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Response of Muraite of Potash on Quality Parameters in Groundnut (*Arachis hypogaea* L.) cv. TMV 13

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A B S T R A C T

Oilseed occupies an important place in Indian economy as it is directly involved in food and industrial needs. Among the oilseed crops grown in India, groundnut crop plays a predominant role in oilseed production. A field experiment was conducted during 2019 at farmers field Mattaparai, Sengapalli village, Paramathi Velur taluk, Namakkal district to study the effect of potassium on growth and yield of groundnut in cv. TMV 13. The initial experimental soil was analyzed with pH of 8.2, EC of 0.6 dS m^{-1} with clay loam in texture. The experiment was laid out in randomized block design with three replications. It includes nine treatments viz., T_1- Absolute control, T_2- RDF (NP alone), T_3- RDF (NP alone) + 25 kg K_2O ha^{-1}, T_4- RDF (NP alone) + 50 kg K_2O ha^{-1}, T_5- RDF (NP alone) + 75 kg K_2O ha^{-1}, T_6- RDF (NP alone) + 100 kg K_2O ha^{-1}, T_7- RDF (NP alone) + 125 kg K_2O ha^{-1}, T_8- RDF (NP alone) + 150 kg K_2O ha^{-1}, T_9- RDF (NP alone) + 175 kg K_2O ha^{-1}. The results of the field experiment revealed that application of potassium significantly increased the oil content and protein content, quality and economic parameters of groundnut. The quality parameters include iodine value, saponification value, peroxide value, free fatty acid and fatty acid profile. The economic parameters include cost of cultivation, gross income, net income and B: C ratio. The maximum oil and protein content were recorded in the treatment T_6 which receives 100 kg K_2O ha^{-1} and the least oil and protein content were recorded in the treatment T_1 (absolute control). The maximum values for quality were recorded in the treatment T_6 which receives 100 kg K_2O ha^{-1} which was on par with the treatment T_7 which receives 125 kg K_2O ha^{-1}. The maximum B: C ratio of 1.85 was recorded by the application of 100 kg K_2O ha^{-1} over other treatments. The lowest B: C ratio of 1.29 was registered in absolute control.

***Key words*:** Groundnut, potassium, quality, fatty acid profile, economics

Oilseed constitutes the principal commercial crops of India and occupies an important place in Indian economy, as it directly involves in food and industrial needs. Among the oilseed crops grown in India, groundnut crop plays a predominant role in oilseed production. Groundnut belongs to C3 plant it needs good sunshine and high temperature to produce more pods. Commercially and nutritionally, it is a very important source of oil. Groundnut contains 13 different vitamins (including A, the B group C and E) along with 26 essential trace minerals, including calcium and iron. It is the 4th most important source of vegetable oil and 3rd main source of vegetable protein in the world. As regards the nutritional value of groundnut, its seed contains about 40-50 per cent oil, 20-30 per cent protein and 10-20 per cent carbohydrates [1]. At present, India ranks 2nd after China with 33 per cent of world's total production, but the productivity is far below than the countries like China, Israel and USA because the crop is traditionally grown in dry land belt of India characterized by poor soil fertility, erratic rainfall and low input levels. It is an important cash crop for tropical farmers. The haulms are used as valuable nutritional fodder.

Groundnut alone contributes 70 percent of the total edible oil production. It is a money yielding crop for marginal farmers which is largely grown during summer and kharif season. According to SEA report, in India, area under groundnut is 40.12 lakh ha, with the total production of 37.70 lakh tonnes and productivity of 931 kg ha^{-1} in kharif during the year 2018-19 [2]. Potassium is one of the 3 main pillers of balanced fertilizer use, along with nitrogen (N) and phosphorus (P). Groundnut is a heavy feeder of potassium

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and an adequate supply of this nutrient is indispensable to harvest a good crop of groundnut.

Potassium has been described as the "quality element" for crop production [3-4]. Plants need large quantities of potassium, as much as, or even more than nitrogen. It is the second most absorbed nutrient by the peanut crop [5] which plays various metabolic functions in plants including photosynthesis, protein synthesis, activation of several enzymes and functioning of the stomata [6] and also have beneficial effect on nitrogen fixation and translocation of photosynthates from the leaves to the root nodules [7]. Potassium improves economic crop produce and its quality. Thus, application of potassium fertilizer results in higher value to product and therefore greater return to the farmer. Here the present investigation was carried out study the effect of different levels of potassium on oil and protein content, oil quality and economics of groundnut in cv. TMV – 13.

MATERIALS AND METHODS

To evaluate the effect of different levels of potassium on growth, yield, nutrient uptake and available nutrients in the postharvest soil of groundnut in cv. TMV – 13 a field experiment was carried out in a farmer's field at Mattaparai, Sengapalli village, Paramathi Velur taluk, Namakkal district of Tamil Nadu state during Dec 2018 to Mar 2019. The initial soil is low in alkaline $KMnO_4$ nitrogen (186.2 kg ha^{-1}), high in Olsen-P (23.3 kg ha^{-1}) and medium in NH_4OAc K (193.26 kg ha^{-1}). The following treatments viz., T_1- Absolute control, T_2- RDF (NP alone), T_3- RDF (NP alone) + 25 kg K_2O ha^{-1}, T_4- RDF (NP alone) + 50 kg K_2O ha^{-1}, T_5- RDF (NP alone) + 75 kg K_2O ha^{-1}, T_6- RDF (NP alone) + 100 kg K_2O ha^{-1}, T_7- RDF (NP alone) + 125 kg K_2O ha^{-1}, T_8- RDF (NP alone) + 150 kg K_2O ha^{-1}, T_9- RDF (NP alone) + 175 kg K_2O ha^{-1} were studied in RBD with three replications.

The recommended dose of N:P dose of 25:50 kg ha^{-1} was applied to all the plots except T_1. The potash is applied to all the plots as planned in the above treatments in three split doses (50% @ basal, 25% @ flowering stage, 25% @ peg formation stage) in the form of muriate of potash. Oil content is estimated through Soxhlet method [8] and protein content as assed by Piper [9]. The Iodine value is estimated through Hanus method (AOAC 920.158 [10]), saponification value through titrimetric method (AOAC 920.160 [11]), peroxide value through titration method (AOAC 965.33 [12]), free fatty acid value through titration method (AOAC 940.28 [13]) and fatty acid profile through gas chromatography – mass spectroscopy method explained in AOCS [14]. The samples for estimating fatty acid profile were given at IIFPT, Thanjavur.

RESULTS AND DISCUSSION

Oil and protein content

The application of potassium at the rate of 100 kg ha^{-1} (T_6) recorded the highest oil content and oil yield of 51.4% and 989 kg ha^{-1} followed by the treatments T_7, T_8, T_9, T_5, T_4, T_3 and T_2. However, the treatments T_6 and T_7, T_8 and T_9 were statistically on par with each other. The lowest oil content and oil yield of 38.0% and 311 kg ha^{-1} were recorded in the treatment T_1 which is absolute control. The increase in oil content in groundnut kernels might be due to the enhanced activity of malic dehydrogenase enzyme, which helps in the synthesis of fatty acids such as malate and oxaloacetate in groundnut kernels thus, resulting in the enhanced oil content [15].

The highest protein content and protein yield of 24.9% and 479 kg ha^{-1} were recorded in the treatment T_6 by the application of potassium at the rate of 100 kg ha^{-1} followed by the treatments T_7, T_8, T_9, T_5, T_4, T_3 and T_2. However, the treatments T_6 and T_7, T_8 and T_9 were statistically on par with each other. The lowest in the above parameters were recorded in absolute control. The increase may be due to the addition of nutrients through chemical fertilizer increased the protein content in groundnut kernel and was attributed to the role of potassium in facilitating the uptake as well as assimilation of nitrogen into simple amino acids and amides which enhanced the peptide synthesis and led to protein synthesis [16].

Table 1 Effect of potassium on oil and protein content and yield of groundnut

Treatments	Oil content (%)	Oil yield (kg ha^{-1})	Protein content (%)	Protein yield (kg ha^{-1})
T_1: Absolute control	38.0	311	19.1	156
T_2: RDF (NP alone)	39.8	402	20.0	202
T_3: RDF (NP alone) + 25 kg K_2O ha^{-1}	41.7	489	20.8	244
T_4: RDF (NP alone) + 50 kg K_2O ha^{-1}	43.9	605	21.7	299
T_5: RDF (NP alone) + 75 kg K_2O ha^{-1}	45.9	724	22.5	355
T_6: RDF (NP alone) + 100 kg K_2O ha^{-1}	51.4	989	24.9	479
T_7: RDF (NP alone) + 125 kg K_2O ha^{-1}	50.8	953	24.3	456
T_8: RDF (NP alone) + 150 kg K_2O ha^{-1}	48.9	854	23.6	412
T_9: RDF (NP alone) + 175 kg K_2O ha^{-1}	48.0	818	23.2	395
SEd	0.8	32.7	0.3	12.0
CD (0.05)	1.7	69.2	0.7	25.4

Oil quality parameters

The different quality parameters of groundnut oil significantly get increased due to the application of graded doses of potassium. The highest iodine value of 94.69 g $100g^{-1}$ oil was observed in the treatment T_6 which received 100 kg K_2O ha^{-1} followed by the treatments T_7, T_8, T_9, T_5, T_4, T_3 and T_2. The treatments (T_5, T_6, T_7, T_8 and T_9) and (T_1, T_2, T_3, T_4 and T_5) were statistically on par with each other. The lowest iodine value of 81.34 g $100g^{-1}$ oil was observed in the treatment T_1 which is absolute control. The high iodine value indicates dehydrogenation. It is a measure of unsaturation in lipid, which again determines the degree of flow. Decrease in iodine value indicates lipid oxidation and this might be due to metallic ions present among other

factors, which enhances or promotes oxidation after the formation of hydroperoxide [17].

In the view of saponification value, the highest value of 194.9 mg KOH g^{-1} was observed in the treatment T_6 which received 100 kg K_2O ha^{-1} followed by the treatments T_7, T_8, T_9, T_5, T_4, T_3 and T_2. The lowest value of 177.5 mg KOH g^{-1} oil was observed in the treatment T_1 which is absolute control. The high saponification value indicated oxidation and its decrease suggest the unset of oxidation [18]. The high saponification value also indicated the presence of greater number of ester bonds, suggesting that the fat molecules were intact. These properties make it useful in soap making industry, it is not attractive as a raw material because of its economic and nutritive implications. The lowest peroxide value and free fatty acid value indicates that the oil is superior in its quality. The treatment which received 100 kg K_2O ha^{-1} recorded the lowest peroxide value of 1.35 g $100g^{-1}$ oil followed by the treatments T_7, T_8, T_9, T_5, T_4, T_3, T_2 and the highest value was recorded in the absolute control (T_1). The low peroxide value indicated slow oxidation of oil [19]. The peroxide formation is slow at first during an induction period that may vary from few weeks to several months according to the particular oil and temperature [20].

Table 2 Effect of different levels of potassium on oil quality parameters of groundnut

Treatments	Iodine value (g $100g^{-1}$ oil)	Saponification value (mg KOH g^{-1} oil)	Peroxide value (g $100g^{-1}$ oil)	Free fatty acid value (mg KOH g^{-1} oil)
T_1: Absolute control	81.34	177.5	1.89	1.49
T_2: RDF (NP alone)	82.68	178.4	1.79	1.37
T_3: RDF (NP alone) + 25 kg K_2O ha^{-1}	84.26	179.7	1.73	1.27
T_4: RDF (NP alone) + 50 kg K_2O ha^{-1}	85.88	180.6	1.65	1.16
T_5: RDF (NP alone) + 75 kg K_2O ha^{-1}	86.95	185.3	1.60	1.05
T_6: RDF (NP alone) + 100 kg K_2O ha^{-1}	94.69	194.9	1.35	0.71
T_7: RDF (NP alone) + 125 kg K_2O ha^{-1}	94.05	191.3	1.39	0.76
T_8: RDF (NP alone) + 150 kg K_2O ha^{-1}	93.58	193.5	1.50	0.89
T_9: RDF (NP alone) + 175 kg K_2O ha^{-1}	92.83	191.9	1.54	0.95
SEd	2.72	4.9	0.04	0.04
CD (0.05)	5.77	10.4	0.09	0.09

The peroxide value is an indicator of deuteriation of fat [21]. On the other hand, the lowest free fatty acid value of 0.71 mg KOH g^{-1} oil was recorded in the treatment T_6 followed by the treatment T_7, T_8, T_9, T_5, T_4, T_3, T_2 and the highest was recorded in absolute control (T_1). This indicates the stability of the products [21]. The presence of free fatty acid and other fatty materials in oil brings about the offensive odour and taste in oil on long storage [22].

Table 3 Effect of potassium on fatty acid profile in groundnut

No	Run time (min)	Name of the compound	Molecular formula	Amount present (%)	
				T_1 Absolute control	T_6 RDF (NP alone) + 100 kg K_2O ha^{-1}
1	15.13	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	13.01	13.53
2	17.45	9,12-Octadecadienoic acid (Z,Z)-, methyl ester	$C_{19}H_{34}O_2$	36.28	36.98
3	17.56	11-Octadecenoic acid, methyl ester	$C_{19}H_{36}O_2$	42.36	38.36
4	17.91	Methyl stearate	$C_{19}H_{38}O_2$	4.66	5.59
5	20.47	Methyl 9-eicosenoate	$C_{21}H_{40}O_2$	- - -	0.39
6	20.86	Heptadecanoic acid, methyl ester	$C_{18}H_{36}O_2$	1.10	1.67
7	23.82	Nonadecanoic acid, methyl ester	$C_{20}H_{40}O_2$	2.21	2.88
8	26.67	Heneicosanoic acid, methyl ester	$C_{22}H_{44}O_2$	0.37	0.59

Table 4 Effect of different levels of potassium on economic parameters of groundnut

Treatments	Cost of cultivation (Rs.)	Gross income (Rs.)	Net income (Rs.)	B: C ratio
T_1: Absolute control	40936	52920	11984	1.29
T_2: RDF (NP alone)	45947	62004	16057	1.35
T_3: RDF (NP alone) + 25 kg K_2O ha^{-1}	46787	69522	22735	1.49
T_4: RDF (NP alone) + 50 kg K_2O ha^{-1}	47607	76890	29283	1.62
T_5: RDF (NP alone) + 75 kg K_2O ha^{-1}	48447	84119	35672	1.74
T_6: RDF (NP alone) + 100 kg K_2O ha^{-1}	49287	91204	41917	1.85
T_7: RDF (NP alone) + 125 kg K_2O ha^{-1}	50107	90884	40777	1.81
T_8: RDF (NP alone) + 150 kg K_2O ha^{-1}	50947	87720	36773	1.72
T_9: RDF (NP alone) + 175 kg K_2O ha^{-1}	51787	87338	35551	1.69

The compound methyl 9-eicosenoate was identified in the treatment which received potassium at the rate of 100 kg K_2O ha^{-1}, however this compound was not present in the groundnut oil which did not receive any dosage of potassium. Thus, potassium plays an important role in the synthesis of a fatty acid and adds value to the quality of oil.

Economic parameters

The highest gross income was observed in the treatment T_6 (Rs. 91,204) followed by T_7, T_8, T_9, T_5, T_4, T_3 and T_2. The lowest gross income was observed in the treatment T_1 (Rs. 52,920). The highest net income was observed in the treatment T_6 (Rs. 41,917) followed by treatmentsT_7, T_8, T_9, T_5, T_4, T_3 and T_2. The lowest gross income was observed in the treatment T_1 (Rs. 11,984). In the view of B:C ratio the highest B:C ratio was observed in the treatment T_6 (1.85) followed by treatmentsT_7, T_8, T_9, T_5, T_4, T_3 and T_2. The lowest B:C ratio was observed in the treatment T_1 (1.29). The increase in gross income, net income and B: C ratio was due to the higher pod and haulm yield [22-24].

CONCLUSION

Groundnut crop significantly responded to the application of potassium at different levels. From the present investigation, it can be concluded that application of 100 kg K_2O ha^{-1} along with RDF of N and P dose of 25: 50 kg ha^{-1} in soil was established as the best treatment by recording the highest oil and protein content, quality and economic parameters of groundnut in clay loam soil in both the seasons.

LITERATURE CITED

1. Okello DK, Biruma M, Deom CM. 2010. Overview of groundnut research in Uganda: Past, present and future. *African Jr. Biotechnology* 9: 6448-6459.
2. Anonymous. 2019. Groundnut outlook. Agricultural Market Intelligence Centre, PJTSAU. 1-3.
3. Usherwood NR. 1985. The role of potassium in crop quality. In: (Eds) Munson R. D. Potassium in Agriculture. ASA-CSSA-SSSA, Madison, WI, USA. pp 489-513.
4. Pettigrew WT, McCarty JC, Vaughn KC. 2000. Leaf senescence-like characteristics contribute to cottons premature photosynthetic decline. *Photosynthesis Research* 65: 187-192.
5. Tasso Junior LC, Marques MO, Nogueira GAL. 2004. A cultura do amendoim, Firsted, Jaboticabal: UNESP. pp 218.
6. Hawkesford M, Horst W, Kichey T, Lambers H, Schjoerring, Moller IS. 2012. Functions of macronutrients: Potassium. *In*: (Eds.), Marschner, Petra. Marschner's Mineral Nutrition of Higher Plants. Elsevier, Adelaide. pp178-189.
7. Savani VN, Vaioshnav MR, Vaishnav PR, Darji VB. 1995. Statistical estimation of relative changes in P content with different levels of applied phosphorus in groundnut. *Jr. Gujarat Agric. University* 21: 119-123.
8. Gupta AL, Varshney ML. 1989. *Practical Manual for Agricultural Chemistry*. Part II, I Ed. Kalyani Publishers, New Delhi. pp 35-37.
9. Piper CS. 1966. *Soil and Plant Analysis*. Hans Publication, Bombay. pp 236.
10. AOAC 920.158. 1995. Association of Official Analytical Chemists.
11. AOAC 920.160. 1995. Association of Official Analytical Chemists.
12. AOAC 940.28. 1995. Association of Official Analytical Chemists.
13. AOAC 965.33. 1995. Association of Official Analytical Chemists.
14. AOCS. 2000. *Official Method of Analysis of American Oil Chemists Society*. Method number Ce 2-66. Preparation of methyl esters of fatty acids. USA.
15. Ummesalma S, Math KK, Bidari BI, Yenagi BS. 2018. Effect of potassium nutrition on yield, quality and economics in groundnut (*Arachis hpogaea* L.) in a Vertisol. *Jr. Pharmacogn Phytochemistry* 7(2): 220-222.
16. Shahid U, Moinuddin. 2002. Genotypic differences in yield and quality of groundnut as affected by potassium nutrition under erratic rainfall conditions. *Jr. Plant Nutrition* 25(7): 1549-1562.
17. Marque Ruiz G, Tasioula M, Margari T, Dobarganes MC. 1995. Quantification and distribution of altered fatty acids in frying fats. *Jr. Am. Oil Chem. Society* 72: 1171-1176.
18. Nkafamia N, Awodu AO, Okoye WL. 2006. Chemical quality parameters and fatty acid composition of oils of some under exploited tropical seeds. *Nigerian Jr. App. Sciences* 4: 151-162.
19. Demain MJ. 1990. *Principles of Food Chemistry*. 2nd Ed. Van Nostrond Reinhold International Company Limited, London, England. pp 37-38.
20. Pearson D. 1981. *The Chemical Analysis of Food*. 8th Edition. J. A. Churchill, London. pp 535.
21. Olaposi AR, Adunni AO. 2010. Chemical composition of three traditional vegetables in Nigeria. *Pakistan Jr. Nutrition* 9(9): 858-860.
22. Aluyor EO, Obahiagbon KO, Ori-jesu M. 2009. Biodegradation of vegetable oils: A review. *Science Res. Essay* 4(6): 543-548.
23. Mohapatra AK, Priyambada P, Pattanayak SK, Satyanarayana T. 2013. Response of groundnut to balanced fertilization and omission of potassium. *Better Crops*. pp 66-69.
24. Srinivasarao Ch. 2013. Impact of potassium on crop productivity, use efficiency, uptake and economics of some rainfed crops in Andhra Pradesh, Southern India: On-Station and On-Farm Experiences. *E-ifc* 33: 3-9.