Effect of Potassium Schoenite (Mahalaabh) on Growth and Yield of Castor, Cotton and Groundnut

Abstract

The need for precise nutrient application has become crucial in agriculture due to climate change and intensive farming practices. Deficiencies in potassium, magnesium and sulphur are critical for enhancing both crop yield and quality. Additionally, agrochemical residues in soil, water and farm products pose significant challenges. Mahalaabh($K_2SO_4 \cdot MgSO_4 \cdot 6H_2O$), a combination of potassium, sulphur and magnesium, offers a balanced solution to address these issues. Field experiments were conducted during the *Kharif* season of 2023-24 at Agrocel Industries Pvt. Ltd., Kachchh, to evaluate the impact of Mahalaabh on castor, cotton and groundnut crops. The trials were executed in a Randomized Block Design, testing different doses of Mahalaabh powder through foliar spray, fertigation and granular soil application. The results demonstrated that Mahalaabh powder is effective in enhancing productivity across the tested crops. In castor, higher doses of 10 kg/acre through drip irrigation and 20g/L foliar application increased productivity by 22.3% and 14.3% over the recommended fertilizer dose (RFD), respectively. However, in cotton, lower doses of 6kg/acre through drip irrigation and 10g/L through foliar application were more effective, resulting in 3.8% and 5.3% yield enhancements compared to RFD. In groundnut, foliar spray at 15 g/L applied thrice at 30-35, 50-55, and 70-75 days after sowing (DAS) was effective, resulting in a 22.9% higher pod yield compared to RFD. These findings highlight the importance of balanced nutrient management practices tailored to specific crop requirements for achieving optimal agricultural productivity.

Keywords: Mahalaabh, Potassium, Cotton, Castor, Groundnut

Introduction

In the era of climate change-induced challenges and intensive agricultural practices, the precise application of nutrients as per soil and plant needs has become paramount. The deficiency of essential nutrients such as potassium, magnesium and sulphurare increasingly evident, posing a significant hurdle to quantitative and qualitative improvements in agricultural production. Additionally, the accumulation of agrochemical residues in soil, water and farm products presents another critical issue hindering sustainable agricultural production and natural resource conservation.The combination of current record global high average temperature for May 2024 that was 0.65°C above the 1991–2020 average and 1.52°C above the 1850–1900 pre-industrial average (Anonymous, 2024); and the abysmal capricious rainfall with some regions experiencing high rainfall and flooding, while others face prolonged dry conditions has been becoming quite critical for agriculture.

Mahalaabh ($K_2SO_4 \cdot MgSO_4 \cdot 6H_2O$), a unique 3-in-1 combination of potassium, sulphur and magnesium, offers a promising solution as a neutral and chemically balanced natural 100% water soluble product. Mahalaabh is certified as Organic product by ECOCERT. Potassium Schoenite, a constituent of Mahalaabh, has demonstrated effectiveness in increasing agricultural productivity by providing potassium (23%) and magnesium (11%).It is environment friendly organic fertilizer derived from natural sources. Mahalaabh is used as soil applied fertilizer as well as for fertigation and foliar application. It improves the flower to fruit ratio; size, lustre, colour, sweetness and firmness of fruits; increases oil, starch and

sugar percentage; improves grain filling in various crops. Mahalaabhcontains very low chlorine content as compared to other fertilizers and hence can be used on chlorine sensitive crops like potato, sugarcane, etc.Previous studies have demonstrated the benefits of applying foliar sprays of potassium schoenite along with recommended doses of NPK in improving plant growth, yield and quality in crops like potato (Ghose *et al*., 2017).

Castor, a key non-edible oilseed crop, is predominantly grown in semiarid and arid regions, with India being the leading producer with 19.73 lakh tonnes annual production (Anonymous, 2023). Cotton, despite facing competition from synthetic fibres, remains the world's leading natural textile fibre, with India ranking first in cultivated area (123.16 lakh ha) and second in production with 312.07 lakh bales (Anonymous, 2023). Groundnut, often referred to as the "King of Oilseeds", is a well-known oilseed crop belonging to the *Leguminosae* family, with India being the second-largest producer globally with 104.54 lakh tonnes annual production (Anonymous, 2023).

In groundnut,adequate potassium supply is essential for proper pod development, kernel filling and maintaining high oil quality (Sanadi *et al*., 2018). Similarly, in cotton, potassium fertilization significantly increased boll weight, boll number, lint yield and fibre quality parameters including fibre length and strength (Pettigrew*et al*., 2008). In castor, potassium fertilization significantly increased seed yield, oil content and oil yield (Sagareand Singh, 1988, Nayak*et al*., 2004).

Magnesium fertilization in groundnut, improves pod number, pod yield and kernel yield, possibly due to its role in enhancing photosynthesis and nutrient translocation (Sireesha and Dawson, 2022). In cotton, magnesium nutrition improved boll retention, boll weight, lint yield and fibre quality traits like micronaire and maturity (Longwell*et al*., 1963). In castor, magnesium application improved seed yield, oil content and oil yield, possibly due to its role in enhancing photosynthesis and nutrient translocation (Munir*et al*., 2007), while sufficient magnesium supply is crucial for maintaining high oil quality and stability in seeds (Reddy*et al*., 2004).

Sulphur is another essential nutrient that plays a significant role in enhancing productivity and quality in these crops. In groundnut, sulphur application significantly increased pod yield, kernel yield and oil content, indicating its importance for overall productivity and quality (Rao *et al*., 2013). In cotton, sulphur application significantly increased boll weight, lint yield and fibre quality parameters like fibre length and strength (Rasheed*et al*., 2006). In castor, sulphur fertilization significantly increased seed yield, oil content and oil yield (Munir *et al*., 2007), while adequate sulphur nutrition is essential for maintaining high protein quality and oil stability in seeds (Reddy*et al*., 2004).

Considering the above situation-specific facts, the experiments were planned to optimize fertilization strategies and enhance crop productivity in the arid region of Kachchh, field trials were conducted at the AGROCEL R & D Farm at Koday, Mandvi during the *Kharif* season of 2023-24 to evaluate the efficacy of this balanced nutrient formulation on the yield and yield components of three economically important crops: castor, cotton and groundnut.

Material and Methods

Field experiments were conducted in a Randomized Block Design (RBD) with three replications at AGROCEL Industries Pvt. Ltd. R&D Farm, Koday, Mandvi, Kachchh during the *Kharif* season of 2023-24 to assess the effect of Potassium Schoenite (Mahalaabh) on the growth and yield of castor (*Ricinus communis* L.), cotton (*Gossypium hirsutum* L.) and groundnut (*Arachis hypogea* L.). The treatments comprised different doses of Mahalaabh powder used both as foliar spray and drenching; and Mahalaabh granules as soil application.

The experiments site represented sandy loam soil with a light brown colour, well-drained and fairly retentive of moisture. The soil was low in available nitrogen, optimum in available phosphorus and medium in available potassium.Fertilizer application was carried out according to the respective treatments for each crop. All necessary agronomic practiceswere followed as per the recommended practices for the respective crops. Thebiometric observations were recorded from five randomly selected plants within each net plot. The parameters observed included plant height (cm), spike length (cm), number of spikes/plant, number of capsules/spike, number of bolls/plant, number of monopodial branches/plant, number of sympodial branches/plant, number of pods/plant, number of seeds/pod, weight of seed cotton/boll (g) and weight of seed cotton/plant (g). That apart, plant population, days to flowering, seed index (g), seed yield (kg/ha), seed cotton yield (kg/ha), and pod yield (kg/ha) were recordedon a net plot basis.The data so collected were statistically analysed for ascertaining precise impact of the treatments on the growth and yield parameters of the respective crops.

Result and Discussion

Effect of Potassium Schoenite on Castor

The data on various treatments in castor revealed non-significant differences in the growth and yield parameters. However, application of Mahalaabh whether as granular basal dose at 50 kg/acre in addition to RFD (Recommended Fertilizer Dose) or Mahalaabh Powder both through drip and foliar was numerically effective in increasing seed yield up to 20.7%, 22.3% and 14.3%, respectively, over RFD (875 kg/acre). Further, Mahalaabh Powder applied through drip irrigation at rates varying from 6 kg/acre to 10 kg/acre showed 17.6% to 22.3% higher seed yield compared to the RFD (Table 1). Overall, T3 (RFD + MLP 10 kg/acre at 40-50 DAS & 100-110 DAS through Drip) gave the highest seed yield (1070 kg/acre) with more numbers of spikes/plant (11.87), capsules/spike (115.87) and seed index (31.44 g), indicating the efficacy of MLP through drip irrigation at higher doses. Similarly, foliar applications were also effective at higher doses with 20g/L giving 14.3% higher seed yield than RFD with conspicuous improvements in spike length, spikes/plant and capsules/spike. That might be due to, Mahalaabh Powder, when applied through drip irrigation, likely ensures a consistent and efficient delivery of nutrients directly to the root zone, promoting better root development and overall plant growth. This results in more spikes per plant, more capsules per spike, and an increased seed index, ultimately leading to higher seed yields. The efficacy of Mahalaabh at higher doses further underscores its potential in optimizing nutrient use efficiency and boosting crop productivity.These results are in consonance with the findings of Vaghasia*et al*. (2019) who have also reported a conspicuous impact of potassic fertilizers in castor with yield enhancement. Adequate potassium supply increases seed yield, oil content and oil yield (Sagare and Singh, 1988).Munir*et al*., (2007) also reported that seed

yield, oil content and oil yield improve when sufficient magnesium is applied. Adequate applicationof sulphur enhances seed formation, seed weight and yield (Munir *et al*., 2007).

Effect of Potassium Schoenite on Cotton

The data on various treatments indicated that there are no significant differences in the growth and yield parameters of cotton. However, treatments included combinations of recommended fertilizer doses (RFD) supplemented with different doses of potassium schoenite applied either through drip irrigation or as foliar sprays gave numerically higher yields than RFD alone. Mahalaabh Powder was more efficient at lower doses. T1 (RFD + Mahalaabh Powder 6 kg/acre) and T4 (RFD + MLP 10g/L) applied at 30-35 DAS and 50-55 DAS emerged as the best doses in the drip and foliar application categories, respectively (Table 2). These treatments resulted in 3.8% and 5.3% higher seed cotton yield compared to the recommended fertilizer dose (1090 kg/acre). In both cases, the seed cotton yield enhancements were attributed to an increase in the number of monopodial branches per plant and the number of bolls per plant. These results underscore the importance of balanced nutrient management and application methods in maximizing cotton yield.This might be due to Potassium directly impacts yield by supporting processes like photosynthesis, protein synthesis, and carbohydrate metabolism, which are crucial for biomass production and development of cotton.Similar results have been reported by Read *et al*. (2006) and Jyothi and Hebsur (2018). Pettigrew (2008) reported that potassium (K) plays a crucial role in enhancing cotton yield and fibre quality;also increases boll weight, boll number and lint percentage.Magnesium (Mg) improves boll retention, boll weight and lint yield (Safaya, 1976). Similarly, adequate sulphur supply enhances boll development, boll weight and lint yield (Rasheed*et al*., 2006).

Effect of Potassium Schoenite on Groundnut

In groundnut, foliar sprays of Mahalaabh were more effective than its application through drip irrigation. Specifically, the treatment involving the recommended fertilizer dose (RFD) along with Mahalaabh powder at the rate of 15 g/L sprayed thrice at 30-35, 50-55 and 70-75 days after sowing (DAS), resulted in a 22.9% higher pod yield compared to RFD alone (722 kg/acre). Furthermore, among the seed yield components, the seed index that reflects seed weight showed a substantial improvement (43.05 g). Thus, foliar sprays of Mahalaabh powder are quite effective in enhancing groundnut pod yield. It might be due to direct and immediate nutrient uptake by the leaves by foliar application, enhancing photosynthesis and nutrient translocation, which results in higher pod yield and improved seed weight.These findings are in consonance with the findings of Chandra*et al*. (2006), Hemeid(2015) and Borah*et al*. (2017).Veeramani*et al*., (2012) reported that potassium plays a vital role in pod development, kernel filling and yield in groundnut. Adequate potassium supply increases pod yield, kernel yield and shelling percentage(Raj*et al*., 2004). Magnesium is crucial for improving pod yield, kernel yield and oil content (Sharavathi*et al*., 2019). Sulphurplays a conspicuous role in enhancing pod formation, kernel development and yield (Jena*et al*., 2006).

Conclusion

It can be concluded from the present study that Mahalaabh powder is quite effective in enhancing productivity across crops. In castor, higher doses of 10 kg/acre through drip and

20g/L foliar application were effective in increasing productivity by 22.3% and 14.3% over RFD, respectively. However, in cotton, lower doses of 6kg/acre through drip and 10g/L through foliar were more effective and resulted in 3.8% and 5.3% yield enhancements compared to RFD. In groundnut, only foliar spray at 15 g/L sprayed thrice (30-35, 50-55 and 70-75 DAS) was effective, resulting in a 22.9% higher pod yield compared to RFD. These findings underscore the importance of crop specific customised nutrient management practices tailored to specific crop requirements for achieving optimal agricultural productivity.

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Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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Table 1. Impact of potassium schoenite (Mahalaabh) on growth, yield and yield attributing characters of castor.

Tr. No.	Treatment details	Plant population /acre	Days to flowering	spike length (cm)	spike/plant	capsule/spike	Seed index (g)	seed yield (kg/acre)
T1	RFD + MLP 6 kg/acre at 40-50& 100-110 DAS through Drip	3629	61.00	70.47	10.13	109.13	30.66	1029
T2	RFD + MLP 8 kg/acre at 40-50 & 100-110 DAS through Drip	3693	61.33	71.93	11.20	109.20	30.73	1050
T3	RFD + MLP 10 kg/acre at 40-50 & 100-110 DAS through Drip	3693	62.00	71.40	11.87	115.87	31.44	1070
T4	RFD + MLP 10 g/L at 40-50 &100-110 DAS as foliar	3757	61.33	68.27	9.87	98.80	30.19	913
T5	RFD + MLP 15 g/L at 40-50 & 100-110 DAS as foliar	3725	63.00	71.20	9.93	99.87	30.40	973
T6	RFD + MLP 20 g/L at 40-50 & 100-110 DAS as foliar	3725	63.33	69.80	10.07	107.00	30.33	1000
T7	RFD + K-mag 50 kg/acre as basal	3757	62.33	70.47	9.60	102.13	29.93	945
T8	RFD + Mahalaabh Gr. 50 kg/acre as basal	3629	61.67	67.87	10.80	111.93	31.03	1056
T9	RFD (72:16:00:08 kg NPKS/Acre)	3661	62.67	63.87	9.47	97.67	30.11	875
S.Em.±		72.00	0.83	2.36	0.61	3.59	0.32	125.76
CD at 5%		NS	NS	NS	NS	10.77	NS	NS
CV %		3.37	2.31	5.89	10.17	5.88	1.80	12.00

Table 2. Impact of potassium schoenite (Mahalaabh) on growth, yield and yield attributing characters of cotton.

Tr. No.	Treatment details	Plant height (cm)	No. of bolls/ plant	No. monopodial branch/plant	No. sympodial branch/plant	Wt. of seed cotton per boll (g)	Wt. of seed cotton per plant (g/pl.)	seed cotton yield (kg/acre)
T1	RFD + MLP 6 kg/acre at 30-35 & 50-55 DAS through Drip	109.73	40.33	2.40	12.20	3.81	155.40	1131
T2	RFD + MLP 8 kg/acre at 30-35 & 50-55 DAS through Drip	94.27	35.20	1.67	13.00	4.25	140.87	1097
T3	RFD + MLP 12.5 kg/acre at 30-35 & 50-55 DAS through Drip	96.27	33.53	2.00	11.93	4.24	123.93	1046
T4	RFD + MLP 10 g/L at 30-35 & 50-55 DAS as foliar	102.20	39.67	2.27	12.87	4.73	163.07	1148
T5	RFD + MLP 15 g/L at 30-35 & 50-55 DAS as foliar	101.80	33.73	2.00	11.47	4.25	150.80	1085
T6	RFD + MLP 20 g/L at 30-35 & 50-55 DAS as foliar	110.27	33.53	2.13	12.53	4.52	142.13	1082
T7	RFD + K-mag 25 kg/acre as basal	104.53	44.53	2.40	11.13	3.76	169.33	1210
T8	RFD + Mahalaabh Gr. 25 kg/acre as basal	94.73	34.53	1.47	12.60	4.03	148.13	962
T9	RFD (80:16:00:26 kg NPKS/Acre)	98.00	38.13	2.33	12.47	4.12	152.20	1090
S.Em. ±		4.74	3.36	0.32	0.62	0.28	13.44	74.36
CD at 5%		NS	NS	NS	NS	NS	NS	NS
CV %		8.10	13.74	12.86	8.74	11.51	12.57	11.77

Table 3. Impact of potassium schoenite (Mahalaabh) on growth, yield and yield attributing characters of groundnut.

Tr. No.	Treatment details	Plant height (cm)	Days to flowering	No. of pods/ plant	No. of seeds/ pod	Seed index (g)	Pod yield (kg/acre)	Shelling %
T1	RFD + MLP 10 g/L at 30-35 & 50-55 DAS as foliar	30.67	32.67	12.27	1.87	41.91	788	63.61
T2	RFD + MLP 10 g/L at 30-35, 50-55 & 70-75 DAS as foliar	30.20	32.00	14.87	1.80	41.53	660	56.21
T3	RFD + MLP 15 g/L at 30-35 & 50-55 DAS as foliar	30.67	29.33	18.13	1.87	41.93	831	69.01
T4	RFD + MLP 15 g/L at 30-35, 50-55 & 70-75 DAS as foliar	30.53	31.67	16.40	1.87	43.05	887	61.74
T5	RFD + MLP 6 kg/acre at 30-35 & 50-55 DAS through Drip	29.13	32.33	16.93	1.80	40.83	725	65.67
T6	RFD + MLP 8 kg/acre at 30-35 & 50-55 DAS through Drip	29.93	34.67	17.07	1.87	40.37	555	57.93
T7	RFD + K-mag 25 kg/acre as basal	29.47	34.00	15.53	1.67	40.78	644	68.32
T8	RFD + Mahalaabh Gr. 25 kg/acre as basal	29.20	31.67	15.13	1.87	41.80	718	65.06
T9	RFD (05:10:12:00 kg NPKS/Acre)	29.87	32.67	13.80	1.93	41.35	722	64.14
S.Em.±		0.88	1.18	1.47	0.12	1.58	84.69	5.29
CD at 5%		NS	NS	NS	NS	NS	NS	NS
CV %		5.07	6.30	10.39	11.09	6.60	12.22	9.43

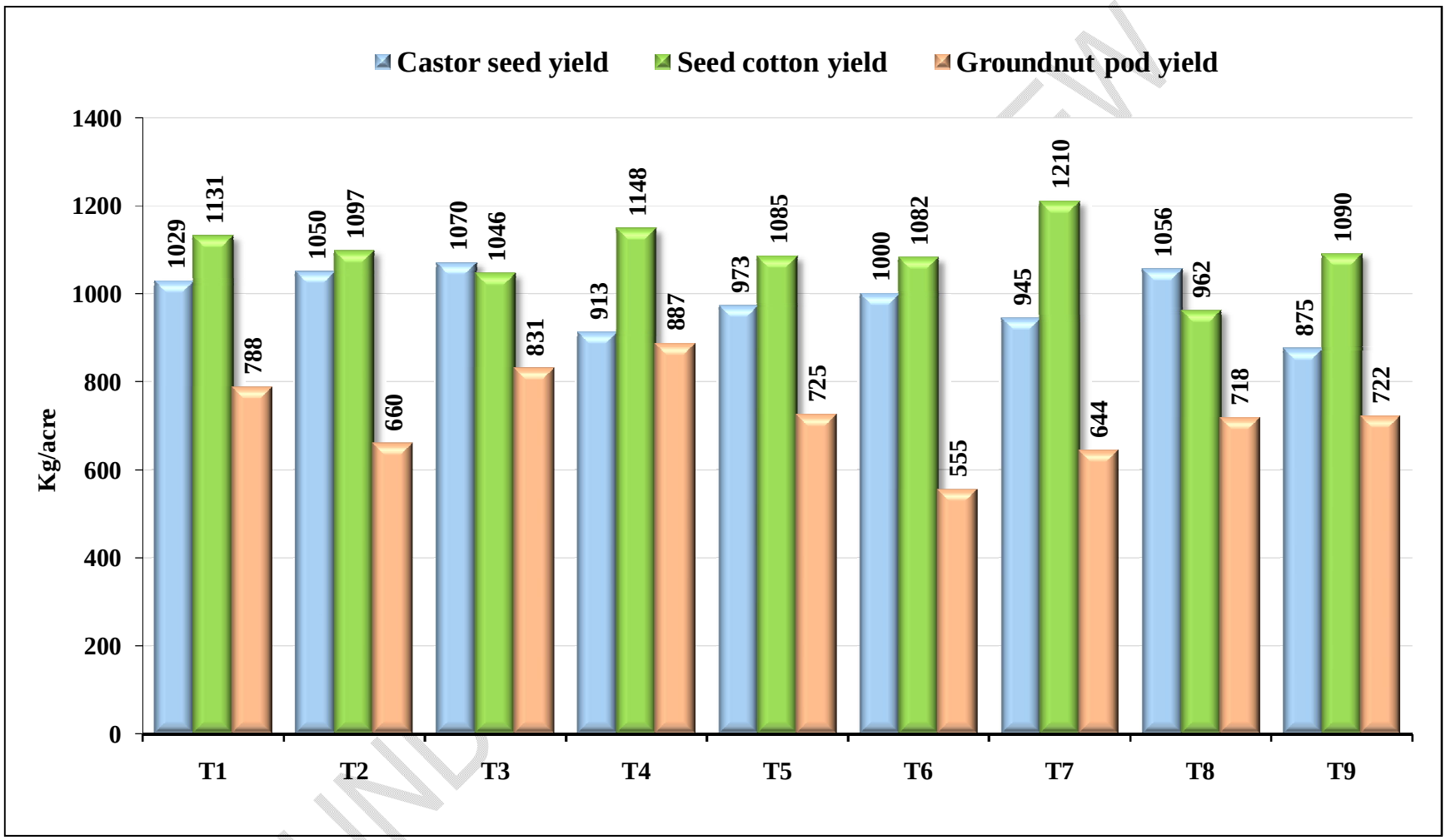

Figure 1: Effect of different Mahalaabh treatments on castor seed yield, seed cotton yield and groundnut pod yield.