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EFFECT OF POTASSIUM HUMATE AND CHEMICAL FERTILIZERS ON YIELD AND YIELD ATTRIBUTES OF GROUNDNUT (*Arachis hypogaea* L.)

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ABSTRACT

A field experiment on groundnut was conducted during *Kharif* 2023, 2024 at the Instructional Farm, SKNCOA, SKNAU, Jobner (Rajasthan) revealed that potassium humate 16 kg PH per hectare (PH_2) significantly improved pod yield (2581, 2662 and 2622 kg ha^{-1}), haulm yield (3589, 3779 and 3684) kernel yield (1691, 1750 and 1720), shelling per cent (65.26, 65.63 and 65.45 per cent), 100 seed weight (44.36, 44.94 and 44.65 g) while among fertility levels application of 75% RDF combined with sulphur at 45 kg ha^{-1} significantly improved pod yield (2541, 2628 and 2585 kg ha^{-1}), haulm yield (3559, 3748 and 3653) kernel yield (1678, 1748 and 1713), shelling per cent (65.77, 66.65 and 66.21 per cent), 100 seed weight (44.76, 45.02 and 44.89 g) during 2023, 2024 and pooled analysis, respectively, under semi-arid conditions of Rajasthan.

Keywords: Groundnut, Potassium humate (PH), fertility levels, Yield parameters, Yield

Introduction

Groundnut (*Arachis hypogaea L.*) is an important commercial legume cum oilseed crop in India. Groundnut or peanut is an herbaceous, self-pollinated, dicotyledonous legume that belongs to the family of crops called leguminosae and the subfamily known as Papilionaceae. It is also called monkey nut. Groundnut is a multipurpose crop that serves as supplementary human food. Its seeds called kernels contain on average 45 to 51 per cent high-quality hydrogenated edible oil, 28 per cent dietary protein, and 24.2 per cent soluble carbohydrates and minerals. During *kharif*, 2024-25, the area under groundnut crop in Rajasthan was 10.55 lakh hectares, production 21.36 lakh tons with a yield of 2024 kg ha^{-1} (GoR, 2025).Potassium humate, derived from humic substances, has gained prominence in the agricultural sector due to its multifaceted benefits (Elshaboury *et al.*, 2021). Potassium humate is a very concentrated form of humus in the naturally occurring lignite which is the brown coal that accompanies coal deposits. All humic substances are composed of chemically complex, nonbiological organic compounds that are largely hydrophilic, amorphous, dark-colored liquids or powders and resistant to chemical and biological degradation (Mackowiak *et al.*, 2001). The plant nutrients that play the most important role in the nutrition of the groundnut crop are nitrogen, phosphorus, potassium and sulphur. Nitrogen is the major nutrient that enhances metabolic processes leading to increased vegetative, reproductive growth and crop yield. Phosphorus plays a vital role in virtually every plant process like photosynthesis, energy storage and transfer, stimulating root development and growth (Singh, 1999). Potassium is essentiality is proven in its multiple roles in assisting and facilitating plant processes. It mainly functions as a conveyer of electrical charge in the plant cell and acts as a catalyst for many of the enzymatic processes in the plant that are necessary for plant processes. Sulphur plays a vital role in the synthesis of amino acids (methionine, cystein and cystine etc.), chlorophyll and certain vitamins (Zhao *et al*., 1997). Therefore, integrating fertility levels with potassium humate is essential for improving the yield of groundnut under semi-arid conditions.

Material and Methods

The present investigation was conducted at the Instructional Agronomy Farm of SKN College of Agriculture, SKN Agriculture University (SKNAU), Jobner (Rajasthan) during the kharif seasons of 2023, 2024 and pooled analysis. The soil of the experimental field was loamy sand in texture, slightly alkaline in reaction (pH 8.12), low in organic carbon (0.21 %) and available nitrogen (123.45 kg ha^{-1}), medium in available phosphorus (15.87 kg ha^{-1}) and potassium (149.88 kg ha^{-1}). The experiment was laid out according to factorial randomized block design and consisted of 21 treatment combinations (3x7) replicated thrice, with three treatments of potassium humate control (PH_0), 8 kg PH ha^{-1} (PH_1), 16 kg PH ha^{-1} (PH2) and seven levels of fertility control (F_0), 50% RDF (F_1), 75% RDF (F_2), 100% RDF (F_3), 50% RDF+Sulphur @ 45 kg ha^{-1} (F_4), 75% RDF+Sulphur @ 45 kg ha^{-1} (F_5) and 100% RDF+Sulphur @ 45 kg ha^{-1} (F_6). The gross plot size was 3.2 m × 4.0 m (12.8 m²) and net plot size was 2.4 m × 3.0 m (7.2 m²). Groundnut variety TG-37A was sown at a seed rate of 100 kg ha^{-1} with crop geometry of 40 cm × 10 cm spacing. A recommended dose of fertilizers (25:60:30 kg N:P: K ha^{-1}). Observations on 100- seed weight, pod yield, haulm yield, shelling per cent, kernel yield was recorded from net plot produce after harvest. The data were analyzed using analysis of variance (ANOVA) in factorial randomized block design.

Results and Discussion

Effect of potassium humate on yield and yield attributes

Pod yield

Potassium humate treatments (Table 1) significantly influenced the pod yield of groundnut during 2023, 2024 and in pooled analysis. Significantly maximum pod yield was produced with the application of 16 kg PH per hectare (PH_2) (2581, 2662 and 2622 kg ha^{-1}), which was significantly higher over 8 kg PH per hectare (PH_1) (2309, 2397 and 2353 kg ha^{-1}) and control (PH_0) during 2023, 2024 and on pooled basis, respectively. The increase in pod yield with application of 16 kg PH per hectare (PH_2) was recorded to be 23.08, 23.98 and 23.54 per cent higher over control during 2023, 2024 and in pooled and in pooled analysis, respectively. Pod yield may be attributed to potassium humate positive influence on soil properties and improved photosynthate translocation. Additionally, enhanced growth parameters and nutrient uptake likely contributed to greater biomass. Similar findings were reported by Dhanasekaran (2011), Sarwar *et al.* (2014), Kumar *et al.* (2014), Patel *et al.* (2017), Sooryasree *et al*. (2025)

Haulm yield

Potassium humate treatments (Table 1) had same order of pattern in influencing the haulm yield as that of pod yield. The data indicated that potassium humate significantly influenced the haulm yield of groundnut during both the years and on pooled basis. Significantly highest haulm yield (3589 kg ha^{-1} in Ist year, 3779 kg ha^{-1} in IInd year and 3684 kg ha^{-1} in pooled analysis) was recorded with the application of 16 kg PH per hectare (PH_2), which was superior over other rest of the potassium humate treatment and control during both the years and on pooled basis. Furthermore, investigation of data shows that the haulm yield of groundnut reported with the application of 8 kg PH per hectare (PH_1) statistically significant with PH_0. 16 kg PH per hectare (PH_2) enhanced groundnut haulm yield to the tune of 26.26, 24.89 and 25.55 per cent over control during 2023, 2024 and on pooled basis, respectively. The enhanced metabolic activity and improved nutrient utilization ultimately promote better plant growth and development Mahdi *et al*., (2021). These findings are in accordance with earlier reports Kumar *et al.* (2014), Awaad *et al*. (2020), Sooryasree *et al*. (2025)

kernel yield

Different levels of potassium humate treatments (Table 1) significantly influenced the kernel yield of groundnut during 2023, 2024 and in pooled analysis. Significantly maximum kernel yield was produced with the application of 16 kg PH per hectare (PH_2) (1691, 1750 and 1720 kg ha^{-1}), which was significantly higher over 8 kg PH per hectare (PH_1) and control (PH_0) during 2023, 2024 and on pooled basis, respectively. The increase in kernel yield with application of 16 kg PH per hectare (PH_2) was recorded to be 28.06, 28.92 and 28.50 per cent higher over control during 2023, 2024 and in pooled and in pooled analysis, respectively. Humic substances enhanced root growth and nutrient uptake and availability leading to improved chlorophyll content, photosynthesis and metabolic activities, thereby resulting in better yield. Similar results were also reported by Sunitha *et al.* (2023) and Kumar *et al.* (2024)

Shelling per cent

A scrutiny of the data table 2 indicates that the application of potassium humate resulted in a significant increase in the shelling per cent during both years of study, as well as in the pooled analysis. Among the different treatments, the highest shelling per cent was observed under the application of 16 kg PH per ha (PH_2), recording shelling per cent 65.26, 65.63 and 65.45 per cent during 2023, 2024 and on a pooled basis, respectively. This treatment proved to be significantly superior to 8 kg PH per ha (PH_1) and control (PH_0) in both years, as well as in pooled results. Furthermore, the results indicated that the use of 16 kg PH per ha (PH_2) increased the shelling per cent by 3.77%, 4.08% and 3.92% over control during 2023, 2024 and in pooled analysis.

100 seed weight

An appraisal of data presented in table 2 indicates that the application of potassium humate resulted in a significant increase in 100 seed weight of groundnut during both years of study as well as in the pooled analysis. Among the different treatments, the highest 100 seed weight was observed with 16 kg PH per ha (PH_2), with weights of, 44.36, 44.94 and 44.65 g in 2023, 2024 and on a pooled basis, respectively. This treatment proved to be significantly superior to 8 kg PH per ha (PH_1) and control (PH_0) in both years, as well as in pooled results. Furthermore, the results indicated that the use of 16 kg PH per ha (PH_2) increased the 100 seed weight by 10.49%, 11.24% and 10.85% over the control during 2023, 2024 and in the pooled analysis, respectively. Kadam *et al*. (2011) reported that growth and yield characters were significantly affected by the application of potassium humate Similar findings were reported by Kumar *et al.* (2014) and Sunitha *et al.* (2023).

Effect of Fertility levelson yield and yield attributes

Pod yield

It is evident from the data summarized in table 1 that progressive increase in fertility level up to 75% RDF combined with sulphur at 45 kg ha^{-1} significantly enhanced the pod yield of groundnut over 100% RDF (F_3) and remaining fertility levels but remained at par with 100% RDF combined with sulphur at 45 kg ha^{-1} (F_6) during both the years of study and in pooled analysis. The significantly higher pod yield of groundnut was produced with 75% RDF combined with sulphur at 45 kg ha^{-1} (2541, 2628 and 2585 kg ha^{-1}), which was not statistically different from 100% RDF combined with sulphur at 45 kg ha^{-1} (F_6) (2630, 2722 and 2676 kg ha^{-1}) but significantly higher than 100% RDF (F_3) during 2023, 2024 and in pooled analysis, respectively. The application of 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5) increased pod yield by 30.21, 31.08 and 30.69 per cent over control (F_0) during 2023, 2024 and in pooled analysis, respectively. The advantage of synchronizing nutrient availability with critical growth and reproductive stages ensures higher pod set, seed filling and final harvest index (Sharma *et al*., 2020). Similar observations were reported Bhosale and Pisal (2017), Yadav *et al*. (2017).

Haulm yield

A critical scrutiny of data presented in table 1 indicates that each incremental supply of fertilizers 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5) significantly increased the haulm yield of groundnut during both the years and in pooled analysis. The significantly higher haulm yield of groundnut was produced with 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5) (3559, 3748 and 3653 kg ha^{-1}), which was not statistically different from 100% RDF combined with sulphur at 45 kg ha^{-1} (F_6) (3647, 3863 and 3755 kg ha^{-1}) but significantly higher than 100% RDF (F_3) and rest of fertility levels during 2023, 2024 and in pooled analysis, respectively. Further data revealed that the haulm yield with 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5) was 32.36, 33.54 and 32.96 per cent higher than control (F_0) during 2023, 2024 and in pooled analysis, respectively. The increase in haulm yield with the recommended dose of fertilizers with sulphur may be attributed to the balanced supply of essential nutrients which promoted vegetative growth, enhanced photosynthetic activity and increased dry matter accumulation thereby resulting in higher biomass production. These findings are supported by earlier reports of Bhosale and Pisal (2017), Nurezannat *et al*. (2019).

Kernel yield

It is evident from the data summarized in table 1 that progressive increase in fertility level up to 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5) significantly enhanced the kernel yield of groundnut over 100% RDF (F_3) and rest of treatment but remained at par with 100% RDF combined with sulphur at 45 kg ha^{-1} (F_6) during both the years of study and in pooled analysis. The significantly higher kernel yield of groundnut was produced with 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5) (1678, 1748 and 1713 kg ha^{-1}), which was not statistically different from 100% RDF (F_6) (1760, 1815 and 1788 kg ha^{-1})

during 2023, 2024 and in pooled analysis, respectively. Further data revealed that the kernel yield with 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5) was 41.08, 42.95 and 42.03 per cent higher than control (F_0) during 2023, 2024 and in pooled analysis, respectively. The increase in kernel yield with the combined application of the recommended dose of fertilizers (RDF) and sulphur may be attributed to the balanced supply of essential nutrients and efficient translocation of assimilates to developing kernels with better seed filling, thereby resulting in higher kernel yield. These findings were also reported Giri *et al.* (2017), Pancholi *et al.* (2017), Sunitha *et al.* (2023).

Shelling per cent

Data in the table 2 showed that fertility levels increased significantly across both years and in the pooled analysis. The significant maximum shelling per cent of groundnut (65.77, 66.65 and 66.21 during 2023, 2024 and in pooled data, respectively) was found with application 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5), which was not significantly different from 100% RDF combined with sulphur at 45 kg ha^{-1} (F_6) but remained superior over 100% RDF (F_3) and rest of treatments as per pooled analysis. The application of 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5) resulted in 8.12, 9.33 and 8.73 per cent higher shelling per cent than the control during 2023, 2024 and pooled analysis, respectively. The increase in shelling percentage may be attributed to the higher kernel yield which resulted from improved seed filling leading to a higher shelling percentage. these findings corroborate the results Ganesh *et al.* (2015) Sengupta *et al.* (2016), Giri *et al.* (2017).

100 seed weight

Data in the Table 2 showed that fertility levels varied significantly with increasing fertility levels. The significant maximum 100 seed weight of groundnut (44.76, 45.02 and 44.89 g during 2023, 2024 and in pooled data, respectively) was found with application 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5), which was not significantly different from 100% RDF combined with sulphur at 45 kg ha^{-1} (F_6) but remained superior over 100% RDF (F_3) and all other remaining treatments as per pooled analysis. The application of 75% RDF combined with sulphur at 45 kg ha^{-1} (F_5) resulted in 16.78, 16.72 and 16.75 per cent higher 100 seed weight than control during 2023, 2024 and pooled analysis, respectively. A better seed filling during the reproductive stage resulting in the development of larger and heavier seeds. The results are in harmony with the findings Pancholi *et al.* (2017), Giri *et al.* (2017), Nurezannat *et al.* (2019).

Conclusion

The findings of the present study demonstrated that the integrated application of potassium humate and chemical fertilizers significantly enhanced the yield and yield attributes of groundnut under the semi-arid conditions of Rajasthan. Application of potassium humate @ 16 kg ha^{-1} resulted in the highest pod yield, haulm yield, kernel yield, shelling percentage and 100-seed weight compared with lower levels and the control. Among the fertility treatments 75% RDF combined with sulphur @ 45 kg ha^{-1} significantly improved yield and yield attributes over 100% RDF alone and remained statistically at par with 100% RDF + sulphur @ 45 kg ha^{-1}. These results indicate that the combined use of potassium humate with a reduced fertilizer dose supplemented with sulphur improves nutrient use efficiency and crop productivity. Therefore, the application of 16 kg potassium humate ha^{-1} along with 75% RDF + sulphur @ 45 kg ha^{-1} may be recommended as an efficient and sustainable nutrient management strategy for maximizing groundnut productivity while reducing chemical fertilizer requirement under the semi-arid conditions of Rajasthan.

Table 1 : Effect of potassium humate and fertility levels on pod, haulm and kernel yield of groundnut

Treatments	Pod yield (kg ha^{-1})			Haulm yield (kg ha^{-1})			Kernel yield (kg ha^{-1})		
	2023	2024	pooled	2023	2024	Pooled	2023	2024	Pooled
Potassium humate									
PH_0 : Control	2097	2147	2122	2843	3026	2934	1320	1358	1339
PH_1 : 8 kg PH ha^{-1}	2309	2397	2353	3285	3396	3341	1485	1550	1518
PH_2 : 16 kg PH ha^{-1}	2581	2662	2622	3589	3779	3684	1691	1750	1720
SEm±	33	35	23	52	55	36	24	26	17
CD (P=0.05)	95	100	65	148	158	100	68	74	47
Fertility levels									
F0 : Control	1951	2005	1978	2689	2806	2748	1189	1223	1206
F1 : 50% RDF	2138	2210	2174	2956	3126	3041	1333	1390	1362
F2 : 75% RDF	2297	2368	2333	3235	3370	3303	1470	1518	1494
F3 : 100% RDF	2391	2454	2423	3318	3464	3391	1539	1594	1567
F4 : 50% RDF+Sulphur @ 45 kg ha^{-1}	2356	2429	2393	3270	3426	3348	1522	1579	1550

F5 : 75% RDF +Sulphur @ 45 kg ha-1	2541	2628	2585	3559	3748	3653	1678	1748	1713
F6 : 100% RDF+Sulphur @ 45 kg ha-1	2630	2722	2676	3647	3863	3755	1760	1815	1788
SEm+	51	53	38	79	84	58	36	40	27
CD (P=0.05)	145	152	106	226	241	164	104	113	77

Table 2 : Effect of potassium humate and fertility levels on shelling and 100 seed weight of groundnut

Treatments	Shelling (%)			100 Seed weight (g)		
	2023	**2024**	**Pooled**	**2023**	**2024**	**Pooled**
Potassium humate						
PH_0 : Control	62.89	63.06	62.98	40.15	40.40	40.28
PH_1 : 8 kg PH ha^{-1}	64.12	64.48	64.30	42.37	42.73	42.55
PH_2 : 16 kg PH ha^{-1}	65.26	65.63	65.45	44.36	44.94	44.65
SEm+	0.26	0.28	0.81	0.41	0.42	0.27
CD (P=0.05)	0.73	0.79	0.52	1.16	1.21	0.77
Fertility levels						
F_0 : Control	60.94	60.96	60.95	38.33	38.57	38.45
F_1 : 50% RDF	62.35	62.79	62.57	40.47	40.81	40.64
F_2 : 75% RDF	63.94	64.06	64.00	42.32	42.70	42.51
F_3 : 100% RDF	64.52	64.82	64.67	42.87	43.14	43.01
F_4 : 50% RDF+Sulphur @ 45 kg ha^{-1}	64.31	64.78	64.55	42.46	43.07	42.76
F_5 : 75% RDF +Sulphur @ 45 kg ha^{-1}	65.77	66.65	66.21	44.76	45.02	44.89
F_6 : 100% RDF+Sulphur @ 45 kg ha^{-1}	66.83	66.67	66.75	44.85	45.50	45.18
SEm+	0.39	0.42	0.28	0.62	0.65	0.45
CD (P=0.05)	1.11	1.21	0.81	1.78	1.85	1.26

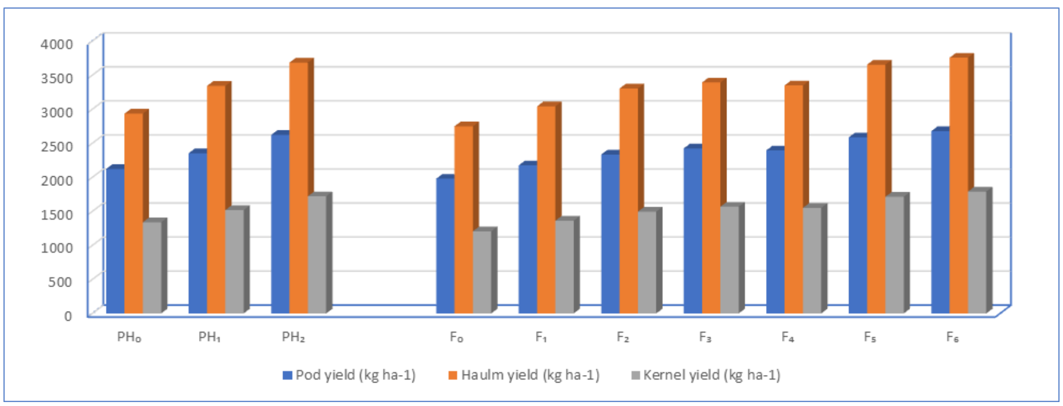

Fig. 1 : Effect of potassium humate and fertility levels on pod, haulm and kernel yield of groundnut

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