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Effect of different sources of potassium application on yield and quality of *rabi* groundnut crop

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ABSTRACT

A field experiment was conducted during the *rabi* season of 2023 on loamy sand soil on the effect of foliar application together with tank silt and wood ash on the growth and yield attributes of groundnut. The experiment consisted of ten treatments with tank silt, wood ash and K_2SO_4 foliar application with different levels of RDK tested in randomized block design with three replications. Results indicated that foliar spray of potassium sulphate along with 75% RDK and tank silt application recorded higher dry matter, yield and quality parameters. which was on par with the treatment involving 75% RDK + wood ash + K_2SO_4 foliar application at 35 DAS also showed increased dry matter production, yield and oil content. However, protein content was found to be lower in the case of wood ash applied treatment compared to tank silt applied plot.

Keywords: Ground nut, Quality, Tank sit, Wood ash and Yield.

Groundnut (*Arachis hypogaea* L.), known as the "king of oil seeds" is an important oil seed and food crop in India, which is also known as peanut or poor man's almond, which belongs to the family Leguminosae. On a dry seed basis, groundnut seed has 44–56% oil and 22–30% protein. It is also a rich source of minerals (phosphorus, calcium, magnesium and potassium) and vitamins (E, K and B groups). It is reported that the total carbohydrates in groundnut seeds, including both soluble and insoluble carbohydrates, range from 9.5 to 19.0% (Chowdhury *et al*., 2015).

Potassium (K) is an important macronutrient for plant growth and development, which is associated with the movement of water, nutrients and carbohydrates in plants. It is involved in many physiological processes like osmoregulation, cation-anion balance, protein synthesis and activation of enzymes. It also reduces lodging, imparts disease resistance and improves the quality and shelf life of crops (Sakarvadia *et al*., 2019).

Ground nut is a crop with a very high potassium requirement. It promotes the synthesis of sugar and starch, boosts peg penetration, and aids in the growth and filling of pods. Groundnut leaves have an adequate K content of 1.6% to 3.0% and lack of which results in less development of the kernel, peg, and flowering (Singh, 2004).

However, the lack of K in balanced nutrition has led to low K status in Indian soils, which has resulted in K mining from the soil reserve. The K status of the soil is determined by the mineralogy of the soil, the K added through fertilizers, and the availability of additional K sources such as organic manures, tank silt, irrigation water, etc. (Rao *et al*, 2014). In this situation, exploration of other potassium sources which can supplement the potassium from fertilizers and increase the yield of crops is needed. Keeping in view of this situation, a field experiment was conducted to study the effect of wood ash and tank silt as alternative sources of potassium along with foliar application of K_2SO_4 on the yield and quality of groundnut.

MATERIAL AND METHODS

The experiment was conducted at Agricultural College Farm, Bapatla under Acharya N G Ranga Agricultural University, Andhra Pradesh with TAG-24 variety of ground nut during *rabi* season in 2023-24 in loamy sand soil. The experiment was laid out in randomized block design (RBD) with ten treatments replicated thrice. The ground nut crop was sown under irrigated conditions with a spacing of 30 cm x 10 cm. Nitrogen, phosphorus and potassium were supplied through urea, single super phosphate (SSP) and muriate of potash (MOP). The recommended dose of 40 kg P_2O_5 and 30 kg N ha^{-1} were applied uniformly to all plots. The recommended dose of K_2O @ 50 kg ha^{-1} was applied as per the treatments. Nitrogen was applied in 2 equal splits (1/2 at the time of sowing and the remaining half at 30 DAS). The entire quantity of P and K fertilizers was applied as basal before sowing. Wood ash @ 500 kg ha^{-1} and tank silt @ 6000 kg ha^{-1} were applied to each plot according to the treatments 1 week before the date of sowing. Foliar spraying of 2% K_2SO_4 was done at 35 DAS according to treatment. The characteristics of wood ash and tank silt used in the experiment in presented in table 1.

Treatment details : T_1 – 100% RDK, T_2 – 75% RDK, T_3 –75% RDK + wood ash, T_4 – 75% RDK + wood ash + K_2SO_4 foliar application at 35 DAS), T_5 – 75% RDK + tank silt, T_6 –75% RDK + tank silt + K_2SO_4 foliar application at 35 DAS, T_7 –50% RDK + wood ash, T_8 – 50% RDK + wood ash + K_2SO_4 foliar application at DAS, T_9 – 50% RDK + tank silt and T_{10} – 50% RDK + tank silt + K_2SO_4 foliar application at 35 DAS.

The dry matter production was estimated by uprooting five plants from the destructive sampling area from each plot at 30 DAS and 60 DAS. These were cleaned and dried in a hot air oven at 60°C till constant weight was obtained. Their weights were recorded and expressed in kg ha^{-1}. The haulm yield was estimated by collecting plants from the net plot area and sundried till constant weight was obtained and their weight was recorded as per plot basis and later converted as the haulm yield (kg ha^{-1}). Similarly, pods from the net plot area were cleaned and pod weight was recorded on the basis of dry pod yield kg per plot. Later the pod yield per net plot was computed on a hectare basis and expressed in kg ha^{-1}. Nitrogen content in the seeds of ground nut was estimated by Kjeldhal's method (Piper, 1966) and the protein per cent in the seeds was calculated by multiplying the nitrogen content by a factor of 6.25. Oil content was measured using a Soxhlet apparatus where about 5 g of groundnut kernels were kept in a Soxhlet extraction apparatus and oil was extracted with petroleum ether. Fisher's method of analysis of variance was followed for the analysis and interpretation of the data as suggested by Panse and Sukhatme (1978). The level of significance used in 'F' test at 0.05 level of probability was worked out for significance.

Table 1. Characteristics of wood ash and tank silt used in the experiment

Sl.No.	Characteristics	Wood ash	Tank silt
1	pH	8.67	8.96
2	EC (dS m^{-1})	0.68	0.83
3	Nitrogen (%)	0.08	0.31
4	Phosphorus (%)	1.21	0.19
5	Potassium (%)	2.5	0.3
6	Organic carbon content (%)	0.03	1.25

RESULTS AND DISCUSSION

Dry matter production

The dry matter production recorded at 30 DAS and 60 DAS were presented in table 2. The dry matter production at different crop growth stages was significantly influenced by the application of different potassium sources like tank silt, wood ash and K_2SO_4 foliar application.

The perusal of data of the dry matter production at 30 DAS indicates that the highest dry matter production (2513 kg ha^{-1}) was recorded at 30 DAS in T_6 receiving 75% RDK + tank silt + K_2SO_4 foliar application at 35 DAS and was on par with T_5 (75% RDK + tank silt), T_4 (75% RDK + wood ash + K_2SO_4 foliar application at 35 DAS), T_3 (75% RDK + wood ash) and T_1 (100% RDK). Lowest dry matter production of 1875 kg ha^{-1} was recorded in T_7 supplied with 50% RDK + wood ash, which was on par with T_2 (75 %RDK), T_{10} (50% RDK + tank silt + K_2SO_4 foliar application at 35 DAS), T_9 (50% RDK + tank silt) and T_8 (50% RDK + wood ash + K_2SO_4 foliar application at 35 DAS). The trend of dry matter accumulation at 60 DAS was different from that of 30 DAS due to the effect of K_2SO_4 foliar spray. At this stage, the significantly highest dry matter accumulation (3474 kg ha^{-1}) was observed in T_6 supplied with 75% RDK + tank silt + K_2SO_4 foliar application at 35 DAS and was on par with T_4 (75% RDK + wood ash + K_2SO_4 foliar application at 35 DAS) and T_1 (100 % RDK). This was followed by T_{10} receiving 50 % RDK + tank silt+ K_2SO_4 foliar application at 35 DAS and was on par with T_8 (50% RDK + wood ash + K_2SO_4 foliar

Table 2. Effect of different sources of potassium application on dry matter production, yield and quality of ground nut

Treatments	Dry matter		Yield (kg ha^{-1})		Oil content (%)	Protein content (%)
	30 DAS	60 DAS	Haulm yield	Pod yield		
T_1 – 100% RDK	2317	3101	2933	2335	44	22.93
T_2– 75% RDK	1992	2700	2433	1944	43.2	22.94
T_3 – 75% RDK + Wood ash	2324	2761	2700	2017	43.3	22.97
T_4 – 75% RDK + Wood ash + K_2SO_4 foliar application at 35 DAS	2334	3435	3250	2545	48.8	23.08
T_5 – 75% RDK + Tank silt	2496	2780	2733	2033	43.5	27.07
T_6 – 75% RDK + Tank silt + K_2SO_4 foliar application at 35 DAS	2513	3474	3287	2566	49.2	27.39
T_7– 50% RDK + Wood ash	1875	2382	2117	1800	42.6	20.63
T_8 – 50% RDK + Wood ash + K_2SO_4 foliar application at 35 DAS	1883	2989	2809	2213	47.9	20.83
T_9 – 50% RDK + Tank silt	1915	2400	2138	1833	42.7	23.5
T_{10} – 50% RDK + Tank silt + K_2SO_4 foliar application at 35 DAS	1926	3017	2849	2240	48.1	23.55
S.Em (±)	**94.1**	**139.1**	**128.4**	**98.2**	**1.6**	**1.2**
CD @ 0.05	**301.1**	**444.9**	**410.6**	**314.1**	**5**	**3.6**
CV (%)	**7.6**	**8.3**	**8.2**	**7.9**	**5.9**	**8.41**

application at 35 DAS), T_3 (75% RDK + wood ash), T_5 (75% RDK + tank silt) and T_2 (75 % RDK). The lowest dry matter accumulation was recorded in T_7 and T_9 treatments received 50 % RDK + wood ash and 50 % RDK + tank silt respectively.

The increase in dry matter production due to the application of wood ash, tank silt and K_2SO_4 foliar application is because of the growth-promoting effect of tank silt, wood ash and foliar application. The increase in dry matter accumulation due to tank silt and wood ash is because of the presence of many essential nutrients in them including a greater quantity of calcium, which is closely connected to the elongation of cells and thus dry matter production (Bonfim-Silva *et al.* 2020: Rajakumar *et al.*, 2016). Foliar application of potassium causes rapid translocation of potassium from leaves than when applied in soil (El-Sheref *et al.*, 2018; Awad *et al.*, 2014). According to Alagarswamy *et al.* (2024), foliar potassium feeding enhances stomatal opening, which enhances the rate of photosynthetic activity and, ultimately, increases the production of dry matter in ground nuts.

Haulm yield

The data presented in table 2 showed a significant influence of tank silt, wood ash and K_2SO_4 foliar application on haulm yield of groundnut. Significantly higher haulm yield (3287 kg ha^{-1}) was reported in T_6 treatment provided with 75% RDK + tank silt + K_2SO_4 foliar application at 35 DAS. This yield was on par with of T_4 (3250 kg ha^{-1}) and T_1 (2933 kg ha^{-1}) provided with 75% RDK + wood ash + K_2SO_4 foliar application at 35 DAS and 100 % RDK respectively. The lowest haulm yield (2117 kg ha^{-1}) was recorded in the T_7 treatment where 50 % RDK + wood ash was given, and this was on par with the T_9 (50% RDK + tank silt).

The increase in haulm yield might be due to the combined effect of tank silt or wood ash along with foliar nutrition. The beneficial effect of readily available nutrients delivered to the crop through foliar spray was attributed to the increase in groundnut haulm yield (Sanadi *et al.* 2018). Through cuticles or stomata, the plant directly absorbed these nutrients, which may have contributed to photosynthesis in the leaves of the plant, increasing haulm yield. The tank silt and wood ash addition also contributed to the increase in haulm yield along with foliar application which might be due to the presence of various essential nutrients in them necessary for the growth and development of plants. (Park *et al*., 2005 and Srinivasa *et al*., 2010).

Pod yield

The data presented in table 2 indicated that there was a significant effect of different treatments on the pod yield of ground nut. The highest pod yield (2566 kg ha^{-1}) was reported in T_6 treatment provided with 75% RDK + tank silt + K_2SO_4 foliar application at 35 DAS. This was on par with the pod yield of T_4 (2545 kg ha^{-1}) and T_1 (2335 kg ha^{-1}) provided with 75% RDK + wood ash + K_2SO_4 foliar application at 35 DAS and 100 % RDK respectively. The lowest pod yield (1800 kg ha^{-1}) was recorded in the T_7 treatment where 50 % RDK + wood ash was given and this was on par with the T_9 treatment which received 50 % RDK + tank silt. The result showed that pod yield has significantly increased due to tank silt or wood ash addition along with K_2SO_4 foliar application and 75 % RDK.

The higher pod yield with tank silt application may be the result of improved soil texture, higher nutrient replenishment, and improved moisture retention (Goverdhan and Ramanjaneyulu, 2014). Moreover, tank silt and wood ash contain considerable amounts of other nutrients also especially calcium. Calcium is the most important element in the development of pods in groundnut (Kadirimangalam *et al*., 2022). The foliar application of potassium enhances the photosynthetic activity and effective transfer of assimilates to reproductive parts which enhances the pod yield (Mekki, 2015).

Oil content

The data presented in table 2 indicates that a significant difference exists between the treatments on the oil content of the groundnut crop. The highest oil content (49.2%) was observed in the T_6 treatment which received 75% RDK+ tank silt + K_2SO_4 foliar application at 35 DAS. This was on par with the oil content of T_4 (48.8%) supplied with 75% RDK+ wood ash+ K_2SO_4 foliar application at 35 DAS, T_{10} (48.1%) supplied with 50% RDK + tank silt + + K_2SO_4 foliar application at 35 DAS and T_8 (47.9%) supplied with 50% RDK + tank silt + + K_2SO_4 foliar application at 35 DAS. The increase in oil content was mainly due to the foliar application of K_2SO_4 in addition to tank silt and wood ash application which might be due to the positive effect of sulphate in enhancing the oil content of groundnut. Oil seeds require more sulphur than other crops because the oil-storing organs in them are mostly sulphur-containing proteins (Kamal *et al*., 2024). The oil content (42.6%) was lowest in the T_7 treatment provided with 50% RDK+ wood ash.

Protein content

The data presented in table 1 indicates that a significant difference exists between the treatments on the protein content of the groundnut crop. The highest protein content (27.39%) was observed in the T_6 treatment which received 75% RDK+ tank silt + K_2SO_4 foliar application at 35 DAS. This was on par with the protein content of T_5 (27.07%) supplied with 75% RDK + tank silt. The protein content (20.63%) was lowest in the T_7 treatment provided with 50% RDK+ wood ash. The result showed that tank silt-amended treatments showed higher protein content compared to wood ash-amended treatments and treatments with only inorganic fertilizer application. The increased protein content can be attributed to the effect of tank silt. The addition of tank silt enhanced the nitrogen content of soil and thus increased the uptake of nitrogen by plants. Whereas the soil nitrogen content in treatments supplied with wood ash and inorganic fertilizer alone showed lower nitrogen content in soil. This lower nitrogen content in soil is reflected in the lower protein content of these treatments compared to tank silt-added soils. Nitrogen is the fundamental unit of amino acids which are the building blocks of protein. An increase in protein content due to the increased application of nitrogen was also confirmed by Li *et al*. (2024).

LITERATURE CITED

Alagarswamy S, Karuppasami K M, Djanaguiraman M, Venugopal P B, Natarajan S, Rathinavelu S and Parasuraman B 2024. Sustaining the Yield of Maize, Blackgram, Greengram, Groundnut, Cotton, Sugarcane, and Coconut through the Application of Nutrients and Plant Growth Regulator Mixture. *Plants.* 13 (11): 1549.

Awad M A, Ismail S M and Al-Qurashi A D 2014. Effect of potassium soil and foliar spray fertilization on yield, fruit quality and nutrient uptake of 'Seweda' date palm grown in sandy loam soil. *Journal of Food, Agriculture and Environment.* 12 (1): 305-311.

Bonfim-Silva E M, Takenaka P Y, Nonato J J, Guimaraes S L and da Silva T J A 2020. Productive characteristics of peanut cultivars fertilized with wood ash. *Australian Journal of Crop Science.* 14 (4): 691-696.

Chowdhury F N, Hossain D, Hosen M and Rahman S 2015. Comparative study on chemical composition of five varieties of groundnut (Arachis hypogaea). *World Journal. of Agricultural Science.* 11 (5): 247-254.

El-Sheref G, Awadalla H and Abu El Fotoh H 2018. Minimizing of using potassium fertilizer by using foliar spraying and organic manuring and its effect on maize productivity and soil properties. *Journal of Soil Sciences and Agricultural Engineering.* 9 (11): 615-625.

Goverdhan M and Ramanjaneyulu A V 2015. Impact of organic amendments and mulch materials on productivity and economics of rainfed groundnut grown on alfisols. *Environment and Ecology.* 33(2): 795-799.

Kadirimangalam S R, Sawargaonkar G and Choudhari P 2022. Morphological and molecular insights of calcium in peanut pod development. *Journal of Agriculture and Food Research.* 9: 100320.

Kamal Dhaka A K, Kamboj E, Sharma A, Ravi and Preeti (2024). Effect of Phosphorus and Sulphur Levels on Yield Attributes, Yield and Quality of Groundnut (*Arachis hypogaea* L.). Agricultural Science Digest.

Li G, Guo X, Sun W, Hou L, Wang G, Tian R and Zhao C 2024. Nitrogen application in pod zone improves yield and quality of two peanut cultivars by modulating nitrogen accumulation and metabolism. *BMC Plant Biology.* 24 (1): 48.

Mekki B B 2015. Yield and yield components of groundnut (*Arachis hypogaea* L.) in response to soil and foliar application of potassium. American-Eurasian Journal of Agricultural and Environmental Science. 15 (10): 1907-1913.

Panse V G and Sukhantme P V 1978. Statistical Methods for Agricultural Workers. ICAR. New Delhi. 199-211.

Park B B, Yanai R D, Sahm J M, Lee D K and Abrahamson L P 2005. Wood ash effects on plant and soil in a Willow bioenergy plantation. *Biomass and Bioenergy.* 28 (4): 355-365.

Piper C S 1966. Soil and Plant Analysis. Hans Publishers, Bombay. 368-369

Rajakumar R, Bagavathi Ammal U, Baskar A, Sankar R and Sreenadha Reddy N 2016. Effect of tank silt and organic manures on nutrient dynamics and performance of bhendi [*Abelmoschus esculentus* (L.) moench]. *Advances in Life Sciences*. 5 (16): 6409-6414.

Rao C S, Reddy S B and Kundu S 2014. Potassium Nutrition and Management in Indian Agriculture. *Indian Journal of Fertilisers*. 58.

Sakarvadia H L, Vekaria L C, Ponkiya H P, Vaghasia P M and Polara K B 2019. Potassium fertilization to *kharif* groundnut in medium black calcareous soils of Saurashtra region of Gujarat. *International Journal of Chemical Studies.* 7 (4): 1752-1755.

Sanadi U, Math K K, Bidari B I and Yenagi B S 2018. Effect of potassium nutrition on yield, quality and economics in groundnut (*Arachis hypogaea* L.) in a Vertisol. *Journal of Pharmacognosy and Phytochemistry*. 7 (2): 220-222.

Singh A L 2004. Mineral nutrient requirement, their disorders and remedies in groundnut. *Groundnut Research in India.* 137-159.

Srinivasa R, Shashidhar K S, Vinoda K S, Chandrashekara C and Gowda R C 2010. Effect of tank silt on physico-chemical properties of soil with fingermillet crop in eastern dry zone of Karnataka. *Environment and Ecology.* 28 (2B): 1424-142.

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