajasthan. The soil of the experimental field was loamy sand, low in organic carbon (0.13 and 0.15%) as analyzed by Walkley and Black's rapid titration method (Jackson, 1973), available nitrogen (130.3 and 130.7 kg ha^{-1}) by alkaline permanganate method (Subbiah and Asija, 1956), phosphorus (16.5 and 16.5 kg ha^{-1}) by Olsen's method (Olsen et al., 1954) and iron (2.2 and 2.4 mg kg^{-1}) by Lindsay and Norvell (1978) but medium in potassium content (175.2 and 175.3) as analyzed by Flame photometer method (Metson, 1956) and alkaline in reaction (8.2). The experiment was evaluated in a split plot design, allocating organic manures and fertilizer in main plots and iron in sub plots and replicated three times. The treatments consisted of eight organic manures and fertilizer levels viz., control, RDF 25 kg N+45 kg P_2O_5 kg ha^{-1}, FYM 15 t ha^{-1}, FYM 7.5 t ha^{-1}+½ RDF, poultry manure 6 t ha^{-1}, poultry manure 3 t ha^{-1}+½ RDF, Vermicompost 5 t ha^{-1}, Vermicompost 2.5 t ha^{-1}+½ RDF and four iron levels viz., 0.0, 5.0, 10.0 and 15.0 kg ha^{-1}. Different sources of nutrients viz., FYM (N-0.42%, P-0.25% and K-0.47% during 2011 and N-0.45%, P-0.22% and K-0.50% during 2012), poultry manure (N-1.25%, P-1.05% and K-0.80% during 2011 and N-1.37%, P-1.15% and K-0.86% during 2012) and vermicompost (N- 1.76%, P-1.45% and K-0.95% during 2011 and N-1.85%, P-1.64% and K-1.06% during 2012) were incorporated into the soil i.e. 21 days before sowing based on soil test. Iron was applied at the sowing time as per treatment through $FeSO_4$. The seed treatment was done with bavistin 2 g kg^{-1} followed by *Rhizobium* culture as per treatments. The amount of rainfall during the crop growth period was 281.6 mm and 533.6 mm in 2011 and 2012, respectively. Nutrient content in plant samples were analyzed as per procedure suggested by Snell and Snell (1959). The data were statistically analyzed as procedure given by Gomez and Gomez (1989) and presented on pooled basis for both the years of study.

3. Results and Discussion

3.1. Growth parameters

All the organic, inorganic sources of nutrients were significantly increased the growth attributes of groundnut. Data (Table 1) indicated that plant height of groundnut was significantly increased by different sources of nutrients. Increase in plant height was more pronounced at 70 and 105 DAS and at harvest. Application of vermicompost 2.5 t+½ RDF recorded the highest plant height and proved superior to control and FYM 15 t at 70, 105 DAS and at harvest. Results showed that dry matter accumulation and branches per plant (Table 1) did not influenced by manures and fertilizers upto 35 DAS but at later stages, the effect was observed significant. Application of poultry manure 3 t+½ RDF produced the highest dry matter accumulation and branches per plant and remained at par with vermicompost 2.5 t+½ RDF while recorded the increase of 30.8, 18.8, 18.2, 18.0, 8.9 and 8.5% over control in case of dry matter accumulation whereas branches $plant^{-1}$ represented an increase of 30.9, 18.5, 14.6, 14.1, 6.6 and 6.5% over control. Application of integrated use of manures and fertilizer had consistent effect on all the growth parameters. Higher plant height was observed in different treatments due to the favorable effect of organic manure on growth on account of improved photo-synthetically active leaf area for longer period during vegetative and reproductive phase led to more absorption and utilization of radiant energy which ultimately resulted in higher plant height.

A perusal of data (Table 1) indicated that the increase in dry weight of nodules due to application of different sources of nutrients resulted that poultry manure 3 t+½ RDF was found to the tune of 15.6, 15.0, 8.9, 8.2, 7.7, 7.0 and 6.8% higher over control on pooled mean basis. The increased value in growth characters might be due to the combined effect of organic and inorganic fertilizers on the increased nutrient availability and microbial activity resulting in better nutrient absorption and growth of crops. The increased growth in terms of plant height, branches $plant^{-1}$, expansion of leaf lamina and chlorophyll content provided greater sites for photosynthesis and diversion of photosynthates towards sink (Akbari et al., 2011).

The highest leaf area index (Table 1) was recorded with application of vermicompost 2.5 t+½ RDF and being at par with poultry manure 3t+½ RDF, FYM 7.5 t+½ RDF, RDF (25 kg N and 45 kg P_2O_5), poultry manure 6 t and vermicompost 5 t. Plant height, dry matter accumulation, and branches $plant^{-1}$, dry weight of nodules were significantly increased (Table 1) with application of 10 kg Fe ha^{-1} over 5 kg Fe ha^{-1} and control and statistically remained at par with 15 kg Fe ha^{-1} at 70, 105 DAS and at harvest. It is inferred that application of 15 kg Fe ha^{-1} recorded the significantly highest LAI and chlorophyll content over control and 5 kg Fe ha^{-1} while it was found at par with 10 kg Fe ha^{-1} on pooled mean basis (Table 1). The magnitude of increase in LAI was 17.7 and 7.1% over control and 5 kg Fe ha^{-1}, respectively and in chlorophyll content increase was 11.3 and 6.2% over control and 5 kg Fe ha^{-1}, respectively. The favorable influence of applied Fe on these characters may be due to its catalytic or stimulatory effect on most of the physiological and metabolic processes of plant. Application of Fe might have increased the availability and steady supply of nutrients for plant metabolism and photosynthetic activity resulting into optimum growth and development of the crop. The results are in conformity with the findings of Sumathi and Rao (2007). The overall growth of plant increased in terms of plant height and leaf area which contributed for higher dry matter production (Malligawad, 2010). This might be due to readily available Fe at early and the critical stage of plant growth that facilitated maximum plant growth.

Table 1: Effect of sources of organic manures and fertilizers under varying levels of iron on growth parameters and yield of groundnut (Pooled)

Treatments	Plant height (cm)			DMC (g plant^{-1})			Branches plant^{-1}			WDN (g)	LAI	CC (mg g^{-1})	NPP	NK PH	PY (kg ha^{-1})	SY (kg ha^{-1})
	70 DAS	105 DAS	AV	70 DAS	105 DAS	AV	70 DAS	105 DAS	AV							
Manures and fertilizers																
Control	10.5	14.0	18.8	18.6	27.5	49.7	6.27	11.40	15.62	94.3	5.06	0.58	12.70	0.94	1806	3185
RDF (25 kg N & 45 kg P_2O_5)	12.6	16.0	21.1	21.6	30.6	55.0	7.23	13.32	17.93	101.2	5.56	0.68	18.33	1.30	2193	3570
FYM 15 t	12.3	15.8	20.8	21.3	30.4	54.7	7.13	12.85	17.26	100.1	5.50	0.65	15.85	1.08	2026	3361
FYM 7.5 t +½ RDF	12.7	16.1	21.3	21.6	30.7	55.1	7.20	13.25	17.85	100.7	5.56	0.65	17.95	1.24	2185	3518
Poultry manure 6 t	13.0	16.5	21.7	23.8	33.6	59.9	8.19	14.29	19.21	102.1	5.59	0.66	20.39	1.54	2421	3785
Poultry manure 3 t+½ RDF	13.2	16.7	21.8	26.0	36.9	65.0	9.10	15.33	20.45	109.0	5.62	0.69	24.37	1.88	2863	4365
Vermicompost 5 t	12.9	16.3	21.5	23.8	33.6	59.7	8.17	14.21	19.19	101.9	5.51	0.67	20.35	1.60	2427	3785
Vermicompost 2.5 t+½ RDF	13.3	16.9	21.9	25.8	36.6	64.8	9.07	15.26	20.39	108.5	5.63	0.69	23.54	1.85	2810	4241
SEm±	0.24	0.30	0.34	0.44	0.63	1.04	0.16	0.16	0.26	1.28	0.07	0.01	0.41	0.03	51	88.38
CD (p=0.05)	0.71	0.87	0.98	1.29	1.83	3.00	0.47	0.45	0.76	3.72	0.20	0.04	1.18	0.09	147	255.97
Fe (kg ha^{-1})																
0	11.0	14.8	19.6	20.9	29.9	54.0	6.99	12.87	17.33	96.8	4.97	0.62	15.21	1.12	2038	3456
5	12.3	15.9	20.9	22.4	32.0	57.1	7.69	13.62	18.29	101.1	5.46	0.65	18.47	1.34	2329	3636
10	13.4	16.7	21.8	23.9	33.5	59.8	8.18	14.16	19.08	104.9	5.74	0.68	21.30	1.61	2461	3868
15	13.7	17.0	22.2	24.1	34.6	61.1	8.32	14.32	19.27	106.0	5.85	0.69	21.77	1.65	2538	3946
SEm±	0.15	0.20	0.22	0.33	0.45	0.78	0.11	0.12	0.21	0.97	0.05	0.01	0.28	0.02	34	52.64
CD (p=0.05)	0.43	0.56	0.62	0.93	1.26	2.19	0.31	0.34	0.59	2.72	0.13	0.03	0.79	0.07	97	147.77

DMC: Dry matter accumulation ; AV: At harvest; DWN: Dry weight of nodules; LAI: Leaf area index; CC: Chlorophyll content; NPP: No.of pods plant^{-1}; NKPH: No.of kernels pod^{-1} at harvest; PY: Pod yield; SY: Stover yield; FYM; Farm yard manure; RDF: Recommended dose of fertilizer; NS: non-significant

3.2. Yield attributes

A perusal of data (Table 1) showed that combined use of manures and fertilizers caused a significant effect on no. of pods plant^{-1}, no. of kernels pod^{-1}, pod and stover yield at harvest over their sole application and control wherein, significantly higher no. of pods plant^{-1} and number of kernels pod^{-1} of groundnut were registered with application of poultry manure 3 t+½ RDF being at par with vermicompost 2.5 t+½ RDF and represented an increase of 91.9, 53.8, 35.8, 32.9, 19.7, and 19.5; and 100.0, 74.0, 51.6, 44.6, 22.0 and 17.5% higher over control and rest of the treatments, respectively. Simultaneously, application of poultry manure 3 t+½ RDF being at par with vermicompost 2.5 t+½ RDF and produced significantly higher pod and stover yield of groundnut and represented an increase of 58.6, 41.4, 31.1, 30.1, 18.2, and 17.9; and 37.0, 29.9, 24.1, 22.3, 15.3 and 15.3% higher over control and rest of the treatments, respectively. No. of pods plant^{-1}, number of kernels pod^{-1}, pod and stover yield increased significantly with supply of nitrogen and phosphorus in suitable combination of manures and fertilizer. This could be attributed to the sustained availability of nutrients throughout the growing season. The increased vegetative growth and the balanced C:N ratio might have increased the synthesis of carbohydrates, which ultimately promoted yield. The higher pod yield of groundnut might be due to cumulative effect of yield attributes such as number of pods, kernel pod^{-1} and weight of grains. These findings are in close conformity with those of Malligawad (2010).

Results showed (Table 1) that the increasing levels of Fe upto 10 kg ha^{-1} significantly increased the no. of pods plant^{-1} (40.0 and 15.3%), number of kernels pod^{-1} (43.7 and 20.1%), pod (20.7 and 14.3%) and stover yield (11.9 and 5.2%), on pooled mean basis over control and 5 kg Fe ha^{-1}, respectively but was found at par with 15 kg Fe ha^{-1}. The increase in no. of pods plant^{-1}, no. of kernels pod^{-1}, pod and stover yield may be attributed to the fact that favorable nutritional environment in rhizosphere and absorption of iron by plant leaves led to increased photosynthesis efficiency and production of assimilates as stated above. The higher translocation of photosynthates in reproductive structures resulted in increased yield attributes which led to the increased pod and stover yield of groundnut. The results of present investigation are in conformity with those of Umamaheswari and Singh (2002).

4. Conclusion

Application of poultry manure 3 t+½ RDF and Fe levels upto 10 kg ha^{-1} significantly increased the dry matter accumulation, branches plant^{-1}, dry weight of nodules, leaf area index, no. of pods plant^{-1}, no. of kernels pod^{-1}, pod yield and stover yield of groundnut during both the years of study.

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