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Effect of Farmyard Manure and Potassium on Nutrient Content and Quality of Kharif Groundnut (Var.- TG-37A) Grown in Loamy Sand

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To study the effect of farmyard manure and potassium on nutrient content and quality of *kharif* groundnut in loamy sand.
Study Design: Factorial Randomized Block Design.
Place and Duration of Study: The field experiment was carried out during *kharif* season at Castor Mustard Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. Gujarat
Methodology: The field trial was laid out in Factorial Randomized Block Design with three replications, and the treatments comprised of two levels of farmyard manure (F_1: 0 t ha^{-1} and F_2: 5 t ha^{-1}), three levels of potassium (K_1: 20 kg K_2O ha^{-1}, K_2: 40 kg K_2O ha^{-1} and K_3: 60 kg K_2O ha^{-1}) and two levels of potassium mobilizing bacteria (B_1: With KMB and B_2: Without KMB).
Results: The results showed that significantly higher oil (50.24 %) and protein (23.90 %) content of groundnut was observed with FYM application at 5 t ha^{-1} (F_2). Moreover, significantly higher content of nitrogen (3.39 %), phosphorus (0.46 %) and potassium (0.61 %) in kernel and in haulm nitrogen (1.49 %), phosphorus (0.20 %), potassium (0.66 %) were observed with application of 5 t FYM ha^{-1}. Among three levels of potassium, K_3 (60 kg K_2O ha^{-1}) recorded significantly maximum oil (50.27 %) and protein (24.19 %) contents, P (0.45 %) and K (0.60 %) content in kernel and N (1.49 %), K (0.66 %) content in haulm. Oil (50.06 %) and protein (23.93 %) contents found positive with KMB application over without KMB.

Keywords: Groundnut; content, quality; FYM; potassium; potassium mobilizing bacteria.

1. INTRODUCTION

Oilseeds constitute the second major agricultural crop in the country next to food grain in terms of tonnage and value. Ever increasing demand of edible oil under limited land resources increase the force for enhancing production and productivity of edible oilseed crops. India ranks second next to china in groundnut production and it is most important oilseed crop in India (Gayathri, 2018). During 2019, India produced 68.62 lakh MT groundnut from 39.31 lakh ha with an average productivity of 1745 kg/ha^{-1} (IOPEPC). Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Madhya Pradesh, Uttar Pradesh, Rajasthan are the major groundnut growing states in India. Gujarat is the largest producer and produced 40% of total groundnut production of the country. In Gujarat area, production and productivity of summer groundnut were 33920 lakh ha, 84000 MT, 2476 kg/ha^{-1}, respectively during 2019 (IOPEPC). Rajkot, Junagadh, Jamnagar and Banaskantha are the dominant districts in Gujarat for groundnut cultivation. The incorporation of bulky organic manures plays an important role in plant nutrition especially for nitrogen. Proper use of fertilizer is necessary for increasing agricultural production and reduced environmental pollution because continuous use of chemical fertilizer has deteriorating effects on soil which in-tum cause decline in productivity. Potassium is known for its ability to increase crop yield and improve quality. It is essential for photosynthesis and pod development in groundnut. It plays a major role in growth and yield as it involves in assimilation, transport and storage tissue development (Cakmak, 2005). Commercial use of Potassium Mobilizing Bacteria (KMB) is new to agriculture. Farmers of North Gujarat use KMB for high K requiring crop like potato. The potato is responding to KMB application. The research is therefore aimed at studying the effect of farmyard manure and potassium on the nutrient content and quality of *kharif* groundnut in loamy sand soil.

2. MATERIALS AND METHODS

2.1 Location of the Experimental Site

The field experiment was conducted at Plot No. 18-B at Castor Mustard Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, District: Banaskantha (Gujarat). The experimental site is geographically located in the North Gujarat at 72° 19' East longitude and 24° 19' North latitude at an altitude of 154.52 metres above mean sea level.

2.2 Season and Crop Varieties

The study was conducted during of *kharif* from June 2019 to October 2019. The groundnut

variety selected was TG 37 A with a duration of 90-100 days.

2.3 Experimental Design

The field trial was laid out in factorial randomized block design with three replications the treatments comprised of two levels of FYM (F_1: 0 t ha^{-1} and F_2: 5 t ha^{-1}), three levels of potassium (K_1: 20 kg K_2O ha^{-1}, K_2: 40 kg K_2O ha^{-1} and K_3: 60 kg K_2O ha^{-1}) and two levels of KMB (B_1 : With and B_2: Without).

2.4 Soil Characteristics

The soil of the experimental site was loamy sand having pH of 7.2, which was low organic carbon (0.15 %) and nitrogen (140 kg ha^{-1}), medium in available phosphorus (43.5 kg ha^{-1}) and potassium (172 kg ha^{-1}).

3. RESULTS AND DISCUSSION

3.1 Oil Contents (%)

3.1.1 Effect of FYM

Significantly higher oil content was recorded 50.24 per cent with application of FYM at 5 t ha^{-1} (F_2) and minimum oil content 49.08 per cent was observed with application of 0 t FYM ha^{-1} (F_1). Oil content in groundnut increased due to "better CO_2 production and greater exchange of nutrients that enhanced the mobility of nutrients under this treatment led to favourable environment in the plant system and thereby increased oil content of groundnut. The results are closely related with the findings of" Ventakesh et al. (2006) and Rahevar et al. (2015).

3.1.2 Effect of potassium

"The treatment K_3 (60 kg K_2O ha^{-1}) recorded significantly the highest oil content (50.27 %) over K_2, K_1 and remained at par with K_2 (40 kg K_2O ha^{-1}). The crop fertilized with 20 kg K_2O ha^{-1} recorded significantly the lowest oil content (48.95 %). Similar trends were also" observed by Salve and Gunjal (2011), Kharade et al. (2013) and Borah et al. (2017).

3.1.3 Effect of KMB

The maximum oil content (50.06 %) was obtained with application of KMB (B_1) and minimum (49.26 %) oil content was recorded with treatment B_2 (without KMB).

3.2 Protein Content (%)

3.2.1 Effect of FYM

Significantly higher protein content (23.90 %) was found with application of 5 t FYM ha^{-1} and the treatment F_1 recorded significantly lower protein content (23.33 %). Probable reason for increasing protein content is that the nitrogen is an integral part of certain co-enzyme involved in protein synthesis. The increase in protein synthesis in groundnut is mainly due to cumulative effect of pod yield. These results are accordance with the finding of Dhadge and Satpute (2014).

3.2.2 Effect of potassium

Treatment K_3 (60 kg K_2O ha^{-1}) recorded significantly higher protein content (24.19 %) as compared to rest of the levels of potassium (K_2 and K_1). There were no differences between treatment K_3 (60 kg K_2O ha^{-1}) and K_2 (40 kg K_2O ha^{-1}). Moreover, significantly lowest protein content (22.97 %) was recorded under treatment K_1 (20 kg K_2O ha^{-1}). "Effect of potassium on protein content might be due to the fact that soil under experiment was medium in available potassium so response gets more in 60 kg K_2O ha^{-1}. Potassium promotes conversion of plant metabolites into proteins and amino acids, thus providing a sink for nitrogen fixed. Similar results" were reported by Gashti et al. (2012) and Rathore et al. (2014).

3.2.3 Effect of KMB

Maximum protein content (23.93 %) in kernels of groundnut was observed with application of KMB (B_1) and minimum (23.30 %) protein content was found with B_2 (without KMB).

3.3 Nitrogen Content in Kernel (%)

3.3.1 Effect of FYM

Treatment F_2 (5 t FYM ha^{-1}) gave significantly highest nitrogen content with 3.39 % in groundnut kernel. However, significantly lowest nitrogen content (3.17 %) was observed with application of FYM at 0 t ha^{-1}. This might be due to FYM application which promoted higher nitrogen fixation and have helped in the increase of content of nutrients due to release of nutrients as its optimum amount for longer period. "These results are similar with findings" of Sutariya et al. (2010) and Vishwakarma et al.

(2012), Indian Oil Seeds and Produce Export Promotion, (2019).

3.3.2 Effect of potassium

During analysis, successive increase in potassium levels had non-significantly increased nitrogen content in kernel of groundnut. Application of potassium at 60 kg ha^{-1} recorded significantly higher value (3.33 %) of nitrogen content of groundnut.

3.3.3 Effect of KMB

Higher nitrogen content (3.31 %) in groundnut kernel was recorded with the B_1 (with KMB) compared to B_2 (without KMB).

3.4 Phosphorus Content in Kernel

3.4.1 Effect of FYM

Highest phosphorus content (0.46 %) was recorded with application of FYM at 5 t ha^{-1} (F_2). The lowest phosphorus content (0.42 %) in kernels of groundnut was recorded (F_1). "The application of FYM resulted in tremendous increase in available phosphorus status of soil which might be attributed to the build-up of available phosphorus owing to formation of fulvic acid and other chelating agents which form soluble complexes with native phosphorus in soils in groundnut" reported by Sutariya et al. (2010) and Vishwakarma et al. (2012).

3.4.2 Effect of potassium

Significantly higher phosphorus content (0.45 %) was recorded with potassium 60 kg ha^{-1}. "The lowest phosphorus content (0.42 %) was recorded under treatment K_1 (20 kg K_2O ha^{-1}). Potassium application affected concentration of N, P and K ions in soil solution and ultimately promote vigorous root development, better K_2O fixation and better growth and development of plant due to higher photosynthetic activity which resulted in higher content of nutrients. Similar findings" were observed by Salve and Gunjal (2011) and Patel et al. (2019).

3.4.3 Effect of KMB

A perusal data indicated that KMB failed to express significant effect on phosphorus content in kernels of groundnut. The phosphorus content (0.44 %) in kernel was observed with both treatments B_1 and B_2.

3.5 Potassium Content in Kernel (%)

3.5.1 Effect of FYM

Application of treatment F_2 (5 t FYM ha^{-1}) and F_1 (0 t FYM ha^{-1}) were observed highest potassium content (0.61 %) and lowest potassium content (0.52 %), respectively in kernels of groundnut during investigation. The "application of organic manures showed higher uptake of potash which might be due to increased nutrient availability and improvement in physical condition of soil. These results were in close conformity with" those of Sutariya et al. (2010) and Vishwakarma et al. (2012).

3.5.2 Effect of potassium

The significantly maximum potassium content in kernel (0.60 %) was recorded under the treatment K_3 (60 kg K_2O ha^{-1}), where treatment K_3 (60 kg K_2O ha^{-1}) remained at par with K_2 (40 kg K_2O ha^{-1}). However, minimum potassium content in kernel was observed under application of 20 kg K_2O ha^{-1} (K_1) with 0.53 per cent. These findings are in conformity with those obtained by Kharade et al. (2013) and Hemeid (2015).

3.5.3 Effect of KMB

Inoculation of groundnut seeds with levels of KMB exerted non-significant effect on potassium content in kernels of groundnut. However, the highest potassium content (0.57 %) in kernels was observed under B_1 (with KMB).

3.6 Nitrogen Content in Haulm

3.6.1 Effect of FYM

Application of treatment F_2 (5 t FYM ha^{-1}) was found significantly superior with highest nitrogen content (1.49 %) than lower N content "with application of FYM at 0 t ha^{-1} (1.41 %). These findings are similar to those" of Sutariya et al. (2010) and Vishwakarma et al. (2012).

3.6.2 Effect of potassium

During the study it was observed that application of 60 kg K_2O ha^{-1} (K_3) gave significantly highest potassium content (1.49 %) in groundnut haulm than lower levels of potassium (K_1 and K_2) and it was statistically at par with 40 kg K_2O ha^{-1} (K_2) (1.45 %). Moreover, application of 20 kg K_2O ha^{-1} (K_1) recorded significantly lowest nitrogen content in haulm with 1.41 per cent. The

"addition of potassium increased its concentration at all stages in groundnut crop, consequently nitrogen content in kernel was increased with increase in potassium levels. The findings are in close agreement with those obtained" by Salve and Gunjal (2011).

3.6.3 Effect of KMB

Nitrogen content in haulm did not differ significantly due to various levels of KMB. However, application of KMB (B_1) gave numerically higher nitrogen content (1.46 %) than KMB (B_2).

3.7 Phosphorus Content in Haulm (%)

3.7.1 Effect of FYM

The results showed significant increase in phosphorus content of groundnut haulm due to different levels of FYM. Treatment F_2 (5 t FYM ha^{-1}) recorded highest phosphorus content (0.20 %) than application of FYM. However, treatment F_1 (0 t FYM ha^{-1}) recorded significantly the lowest phosphorus content (0.17 %). More or less similar result has been reported by Reddy et al. (2004), Sutaria et al. (2010) and Vishwakarma et al. (2012), Cakmark. (2005), Ghasti et al.,(2012).

3.7.2 Effect of potassium

Results showed that effect of different levels of potassium on phosphorus content in haulm of groundnut was noted non-significant. Crop fertilized with 60 kg K_2O ha^{-1}, 40 kg K_2O ha^{-1} and 20 kg K_2O ha^{-1} recorded similar phosphorus content (0.19 %) in haulm of groundnut.

3.7.3 Effect of KMB

The results presented in Table 1 showed that using KMB has no significant effect on phosphorus content of groundnut haulm. The treatment B_2 (without KMB) and B_1 (with KMB) observed similar phosphorus content (0.19 %) in haulm of groundnut during the period of experimentation.

Table 1. Oil, Protein content, Nutrient content in kernel and haulm against different treatment

Treatments	Oil content (%)	Protein content (%)	Nutrient content in kernel (%)			Nutrient content in haulm (%)		
			N	P	K	N	P	K
Levels of FYM								
F_1 (0 t ha^{-1})	49.08	23.33	3.17	0.42	0.52	1.41	0.17	0.60
F_2 (5 t ha^{-1})	50.24	23.90	3.39	0.46	0.61	1.49	0.20	0.66
S.Em. ±	0.26	0.19	0.03	0.01	0.01	0.02	0.003	0.01
CD at 5%	0.76	0.57	0.08	0.02	0.03	0.05	0.01	0.02
Level of potassium								
K_1 (20 kg ha^{-1})	48.95	22.97	3.22	0.42	0.53	1.41	0.19	0.60
K_2 (40 kg ha^{-1})	49.76	23.68	3.29	0.45	0.57	1.45	0.19	0.64
K_3 (60 kg ha^{-1})	50.27	24.19	3.33	0.45	0.60	1.49	0.19	0.66
S.Em. ±	0.32	0.24	0.03	0.01	0.01	0.02	0.003	0.01
CD at 5%	0.94	0.70	NS	0.02	0.04	0.06	NS	0.02
Levels of KMB								
B_1 (With)	50.06	23.93	3.31	0.44	0.57	1.46	0.19	0.64
B_2 (Without)	49.26	23.30	3.26	0.44	0.56	1.44	0.19	0.62
S.Em. ±	0.26	0.19	0.03	0.01	0.01	0.02	0.003	0.01
CD at 5%	0.76	0.57	NS	NS	NS	NS	NS	NS
Interaction								
F×K	NS	NS	NS	NS	NS	NS	NS	NS
F×B	NS	NS	NS	NS	NS	NS	NS	NS
K×B	NS	NS	NS	NS	NS	NS	NS	NS
F×K×B	NS	NS	NS	NS	NS	NS	NS	NS
C.V (%)	2.23	3.48	3.52	5.39	7.70	4.95	6.42	4.65

3.8 Potassium Content in Haulm (%)

3.8.1 Effect of FYM

The maximum (0.66 %) potassium in haulm recorded with application of FYM @ 5 t ha^{-1} (F_2) and minimum (0.60 %) was observed due to no application of FYM (F_1). The results obtained are in accordance with the findings of Reddy et al. (2004), Sutariya et al. (2010) and Vishwakarma et al. (2012).

3.8.2 Effect of potassium

Treatment K_3 (60 kg K_2O ha^{-1}) recorded significantly higher potassium content (0.66 %) in groundnut haulm which was remained at par with treatment K_2 (40 kg K_2O ha^{-1}) with 0.64 %. The lowest potassium content in haulm (0.60 %) was recorded under treatment K_1 (20 kg K_2O ha^{-1}). The results are similar to the findings of Salve and Gunjal (2011) and Patel et al. (2019).

3.8.3 Effect of KMB

The results showed that KMB produce non-significant effect on potassium content of groundnut haulm. However, numerically higher value of potassium content of haulm (0.64 %) was recorded with treatment B 1 (with KMB).

4. CONCLUSION

Based on the results obtained from this study, it is concluded that, to achieve quality produce from *kharif,* groundnut (TG 37 A) grown under loamy sand requires application of manure at 5 t FYM ha^{-1} and 40 kg K_2O ha^{-1} along with seed inoculation with KMB and recommended dose of nitrogen and phosphorus.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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