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Influence of Phosphorus and Sulphur Application oon Nutrient Content and Uptake by Sesamum in High Phosphorus Soils of Telangana

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ABSTRACT

A pot culture experiment was conducted on "Influence of Phosphorus and Sulphur Application on Nutrient Content and Uptake by Sesamum in High Phosphorus soils of Telangana". In this experiment, two high phosphorus status soils were selected consisting of 67.29 kg P2O5 ha^{-1} and 83.46 kg P2O5 ha-1. Treatments mainly include five levels of phosphorus (P0-0, P1- 5, P2-10, P3-15 & P4-20 kg ha-1 of soil) and four levels of sulphur (S0-0, S1-10, S2-20 & S3-30 kg ha-1 of soil) and it was conducted factorial completely randomized design. Results indicated that a significant increase in nutrient content and uptake by sesamum crop could be achieved by combined application of 15 kg P2O5 ha^{-1} (75 % RDP) + 20 kg S ha^{-1} in both high available phosphorus soils. Among the various treatments tested, the highest nutrient content and uptake by sesamum crop was recorded with a combined application of 75 per cent RDP (15 kg P2O5 ha^{-1}) + 20 kg S ha^{-1} in soil 1 and 50 per cent RDP (10 kg P2O5 ha^{-1}) + 20 kg S ha^{-1} in soil 2.

Keywords: *Sesamum, high P soil, nitrogen, phosphorus, potassium, and sulphur content and their uptake*

INTRODUCTION

In intensively cultivated areas, the indiscriminate application of phosphorus was leading to phosphorus accumulation in the top layers of soil. In some studies, it was revealed that at high phosphorus status in soils, the recommended dose of phosphorus can be reduced without any reduction in the economic yield of the crop. It was observed that P dose could be skipped in either of any crop or reduced to 50 per cent under the rice-wheat sequence, if the soil contains high available phosphorus [7]. Reduced P application by 25-50 per-cent from the current RDP in high P soils is reported to be a possible saving measure without sacrificing the yields in crops like rice, sunflower and in rice-rice and rice-sunflower-cropping sequences [1; 12; 18 and 22].

Sulphur plays a key role in plant metabolism, synthesis of essential oils, chlorophyll formation, and development of cells. It also increases cold resistance and drought hardiness of oilseed crops. Use of sulphur free fertilizers, heavy sulphur removal by the crops under intensive cultivation and neglect of sulphur replenishment contributed to widespread sulphur deficiencies in arable soils. In recent years sulphur has become one of the major limiting nutrients for oilseeds. In crop sequences involving oilseeds, sulphur application was found to be profitable.

In Telangana State, the occurrence of high- P soils as evidenced by the recording of > 70 per-cent of soils having high P status. Thus, in intensively cultivated areas where fertilizer use has been rampant, the reports of high P soils are coming into light.

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Recent reports indicated that more than 80 per-cent of soils in Nizamabad, Kamareddy, Rajanna Siricilla, Karimnagar, Siddipet, Jagtiyal and Peddapalli districts of Telangana state have high P soils. Hence, the above study was conducted as there was little information on the impact of various sulphur levels on sesamum grown in high P soils.

MATERIALS and METHODS

Initially, soils were screened for available phosphorus in and around Ranga Reddy district. Based on available phosphorus status, two soils were selected for conducting pot culture experiment S1 (67.29 kg P2O5 ha^{-1}) and S2 (83.46 kg P2O5 ha^{-1}). In the above- selected soils (S_1 and S_2) pot culture experiment was conducted with sesamum as test crop (JCS 1020) during summer 2022-23 at the Agricultural Research Institute, Rajendranagar and Hyderabad. Initial soil characteristics of the experimental soil was done by following standard procedures and are presented in table 1.

Treatments mainly comprise of five levels of phosphorus (P0-0, P_1- 5, P_2-10, P_3-15 and P_4-20 kg P2O5 ha^{-1} of soil), four levels of sulphur (S_0-0, S_1-$_1$0, S_2-20 and S_3-30 kg S ha^{-1} of soil) with a total of twenty treatmental combinations with four replications laid out in Factorial Completely Randomized Design. The recommended dose of fertilizers for sesamum is 60-20-20 kg N, P2O5 & K2O ha-^{1}. Nitrogen, phosphorus, potassium and sulphur nutrient requirements were met through Urea, diammonium hydrogen phosphate, potassium chloride and potassium sulphate respectively. Entire dose of phosphorus, potassium and sulphur were applied as basally for all the pots as per the treatments while fifty percent of nitrogen was applied as basal. The remaining fifty percent of nitrogen was applied at 30 DAS. All the prophylactic plant protection measures were adopted as and when needed during the crop growth period. Statistical analysis was carried out as per the procedures [16].

Table 1 Physico-chemical and chemical properties of the experimental soil Particulars

Soil parameters	Soil (S_1)	Soil (S_2)
Textural class	Sandy clay loam	Sandy clay loam
Soil reaction (pH)	7.52	7.68
Electrical conductivity (dS $m^{-1)}$	0.36	0.28
Organic carbon (g kg^{-1})	2.1	2.5
Available nitrogen (kg N ha^{-1})	151	157
Available phosphorus (kg P_2O_5 ha^{-1})	67.29	83.46
Available potassium (kg K_2O ha^{-1})	386	394
Available sulphur (mg S kg^{-1})	16	18

RESULTS AND DISCUSSION

Effect of different levels of phosphorus and sulphur on nitrogen content and uptake by sesamum seed

Phosphorus application at varied levels has significantly influenced the nitrogen content of sesamum seed in high native phosphorus status soils and was tabulated in Tables 2 and 3. Maximum nitrogen content (3.69 per cent) and uptake (424 mg pot^{-1}) by sesamum seed was recorded in treatment receiving P_{100} (20 kg P_2O_5 ha^{-1}) but it was statistically on par with P_{75} (3.65 per cent and 416 mg pot^{-1}). In high native phosphorus soils, improvement in the nitrogen content of sesamum seed was not significantly influenced when phosphorus application was raised from P_{75} to P_{100}. Phosphorus application has raised the seed nitrogen content and uptake in high native phosphorus status soils due to the fact that phosphorus stimulates the early development of root growth which in turn might have facilitated efficient utilization of nutrients from deeper layers of soil. The above findings were in concurrence [5] and [23] in low to medium P- status soils. In high native phosphorus status soils also, similar results were seen.

Among various sulphur levels, treatment receiving S_{30} (30 kg S ha^{-1}) has recorded significantly highest nitrogen content (3.57 per-cent) and uptake (407 mg pot^{-1}) in seed over other sulphur doses but at par with S_{20} (3.55 per-cent and 401 mg pot^{-1}).

Sulphur application might have resulted in profuse vegetative and root growth, thereby activating the absorption of nutrients, which in turn enhanced nutrients concentration and dry matter accumulation. Similar findings were reported [19] and [17]. From the above findings we can conclude that the crop requires sufficient amounts of phosphorus along with sulphur to meet the crop requirements in high P soils.

A significant interaction effect was observed between different doses of phosphorus and sulphur on nitrogen content and uptake by sesamum seed in high P soils. The highest nitrogen content (3.84 per cent) in sesamum seed was seen in the treatment receiving P_{100} S_{30} (20 kg P_2O_5 ha^{-1} + 30 kg S ha^{-1}) and it is on par with the

treatments receiving P_{100} either with S_{20} or S_{10} and P_{75} either with S_{30} or S_{20} or S_{10} respectively. It was opined that there was the synergistic effect of phosphorus and sulphur on nitrogen uptake by sesamum seed at lower levels of application (13).

The overall interaction between soils, phosphorus, and suphur was found to be statistically significant. Maximum nitrogen (3.76 per cent) content was attained in the treatments receiving the combined application of P_{100} @ 20 kg P_2O_5 ha^{-1} and sulphur (30 kg S ha^{-1}) but on par with treatments P_{100} S_{20}, P_{100} S_{10}, P_{75} S_{30}, P_{75} S_{20} and P_{75} S_{10} in soils pertaining to S_1 (67.29 kg P_2O_5 ha^{-1}). In S_2 soils (83.46 kg P_2O_5 ha^{-1}), seed nitrogen content in sesamum was highest (3.92 per cent) in treatment applied with P_{100} @ 20 kg P_2O_5 ha^{-1} and sulphur (30 kg S ha^{-1}) but at par with $P_{100}S_{20}$, P_{100} S_{10}, $P_{75}S_{30}$, $P_{75}S_{20}$, $P_{75}S_{10}$, $P_{50}S_{30}$ and $P_{50}S_{20}$.

Effect of different levels of P and S on nitrogen content and uptake by sesamum stalk

Nitrogen content and uptake by sesamum stalk were significantly influenced by phosphorus application in high native phosphorus status soils and given in Tables 4 and 5. The highest nitrogen content (1.49 per-cent) and uptake (322 mg pot^{-1}) by sesamum stalk was recorded in the treatment receiving P_{100} (20 kg P_2O_5 ha^{-1}) but it is statistically on par with P_{75} (1.47 per cent & 316 mg pot^{-1}). Among various sulphur levels, treatment receiving S_{30} (30 kg S ha^{-1}) has recorded significantly highest nitrogen content (1.46 per-cent) and uptake (314 mg pot^{-1}) by stalk over other sulphur doses but at par with S_{20} (1.43 per-cent and 304 mg pot^{-1}).

A significant interaction effect was observed between different doses of phosphorus and sulphur on nitrogen content and uptake by sesamum stalk in high P soils. The highest nitrogen content 1.58 per-cent and uptake 348 mg pot^{-1} by stalk was recorded in $P_{100}S_{30}$ (20 kg P_2O_5 ha^{-1} & 30 kg S ha^{-1}) but on par with $P_{75}S_{20}$.

Interaction effect among two selected soils, phosphorus and sulphur on the nitrogen content of sesamum stalk was found to be statistically significant. In both S_1 (67.29 kg P_2O_5 ha^{-1}) & S_2 (83.46 kg P_2O_5 ha^{-1}) soils, highest nitrogen content (1.55 & 1.60 per cent) in sesamum stalk was noted in the $P_{100}S_{30}$ combination. Phosphorus application has significantly raised the nitrogen content in sesamum stalk [5] and [23].

Effect of different levels of P and S on phosphorus content and uptake by sesamum seed

Phosphorus application has significantly influenced phosphorus content in sesamum seed in high native phosphorus status soils as presented in table 6 and 7. Maximum phosphorus content (0.46 per cent) and uptake (53 mg pot^{-1}) by sesamum seed was recorded with the treatment receiving P_{100} (20 kg P_2O_5 ha^{-1}) but on par with P_{75}. It might be due to the availability of more phosphorus in the initial stages which might have led to stronger root growth. As the root growth was amplified more phosphorus was absorbed from soil and resulted in increased phosphorus content in seed. The above findings are in accordance with [23].

Phosphorus content and uptake by sesamum seed was significantly increased with application of varied sulphur levels. Sulphur applied @ 30 kg S ha^{-1} has recorded significantly higher phosphorus content (0.43 per cent) and uptake (49 mg pot^{-1}) by sesamum seed but on par with S_{20} (0.41 per-cent and 46 mg pot^{-1}). [26] observed that phosphorus content in sesamum seed was increased with the addition of sulphur. It may be due to the mobilization of soil phosphorus into an accessible form by the action of the acid produced due to the application of sulphur. It resulted in the availability of more phosphorus in soil and later more absorption. An enhancement in phosphorus uptake with sulphur addition was reported in sunflower [10]. Similar findings were also accorded by [14] in sesamum at low and medium P-status soils.

A significant interaction was observed between phosphorus and sulphur on phosphorus content and uptake by sesamum seed. The highest phosphorus content (0.49 per cent) and uptake (59 mg pot^{-1}) by sesamum seed was recorded in the treatmental combination of $P_{100}S_{30}$ which is on par with P_{100} S_{20}, $P_{75}S_{30}$ and P_{75} S_{20}. Synergistic interaction was seen between phosphorus and sulphur on phosphorus content and uptake in toria crop at lower levels of application [4]. Similarly, [13] and [8] has reported phosphorus uptake was enhanced with combined application of phosphorus and sulphur in soybean.

The interaction impact between phosphorus, sulphur, and two high P soils on phosphorus concentration of sesame seed was found to be statistically significant. Maximum phosphorus content (0.47 per-cent) in sesamum seed was attained in the treatment combination $P_{100}S_{30}$ which is on par with $P_{100}S_{20}$, $P_{75}S_{30}$, and $P_{75}S_{20}$ in soils.

Effect of different levels of P and S on phosphorus content and uptake by sesamum stalk

Different levels of phosphorus application have significantly influenced phosphorus content and uptake by sesamum stalk in high native phosphorus status soils as shown in Table 8 and 9. The highest phosphorus content (0.31 per-cent) and uptake (66 mg pot^{-1}) by sesamum stalk was recorded in treatment receiving P_{100}
(20 kg P_2O_5 ha^{-1}) but it was found to be at par with treatment receiving phosphorus application @ 15 kg P_2O_5 ha^{-1}.

Phosphorus content and uptake by sesamum stalk were significantly increased with varied sulphur levels. Application of sulphur @ 30 kg S ha^{-1} has recorded significantly higher phosphorus content (0.28 per-cent) and uptake (60 mg pot^{-1}) by sesamum stalk but on par with S_{20} while the lowest phosphorus content and uptake by sesamum stalk were seen in control.

Significant interaction between phosphorus and sulphur doses was observed on phosphorus content and uptake by sesamum stalk. Highest phosphorus content (0.33 per-cent) and uptake (73 mg pot^{-1}) by sesamum stalk was recorded in the treatmental combination of $P_{100}S_{30}$ which is on par with P_{100} S_{20}, $P_{75}S_{30}$ and P_{75} S_{20}.

Interaction impact of high P soils, phosphorus and sulphur on phosphorus concentration and uptake by sesamum stalk was found to be statistically significant. In Sunflower [1] phosphorus contents in plant parts were boosted in high native phosphorus status soils. Similar findings were also observed in soybeans [11]. They have also opined that significant enhancement in phosphorus content in both seed and stover might be due to increased root growth which in turn intensified roots foraging capacity and allowed them to absorb more of less mobile phosphorus. Phosphorus application in high P soils has elevated phosphorus uptake by sesamum [20] and [9]. The availability of more solution phosphorus in soils might have led to increased phosphorus content in plant parts in high P soils.

Effect of different levels of P and S on potassium content and uptake by sesamum seed

Potassium content and uptake by sesamum seed were not influenced by various doses of phosphorus in high inherent phosphorus status soils and was given in Table 10 and 11. The overall potassium content in sesamum seed was extended from 0.84 to 0.96 per cent with the average value of 0.91 per cent. Potassium uptake by sesamum seed increased significantly raised with phosphorus application from control (P_0) to 5 kg P_2O_5 ha^{-1} (P_{25}) while higher doses of phosphorus application had resulted in a non-significant increase. Potassium uptake by sesamum seed was ranged between 84 to 111 mg pot^{-1} with a mean of 100 mg pot^{-1}.

Potassium content and uptake by sesamum seed were significantly increased with increasing sulphur levels from 10 to 30 kg S ha^{-1}. Significantly higher potassium content (0.97 per cent) and uptake (110 mg pot^{-1}) by sesamum seed was seen in S_{30} (30 kg S ha^{-1}) treatment but at par with 20 kg S ha^{-1}. The interaction effect of phosphorus and sulphur on potassium content and uptake by sesamum seed was found to be statistically significant.

The treatment receiving $P_{100}S_{30}$ has attained the highest potassium content (1.03 per-cent) and uptake (124 mg pot^{-1}) by sesamum seed but on par with $P_{100}S_{20}$, $P_{75}S_{30}$ and $P_{75}S_{20}$. The interaction effect of phosphorus, sulphur, and two high P soils was found to be statistically significant on potassium content of sesamum seed.

Effect of different levels of P and S on potassium content and uptake by sesamum stalk

Application of phosphorus in various amounts had a non-significant influence on potassium content in sesamum stalk in high native available phosphorus status soils (Tables 12 and 13). Potassium uptake by the sesamum stalk was significantly increased from 278 to 309 mg pot^{-1} as the phosphorus dose was enhanced from P_0 (control) to P_{25} (5 kg P_2O_5 ha^{-1}) while at higher doses of phosphorus had a non-significant influence. Similarly, sulphur application also not significantly influence the potassium content in sesamum stalk. Application of S_{10} (10 kg S ha^{-1}) sulphur recorded significantly higher potassium uptake by sesamum stalk (311 mg pot^{-1}) compared to control with 285 mg pot^{-1} while at higher doses of sulphur there was the non-significant effect on potassium uptake by sesamum stalk.

Interaction between different levels of phosphorus and sulphur on potassium content in sesamum stalk was found to be statistically non-significant. Maximum potassium content (1.63 per cent) in sesamum stalk with combined application of $P_{100}S_{30}$ but on par with all other combinations in this study. The interaction effect has shown statistically significant results on potassium uptake by sesamum stalk. The highest potassium uptake (360 mg pot^{-1}) by sesamum stalk was obtained with combined application of $P_{100}S_{30}$. Positive enhancement in potassium uptake by sesamum with phosphorus application to the crop [2]. Increase in uptake of potassium by seed and stalk with sulphur might be due to differences in yield at various levels. Similar findings were also observed by [17] and [23].

Effect of different levels of P and S on sulphur content and uptake by sesamum seed

Application of phosphorus in various levels has significantly influenced the sulphur content and uptake by sesamum seed and is given in Tables 14 and 15. The highest sulphur content (0.40 per cent) and uptake (46
mg pot^{-1}) by sesamum seed was recorded in the treatment receiving P_{100} (20 kg P_2O_5 ha^{-1}) but it was at par with P_{75} treatment. Sulphur content and uptake by sesamum seed was significantly improved with increasing sulphur levels. Sulphur applied treatment S_{30} (30 kg S ha^{-1}) has recorded significantly higher sulphur content (0.38 per cent) and uptake (43 mg pot^{-1}) by sesamum seed but on par with S_{20} treatment while the lowest sulphur content and uptake was seen in control.

Application of varied levels of phosphorus and sulphur has shown a significant interaction effect on sulphur content and uptake by sesamum seed. Maximum sulphur content (0.43 per cent) and uptake (52 mg pot^{-1}) by sesamum seed was attained in the treatment receiving P_{100} S_{30} while it was on par with the treatments $P_{100}S_{20}$, $P_{100}S_{10}$, $P_{75}S_{30}$ and $P_{75}S_{20}$ respectively.

Interaction among phosphorus, sulphur, and soils selected was found to be statistically significant on sulphur content and uptake by sesame seed. Improvement in sulphur concentration with phosphorus application was also reported by [6] and [24] in sesamum. According to the above workers sulphur uptake was increased due to synergistic interaction between phosphorus and sulphur.

Higher availability of sulphur at higher concentrations has resulted in rapid absorption due to its high mobility. It may also be attributed to desorption of sulphate from the exchange complex by phosphate ions, which increased the concentration of sulphate in the soil solution and made easy absorption of sulphur. Phosphorus and sulphur had shown the synergistic effect on these two elements at lower levels of application [8]. Similar trend was observed in high P soils.

Effect of different levels of P and S on sulphur content and uptake by sesamum stalk

Phosphorus applied in various doses has significantly influenced the sulphur content and uptake by sesamum stalk in high phosphorus status soils (Table 16 and 17). The highest sulphur content (0.18 per cent) and uptake (38 mg pot^{-1}) by sesamum stalk was recorded with the treatment receiving 20 kg P_2O_5 ha^{-1} but on par with P_{75}.

Sulphur content and uptake by sesamum stalk was significantly increased as the sulphur dose was raised from 0 to 30 kg S ha^{-1}. Sulphur application @ 30 kg S ha^{-1} has recorded significantly higher sulphur content (0.17 per cent) and uptake (37 mg pot^{-1}) by sesamum stalk but on par with S_{20}. Phosphorus and sulphur had shown statistically significant interaction on sulphur content and uptake by sesamum stalk. Highest sulphur content (0.20 per cent) and uptake (43 mg pot^{-1}) by sesamum stalk was recorded in $P_{100}S_{30}$ (20 kg P_2O_5 ha^{-1} + 30 kg S ha^{-1}) but on par with $P_{100}S_{20}$, $P_{75}S_{30}$, $P_{75}S_{20}$ and $P_{50}S_{30}$.

Sulphur uptake in sesamum stalk has followed a similar trend as that of sulphur content. The increase in sulphate uptake may be attributed partially because of priming impact of nutrients. These results are corroborated with the findings of [3], [15] and [25] in non-high P soil, the present investigation with high P soil has also shown a similar trend.

CONCLUSION

In the above experiment, we can conclude that sesamum yield can be enhanced through combined application of phosphorus and sulphur. Synergistic effect of phosphorus and sulphur was seen on sesamum seed yield. The optimum doses of phosphorus and sulphur needed to obtain higher sesamum yields, nutrient content and uptake in high P soils was $P_{75}S_{20}$ (15 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}) and $P_{50}S_{20}$ (10 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}).

Future Scope of Study

The amount of phosphorus and sulphur required to increase sesamum yields in high phosphorus status soils has to be investigated at field level under various climatic conditions. It will enable in saving of phosphorus fertilizer in high phosphorus status soils (>150 kg P_2O_5 ha^{-1}).

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Table 2: Effect of different levels of P and S on nitrogen content (%) of sesamum seed in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	**S_0 (Control)**	**S_{10} (10 kg S ha^{-1})**	**S_{20} (20 kg S ha^{-1})**	**S_{30} (30 kg S ha^{-1})**	**Mean**	**S_0 (Control)**	**S_{10} (10 kg S ha^{-1})**	**S_{20} (20 kg S ha^{-1})**	**S_{30} (30 kg S ha^{-1})**	**Mean**	**Grand Mean**
P_0 (Control)	2.91	3.05	3.20	3.24	3.10	3.00	3.11	3.23	3.30	3.16	3.13
P_{25} (5 kg P_2O_5 ha^{-1})	3.07	3.16	3.27	3.30	3.20	3.13	3.26	3.47	3.49	3.34	3.27
P_{50} (10 kg P_2O_5 ha^{-1})	3.14	3.23	3.39	3.40	3.29	3.36	3.54	3.69	3.72	3.58	3.43
P_{75} (15 kg P_2O_5 ha^{-1})	3.35	3.54	3.70	3.72	3.58	3.47	3.70	3.86	3.87	3.73	3.65
P_{100} (20 kg P_2O_5 ha^{-1})	3.41	3.58	3.74	3.76	3.62	3.52	3.72	3.90	3.92	3.77	3.69
Mean	3.18	3.31	3.46	3.48	3.36	3.30	3.47	3.63	3.66	3.51	3.44

2 Factor Tables													
	S_0	**S_{10}**	**S_{20}**	**S_{30}**	**Mean**		**Soil 1**	**Soil 2**	**Mean**		**Soil 1**	**Soil 2**	**Mean**
P_0	2.96	3.08	3.22	3.27	3.13	**P_0**	3.10	3.16	3.13	**S_0**	3.18	3.30	3.24
P_{25}	3.10	3.21	3.37	3.40	3.27	**P_{25}**	3.20	3.34	3.27	**S_{10}**	3.31	3.47	3.39
P_{50}	3.25	3.39	3.54	3.56	3.43	**P_{50}**	3.29	3.58	3.43	**S_{20}**	3.46	3.63	3.55
P_{75}	3.41	3.62	3.78	3.80	3.65	**P_{75}**	3.58	3.73	3.65	**S_{30}**	3.48	3.66	3.57
P_{100}	3.47	3.65	3.82	3.84	3.69	**P_{100}**	3.62	3.77	3.69	**Mean**	3.36	3.51	3.44
Mean	3.24	3.39	3.55	3.57	3.44	**Mean**	3.36	3.51	3.44		**S**	**Soil**	**S X Soil**
	P	**S**	**P X S**				**P**	**Soil**	**P X Soil**	**SEm(±)**	0.063	0.054	0.081
SEm(±)	0.090	0.063	0.112			**SEm(±)**	0.090	0.054	0.094	**CD (P=0.05)**	0.14	0.12	0.18
CD (P=0.05)	0.20	0.14	0.25			**CD (P=0.05)**	0.20	0.12	0.21	**Soil X P X S:SEm(±):** 0.126			**CD (P=0.05):** 0.28

Table 3. Effect of different levels of P and S on nitrogen uptake (mg pot^{-1}) by sesamum seed in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	273	303	327	333	309	285	315	331	342	318	314
P_{25} (5 kg P_2O_5 ha^{-1})	312	334	350	356	338	313	350	375	382	355	347
P_{50} (10 kg P_2O_5 ha^{-1})	331	349	370	379	358	349	387	440	446	405	382
P_{75} (15 kg P_2O_5 ha^{-1})	356	388	440	444	407	365	413	462	465	426	416
P_{100} (20 kg P_2O_5 ha^{-1})	363	399	447	451	415	373	420	468	472	433	424
Mean	327	355	387	393	365	337	377	415	421	388	376

2 Factor Tables												
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	279	309	329	338	314	P_0	309	318	314	S_0	327	337	332
P_{25}	312	342	363	369	347	P_{25}	338	355	347	S_{10}	355	377	366
P_{50}	340	368	405	413	382	P_{50}	358	405	382	S_{20}	387	415	401
P_{75}	360	400	451	454	416	P_{75}	407	426	416	S_{30}	393	421	407
P_{100}	368	410	458	462	424	P_{100}	415	433	424	Mean	366	386	376
Mean	332	366	401	407	376	Mean	365	388	376		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	10.91	9.07	17.05
SEm(±)	11.71	10.91	20.10			SEm(±)	11.71	9.07	18.40	CD (P=0.05)	24.22	20.14	38.20
CD (P=0.05)	26.12	24.22	45.02			CD (P=0.05)	26.12	20.14	41.22	Soil X P X S:SEm(±): 22.84			CD (P=0.05): 51.16

Table 4. Effect of different levels of P and S on nitrogen content (%) of sesamum stalk in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	1.06	1.16	1.26	1.28	1.19	1.10	1.20	1.29	1.37	1.24	1.21
P_{25} (5 kg P_2O_5 ha^{-1})	1.13	1.21	1.33	1.35	1.25	1.14	1.25	1.40	1.42	1.30	1.28
P_{50} (10 kg P_2O_5 ha^{-1})	1.16	1.26	1.36	1.38	1.29	1.27	1.37	1.51	1.53	1.42	1.36
P_{75} (15 kg P_2O_5 ha^{-1})	1.29	1.39	1.51	1.53	1.43	1.41	1.49	1.54	1.59	1.51	1.47
P_{100} (20 kg P_2O_5 ha^{-1})	1.31	1.41	1.53	1.55	1.45	1.43	1.51	1.55	1.60	1.52	1.49
Mean	1.19	1.28	1.40	1.42	1.32	1.27	1.36	1.46	1.50	1.40	1.36

2 Factor Tables												
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	1.08	1.18	1.27	1.32	1.21	P_0	1.19	1.24	1.21	S_0	1.19	1.27	1.23
P_{25}	1.13	1.23	1.37	1.38	1.28	P_{25}	1.25	1.30	1.28	S_{10}	1.28	1.36	1.32
P_{50}	1.22	1.31	1.44	1.46	1.36	P_{50}	1.29	1.42	1.36	S_{20}	1.40	1.46	1.43
P_{75}	1.35	1.44	1.52	1.56	1.47	P_{75}	1.43	1.51	1.47	S_{30}	1.42	1.50	1.46
P_{100}	1.37	1.46	1.54	1.58	1.49	P_{100}	1.45	1.52	1.49	Mean	1.32	1.40	1.36
Mean	1.23	1.32	1.43	1.46	1.36	Mean	1.32	1.40	1.36		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	0.041	0.032	0.045
SEm(±)	0.045	0.041	0.067			SEm(±)	0.045	0.032	0.049	CD (P=0.05)	0.09	0.07	0.10
CD (P=0.05)	0.10	0.09	0.15			CD (P=0.05)	0.10	0.07	0.11	Soil X P X S:SEm(±): 0.116			CD (P=0.05): 0.26

Table 5. Effect of different levels of P and S on nitrogen uptake (mg pot^{-1}) by sesamum stalk in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	180	220	241	261	225	190	232	256	280	240	233
P_{25} (5 kg P_2O_5 ha^{-1})	224	244	276	280	256	228	258	295	305	272	264
P_{50} (10 kg P_2O_5 ha^{-1})	231	260	291	297	270	259	288	331	335	303	286
P_{75} (15 kg P_2O_5 ha^{-1})	261	298	331	338	307	289	322	339	352	325	316
P_{100} (20 kg P_2O_5 ha^{-1})	268	307	337	342	313	296	334	342	354	331	322
Mean	233	266	295	303	274	252	287	313	325	294	284

2 Factor Tables												
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	185	226	249	270	233	P_0	225	240	233	S_0	233	252	243
P_{25}	226	251	286	293	264	P_{25}	256	272	264	S_{10}	266	287	276
P_{50}	245	274	311	316	286	P_{50}	270	303	286	S_{20}	295	313	304
P_{75}	275	310	335	345	316	P_{75}	307	325	316	S_{30}	303	325	314
P_{100}	282	320	339	348	322	P_{100}	313	331	322	Mean	274	294	284
Mean	243	276	304	314	284	Mean	274	294	284		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	9.06	7.58	9.50
SEm(±)	10.11	9.06	10.41			SEm(±)	10.11	7.58	9.98	CD (P=0.05)	20.12	16.82	21.12
CD (P=0.05)	22.54	20.12	23.12			CD (P=0.05)	22.54	16.82	22.26	Soil X P X S:SEm(±): 11.71			CD (P=0.05): 26.12

Table 6. Effect of different levels of P and S on phosphorus content (%) of sesamum seed in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	0.16	0.22	0.28	0.29	0.24	0.20	0.27	0.32	0.33	0.28	0.25
P_{25} (5 kg P_2O_5 ha^{-1})	0.30	0.33	0.37	0.40	0.35	0.32	0.35	0.39	0.41	0.37	0.36
P_{50} (10 kg P_2O_5 ha^{-1})	0.35	0.39	0.42	0.43	0.40	0.41	0.43	0.47	0.48	0.45	0.42
P_{75} (15 kg P_2O_5 ha^{-1})	0.39	0.43	0.45	0.47	0.43	0.42	0.46	0.48	0.49	0.46	0.45
P_{100} (20 kg P_2O_5 ha^{-1})	0.40	0.43	0.46	0.47	0.44	0.43	0.46	0.49	0.50	0.47	0.46
Mean	0.32	0.36	0.39	0.41	0.37	0.35	0.39	0.43	0.44	0.40	0.39

2 Factor Tables												
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	0.18	0.25	0.30	0.31	0.25	P_0	0.24	0.28	0.25	S_0	0.32	0.35	0.34
P_{25}	0.31	0.34	0.38	0.40	0.36	P_{25}	0.35	0.37	0.36	S_{10}	0.36	0.39	0.38
P_{50}	0.38	0.41	0.44	0.45	0.42	P_{50}	0.40	0.45	0.42	S_{20}	0.39	0.43	0.41
P_{75}	0.41	0.44	0.46	0.48	0.45	P_{75}	0.43	0.46	0.45	S_{30}	0.41	0.44	0.43
P_{100}	0.42	0.45	0.47	0.49	0.46	P_{100}	0.44	0.47	0.46	Mean	0.37	0.40	0.39
Mean	0.34	0.38	0.41	0.43	0.39	Mean	0.37	0.40	0.39		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	0.009	0.005	0.009
SEm(±)	0.009	0.009	0.013			SEm(±)	0.009	0.005	0.009	CD (P=0.05)	0.02	0.01	0.02
CD (P=0.05)	0.02	0.02	0.03			CD (P=0.05)	0.02	0.01	0.02	Soil X P X S:SEm(±): 0.01			CD (P=0.05):0.03

Table 7. Effect of different levels of P and S on phosphorus uptake (mg pot^{-1}) by sesamum seed in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	13	22	29	30	23	17	28	33	35	28	26
P_{25} (5 kg P_2O_5 ha^{-1})	28	35	39	43	36	31	38	42	44	39	38
P_{50} (10 kg P_2O_5 ha^{-1})	37	43	44	48	43	42	47	56	58	51	47
P_{75} (15 kg P_2O_5 ha^{-1})	42	46	54	57	49	45	51	57	58	53	51
P_{100} (20 kg P_2O_5 ha^{-1})	43	49	55	57	51	46	52	59	60	54	53
Mean	33	39	44	47	41	36	43	49	51	45	43

2 Factor Tables												
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	15	25	31	32	26	P_0	23	28	26	S_0	33	36	34
P_{25}	30	36	41	43	38	P_{25}	36	39	38	S_{10}	39	43	41
P_{50}	39	45	50	53	47	P_{50}	43	51	46	S_{20}	44	49	46
P_{75}	43	48	55	57	51	P_{75}	49	53	51	S_{30}	47	51	49
P_{100}	45	51	57	59	53	P_{100}	51	54	53	Mean	41	45	43
Mean	34	41	46	49	43	Mean	41	45	43		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	1.35	0.91	1.84
SEm(±)	1.61	1.35	2.25			SEm(±)	1.61	0.91	2.23	CD (P=0.05)	3.00	2.02	4.12
CD (P=0.05)	3.58	3.00	5.04			CD (P=0.05)	3.58	2.02	5.00	Soil X P X S:SEm(±): 2.77			CD (P=0.05): 6.16

Table 8. Effect of different levels of P and S on phosphorus content (%) of sesamum stalk in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	0.10	0.15	0.19	0.20	0.16	0.12	0.16	0.20	0.22	0.17	0.16
P_{25} (5 kg P_2O_5 ha^{-1})	0.18	0.21	0.23	0.24	0.21	0.16	0.21	0.25	0.28	0.22	0.22
P_{50} (10 kg P_2O_5 ha^{-1})	0.21	0.24	0.26	0.27	0.24	0.23	0.27	0.30	0.31	0.28	0.26
P_{75} (15 kg P_2O_5 ha^{-1})	0.24	0.29	0.30	0.31	0.28	0.26	0.30	0.32	0.33	0.30	0.29
P_{100} (20 kg P_2O_5 ha^{-1})	0.25	0.30	0.31	0.32	0.29	0.27	0.31	0.33	0.34	0.32	0.31
Mean	0.19	0.23	0.26	0.27	0.24	0.21	0.25	0.28	0.29	0.26	0.25

2 Factor Tables													
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	0.11	0.15	0.19	0.21	0.16	P_0	0.16	0.17	0.16	S_0	0.19	0.21	0.20
P_{25}	0.17	0.21	0.24	0.26	0.22	P_{25}	0.21	0.22	0.22	S_{10}	0.23	0.25	0.24
P_{50}	0.23	0.25	0.28	0.29	0.26	P_{50}	0.24	0.28	0.26	S_{20}	0.26	0.28	0.27
P_{75}	0.26	0.29	0.31	0.32	0.29	P_{75}	0.28	0.30	0.29	S_{30}	0.27	0.29	0.28
P_{100}	0.27	0.31	0.32	0.33	0.31	P_{100}	0.29	0.32	0.31	Mean	0.24	0.26	0.25
Mean	0.20	0.24	0.27	0.28	0.25	Mean	0.24	0.26	0.25		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	0.004	0.004	0.008
SEm(±)	0.009	0.005	0.013			SEm(±)	0.009	0.004	0.013	CD (P=0.05)	0.01	0.01	0.02
CD (P=0.05)	0.02	0.01	0.03			CD (P=0.05)	0.02	0.01	0.03	Soil X P X S:SEm(±): 0.017			CD (P=0.05): 0.04

Table 9. Effect of different levels of P and S on phosphorus uptake (mg pot^{-1}) by sesamum stalk in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	**S_0 (Control)**	**S_{10} (10 kg S ha^{-1})**	**S_{20} (20 kg S ha^{-1})**	**S_{30} (30 kg S ha^{-1})**	**Mean**	**S_0 (Control)**	**S_{10} (10 kg S ha^{-1})**	**S_{20} (20 kg S ha^{-1})**	**S_{30} (30 kg S ha^{-1})**	**Mean**	**Grand Mean**
P_0 (Control)	16	27	36	40	30	20	30	39	44	33	32
P_{25} (5 kg P_2O_5 ha^{-1})	36	41	48	49	43	31	43	52	59	46	45
P_{50} (10 kg P_2O_5 ha^{-1})	42	49	56	58	51	47	57	65	68	60	55
P_{75} (15 kg P_2O_5 ha^{-1})	49	62	66	68	61	53	64	70	72	65	63
P_{100} (20 kg P_2O_5 ha^{-1})	50	65	69	71	64	56	67	73	75	68	66
Mean	39	49	55	57	50	42	52	60	64	54	52

2 Factor Tables												
	S_0	**S_{10}**	**S_{20}**	**S_{30}**	**Mean**		**Soil 1**	**Soil 2**	**Mean**		**Soil 1**	**Soil 2**	**Mean**
P_0	18	29	37	42	32	**P_0**	30	33	32	**S_0**	39	42	40
P_{25}	33	42	50	54	45	**P_{25}**	43	46	45	**S_{10}**	49	52	50
P_{50}	46	53	61	63	55	**P_{50}**	51	60	55	**S_{20}**	55	60	57
P_{75}	52	63	68	70	63	**P_{75}**	61	65	63	**S_{30}**	57	64	60
P_{100}	54	67	71	73	66	**P_{100}**	64	68	66	**Mean**	50	54	52
Mean	40	50	57	60	52	**Mean**	50	54	52		**S**	**Soil**	**S X Soil**
	P	**S**	**P X S**				**P**	**Soil**	**P X Soil**	**SEm(±)**	1.79	1.35	2.18
SEm(±)	2.18	1.79	3.16			**SEm(±)**	2.18	1.35	2.76	**CD (P=0.05)**	4.00	3.52	4.84
CD (P=0.05)	4.86	4.00	7.12			**CD (P=0.05)**	4.86	3.52	6.22	**Soil X P X S:SEm(±):** 3.39			**CD (P=0.05):** 7.53

Table 10. Effect of different levels of P and S on potassium content (%) of sesamum seed in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	**S_0 (Control)**	**S_{10} (10 kg S ha^{-1})**	**S_{20} (20 kg S ha^{-1})**	**S_{30} (30 kg S ha^{-1})**	**Mean**	**S_0 (Control)**	**S_{10} (10 kg S ha^{-1})**	**S_{20} (20 kg S ha^{-1})**	**S_{30} (30 kg S ha^{-1})**	**Mean**	**Grand Mean**
P_0 (Control)	0.75	0.82	0.86	0.88	0.83	0.78	0.83	0.88	0.90	0.85	0.84
P_{25} (5 kg P_2O_5 ha^{-1})	0.83	0.87	0.90	0.93	0.88	0.81	0.88	0.93	0.96	0.89	0.89
P_{50} (10 kg P_2O_5 ha^{-1})	0.85	0.89	0.93	0.95	0.90	0.82	0.90	0.98	0.99	0.92	0.91
P_{75} (15 kg P_2O_5 ha^{-1})	0.88	0.93	0.96	0.98	0.94	0.84	0.93	1.01	1.03	0.95	0.94
P_{100} (20 kg P_2O_5 ha^{-1})	0.88	0.94	0.99	1.02	0.95	0.87	0.95	1.03	1.05	0.97	0.96
Mean	0.84	0.89	0.93	0.95	0.90	0.82	0.89	0.97	0.99	0.92	0.91

2 Factor Tables													
	S_0	**S_{10}**	**S_{20}**	**S_{30}**	**Mean**		**Soil 1**	**Soil 2**	**Mean**		**Soil 1**	**Soil 2**	**Mean**
P_0	0.76	0.82	0.87	0.89	0.84	**P_0**	0.83	0.85	0.84	**S_0**	0.84	0.82	0.83
P_{25}	0.82	0.87	0.92	0.95	0.89	**P_{25}**	0.88	0.89	0.89	**S_{10}**	0.89	0.89	0.89
P_{50}	0.84	0.90	0.96	0.97	0.91	**P_{50}**	0.90	0.92	0.91	**S_{20}**	0.93	0.97	0.95
P_{75}	0.86	0.93	0.98	1.00	0.94	**P_{75}**	0.94	0.95	0.94	**S_{30}**	0.95	0.99	0.97
P_{100}	0.87	0.94	1.01	1.03	0.96	**P_{100}**	0.95	0.97	0.96	**Mean**	0.90	0.92	0.91
Mean	0.83	0.89	0.95	0.97	0.91	**Mean**	0.90	0.92	0.91		**S**	**Soil**	**S X Soil**
	P	**S**	**P X S**				**P**	**Soil**	**P X Soil**	**SEm(±)**	0.036	0.031	0.054
SEm(±)	0.051	0.036	0.045			**SEm(±)**	0.051	0.031	0.068	**CD (P=0.05)**	0.08	NS	NS
CD (P=0.05)	NS	0.08	0.10			**CD (P=0.05)**	NS	NS	NS	**Soil X P X S: SEm(±):** 0.076			**CD (P=0.05):** 0.17

Table 11. Effect of different levels of P and S on potassium uptake (mg pot^{-1}) by sesamum seed in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	**S_0 (Control)**	**S_{10} (10 kg S ha^{-1})**	**S_{20} (20 kg S ha^{-1})**	**S_{30} (30 kg S ha^{-1})**	**Mean**	**S_0 (Control)**	**S_{10} (10 kg S ha^{-1})**	**S_{20} (20 kg S ha^{-1})**	**S_{30} (30 kg S ha^{-1})**	**Mean**	**Grand Mean**
P_0 (Control)	70	81	87	90	82	74	84	91	94	85	84
P_{25} (5 kg P_2O_5 ha^{-1})	84	91	96	101	93	81	94	101	106	95	94
P_{50} (10 kg P_2O_5 ha^{-1})	90	96	102	105	98	85	99	117	118	105	101
P_{75} (15 kg P_2O_5 ha^{-1})	93	101	115	117	106	89	104	120	124	109	108
P_{100} (20 kg P_2O_5 ha^{-1})	93	105	118	122	109	92	107	124	127	112	111
Mean	86	95	104	107	98	84	97	110	113	101	100

2 Factor Tables												
	S_0	**S_{10}**	**S_{20}**	**S_{30}**	**Mean**		**Soil 1**	**Soil 2**	**Mean**		**Soil 1**	**Soil 2**	**Mean**
P_0	72	83	89	92	84	**P_0**	82	85	84	**S_0**	86	84	85
P_{25}	82	93	99	103	94	**P_{25}**	93	95	94	**S_{10}**	95	97	96
P_{50}	87	97	109	112	101	**P_{50}**	98	105	101	**S_{20}**	104	110	107
P_{75}	91	103	118	120	108	**P_{75}**	106	109	108	**S_{30}**	107	113	110
P_{100}	92	106	121	124	111	**P_{100}**	109	112	111	**Mean**	98	101	100
Mean	85	96	107	110	100	**Mean**	98	101	100		**S**	**Soil**	**S X Soil**
	P	**S**	**P X S**				**P**	**Soil**	**P X Soil**	**SEm(±)**	3.21	3.58	3.64
SEm(±)	3.70	3.21	4.58			**SEm(±)**	3.70	3.58	4.34	**CD (P=0.05)**	7.12	NS	8.12
CD (P=0.05)	8.24	7.12	10.26			**CD (P=0.05)**	8.24	NS	9.61	**Soil X P X S:SEm(±):** 4.45			**CD (P=0.05):** 9.88

Table 12. Effect of different levels of P and S on potassium content (%) of sesamum stalk in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	**S_0 (Control)**	**S_{10} (10 kg S ha^{-1})**	**S_{20} (20 kg S ha^{-1})**	**S_{30} (30 kg S ha^{-1})**	**Mean**	**S_0 (Control)**	**S_{10} (10 kg S ha^{-1})**	**S_{20} (20 kg S ha^{-1})**	**S_{30} (30 kg S ha^{-1})**	**Mean**	**Grand Mean**
P_0 (Control)	1.39	1.43	1.48	1.50	1.45	1.41	1.44	1.47	1.51	1.46	1.45
P_{25} (5 kg P_2O_5 ha^{-1})	1.43	1.49	1.51	1.53	1.49	1.44	1.49	1.54	1.56	1.51	1.50
P_{50} (10 kg P_2O_5 ha^{-1})	1.44	1.51	1.55	1.57	1.52	1.46	1.50	1.58	1.59	1.53	1.52
P_{75} (15 kg P_2O_5 ha^{-1})	1.47	1.52	1.58	1.61	1.54	1.48	1.52	1.60	1.61	1.55	1.55
P_{100} (20 kg P_2O_5 ha^{-1})	1.47	1.54	1.61	1.62	1.56	1.50	1.54	1.62	1.64	1.57	1.57
Mean	1.44	1.50	1.54	1.56	1.51	1.46	1.50	1.56	1.58	1.53	1.52

2 Factor Tables													
	S_0	**S_{10}**	**S_{20}**	**S_{30}**	**Mean**		**Soil 1**	**Soil 2**	**Mean**		**Soil 1**	**Soil 2**	**Mean**
P_0	1.40	1.44	1.47	1.51	1.45	**P_0**	1.45	1.46	1.45	**S_0**	1.44	1.46	1.45
P_{25}	1.44	1.49	1.53	1.55	1.50	**P_{25}**	1.49	1.51	1.50	**S_{10}**	1.50	1.50	1.50
P_{50}	1.45	1.50	1.56	1.58	1.52	**P_{50}**	1.52	1.53	1.52	**S_{20}**	1.54	1.56	1.55
P_{75}	1.48	1.52	1.59	1.61	1.55	**P_{75}**	1.54	1.55	1.55	**S_{30}**	1.56	1.58	1.57
P_{100}	1.49	1.54	1.61	1.63	1.57	**P_{100}**	1.56	1.57	1.57	**Mean**	1.51	1.53	1.52
Mean	1.45	1.50	1.55	1.57	1.52	**Mean**	1.51	1.53	1.52		**S**	**Soil**	**S X Soil**
	P	**S**	**P X S**				**P**	**Soil**	**P X Soil**	**SEm(±)**	0.08	0.07	0.11
SEm(±)	0.09	0.08	0.14			**SEm(±)**	0.09	0.07	0.13	**CD (P=0.05)**	NS	NS	NS
CD (P=0.05)	NS	NS	NS			**CD (P=0.05)**	NS	NS	NS	**Soil X P X S:SEm(±):** 0.15			**CD (P=0.05):** NS

Table 13. Effect of different levels of P and S on potassium uptake (mg pot^{-1}) by sesamum stalk in high P soils

3 Factor Tables										
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})				
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	237	272	284	306	275	244	279	291	309	281	278
P_{25} (5 kg P_2O_5 ha^{-1})	285	299	314	319	304	288	306	325	336	314	309
P_{50} (10 kg P_2O_5 ha^{-1})	287	311	331	337	316	297	316	345	349	326	321
P_{75} (15 kg P_2O_5 ha^{-1})	297	327	348	354	331	304	328	352	356	335	333
P_{100} (20 kg P_2O_5 ha^{-1})	301	335	353	357	336	311	336	357	362	341	339
Mean	281	309	326	335	313	289	313	334	342	319	316

2 Factor Tables												
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	240	276	287	307	278	P_0	275	281	278	S_0	281	289	285
P_{25}	287	303	320	328	309	P_{25}	304	314	309	S_{10}	309	313	311
P_{50}	292	313	338	343	321	P_{50}	316	326	321	S_{20}	326	334	330
P_{75}	300	328	350	355	333	P_{75}	331	335	333	S_{30}	335	342	338
P_{100}	306	335	355	360	339	P_{100}	336	341	339	Mean	313	319	316
Mean	285	311	330	338	316	Mean	313	319	316		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	9.12	9.24	9.57
SEm(±)	9.92	9.12	17.92			SEm(±)	9.92	9.24	10.57	CD (P=0.05)	20.24	NS	21.16
CD (P=0.05)	22.12	20.24	40.14			CD (P=0.05)	22.12	NS	23.47	Soil X P X S:SEm(±): 16.09			CD (P=0.05): 35.56

Table 14. Effect of different levels of P and S on sulphur content (%) of sesamum seed in high P soils

3 Factor Tables										
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})				
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	0.25	0.29	0.30	0.31	0.29	0.26	0.29	0.31	0.33	0.30	0.29
P_{25} (5 kg P_2O_5 ha^{-1})	0.29	0.30	0.32	0.33	0.31	0.30	0.32	0.35	0.36	0.33	0.32
P_{50} (10 kg P_2O_5 ha^{-1})	0.31	0.34	0.36	0.37	0.34	0.32	0.35	0.41	0.42	0.38	0.36
P_{75} (15 kg P_2O_5 ha^{-1})	0.33	0.36	0.39	0.40	0.37	0.37	0.39	0.42	0.43	0.40	0.39
P_{100} (20 kg P_2O_5 ha^{-1})	0.34	0.37	0.40	0.41	0.38	0.38	0.42	0.44	0.45	0.42	0.40
Mean	0.30	0.33	0.35	0.36	0.34	0.32	0.35	0.39	0.40	0.37	0.35

2 Factor Tables													
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	0.25	0.29	0.30	0.32	0.29	P_0	0.29	0.30	0.29	S_0	0.30	0.32	0.31
P_{25}	0.29	0.31	0.34	0.34	0.32	P_{25}	0.31	0.33	0.32	S_{10}	0.33	0.35	0.34
P_{50}	0.31	0.35	0.38	0.39	0.36	P_{50}	0.34	0.38	0.36	S_{20}	0.35	0.39	0.37
P_{75}	0.35	0.37	0.40	0.41	0.39	P_{75}	0.37	0.40	0.39	S_{30}	0.36	0.40	0.38
P_{100}	0.36	0.40	0.42	0.43	0.40	P_{100}	0.38	0.42	0.40	Mean	0.34	0.37	0.35
Mean	0.31	0.34	0.37	0.38	0.35	Mean	0.34	0.37	0.35		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	0.005	0.004	0.008
SEm(±)	0.009	0.005	0.014			SEm(±)	0.009	0.004	0.013	CD (P=0.05)	0.01	0.01	0.02
CD (P=0.05)	0.02	0.01	0.03			CD (P=0.05)	0.02	0.01	0.03	Soil X P X S:SEm(±): 0.08			CD (P=0.05): 0.16

Table 15. Effect of different levels of P and S on sulphur uptake (mg pot^{-1}) by sesamum seed in high P soils

3 Factor Tables										
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	23	29	30	32	29	24	29	32	34	30	29
P_{25} (5 kg P_2O_5 ha^{-1})	29	32	35	35	33	30	34	38	39	35	34
P_{50} (10 kg P_2O_5 ha^{-1})	32	37	39	41	37	33	38	49	50	43	40
P_{75} (15 kg P_2O_5 ha^{-1})	35	39	46	48	42	39	43	50	52	46	44
P_{100} (20 kg P_2O_5 ha^{-1})	36	41	48	50	44	40	47	53	54	49	46
Mean	31	36	40	41	37	33	38	44	46	40	39

2 Factor Tables												
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	24	29	31	33	29	P_0	29	30	29	S_0	31	33	32
P_{25}	29	33	36	37	34	P_{25}	33	35	34	S_{10}	36	38	37
P_{50}	33	38	44	46	40	P_{50}	37	43	40	S_{20}	40	44	42
P_{75}	37	41	48	50	44	P_{75}	42	46	44	S_{30}	41	46	43
P_{100}	38	44	50	52	46	P_{100}	44	49	46	Mean	37	40	39
Mean	32	37	42	43	39	Mean	37	40	39		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	1.34	1.25	2.38
SEm(±)	1.45	1.34	1.89			SEm(±)	1.45	1.25	2.30	CD (P=0.05)	3.00	2.77	5.33
CD (P=0.05)	3.24	3.00	4.23			CD (P=0.05)	3.24	2.77	5.15	Soil X P X S:SEm(±): 5.63			CD (P=0.05): 12.55

Table 16. Effect of different levels of P and S on sulphur content (%) of sesamum stalk in high P soils

3 Factor Tables										
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	0.05	0.09	0.11	0.13	0.10	0.09	0.11	0.13	0.14	0.12	0.11
P_{25} (5 kg P_2O_5 ha^{-1})	0.10	0.11	0.13	0.14	0.12	0.11	0.14	0.16	0.18	0.14	0.13
P_{50} (10 kg P_2O_5 ha^{-1})	0.11	0.13	0.16	0.17	0.14	0.13	0.16	0.18	0.19	0.16	0.15
P_{75} (15 kg P_2O_5 ha^{-1})	0.12	0.16	0.17	0.18	0.16	0.14	0.17	0.19	0.20	0.17	0.17
P_{100} (20 kg P_2O_5 ha^{-1})	0.15	0.17	0.18	0.19	0.17	0.15	0.17	0.20	0.21	0.18	0.18
Mean	0.11	0.13	0.15	0.16	0.14	0.12	0.15	0.17	0.18	0.16	0.15

2 Factor Tables													
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	0.07	0.11	0.13	0.14	0.11	P_0	0.10	0.12	0.11	S_0	0.11	0.12	0.11
P_{25}	0.10	0.13	0.14	0.16	0.13	P_{25}	0.12	0.14	0.13	S_{10}	0.13	0.15	0.14
P_{50}	0.12	0.14	0.17	0.18	0.15	P_{50}	0.14	0.16	0.15	S_{20}	0.15	0.17	0.16
P_{75}	0.13	0.16	0.18	0.19	0.17	P_{75}	0.16	0.17	0.17	S_{30}	0.16	0.19	0.17
P_{100}	0.15	0.17	0.19	0.20	0.18	P_{100}	0.17	0.18	0.18	Mean	0.14	0.16	0.15
Mean	0.11	0.14	0.16	0.17	0.15	Mean	0.14	0.16	0.15		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	0.004	0.004	0.008
SEm(±)	0.005	0.004	0.009			SEm(±)	0.005	0.004	0.008	CD (P=0.05)	0.01	0.01	0.02
CD (P=0.05)	0.01	0.01	0.02			CD (P=0.05)	0.01	0.01	0.02	Soil X P X S:SEm(±): 0.014			CD (P=0.05): 0.03

Table 17. Effect of different levels of P and S on sulphur uptake (mg pot^{-1}) by sesamum stalk in high P soils

3 Factor Tables											
	Soil 1(67.29 kg P_2O_5 ha^{-1})					Soil 2(83.46 kg P_2O_5 ha^{-1})					
P levels	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	S_0 (Control)	S_{10} (10 kg S ha^{-1})	S_{20} (20 kg S ha^{-1})	S_{30} (30 kg S ha^{-1})	Mean	Grand Mean
P_0 (Control)	9	18	21	27	19	15	21	26	29	23	21
P_{25} (5 kg P_2O_5 ha^{-1})	20	21	26	29	24	21	29	33	38	30	27
P_{50} (10 kg P_2O_5 ha^{-1})	21	27	34	37	29	26	33	38	41	34	32
P_{75} (15 kg P_2O_5 ha^{-1})	25	34	38	40	34	28	36	41	45	37	36
P_{100} (20 kg P_2O_5 ha^{-1})	31	37	40	41	37	31	37	43	46	39	38
Mean	21	27	32	35	29	24	31	36	40	33	31

2 Factor Tables													
	S_0	S_{10}	S_{20}	S_{30}	Mean		Soil 1	Soil 2	Mean		Soil 1	Soil 2	Mean
P_0	12	20	24	28	21	P_0	19	23	21	S_0	21	24	23
P_{25}	20	25	30	33	27	P_{25}	24	30	27	S_{10}	27	31	29
P_{50}	24	30	36	39	32	P_{50}	29	34	32	S_{20}	32	36	34
P_{75}	27	35	39	42	36	P_{75}	34	37	36	S_{30}	35	40	37
P_{100}	31	37	42	43	38	P_{100}	37	39	38	Mean	29	33	31
Mean	23	29	34	37	31	Mean	29	33	31		S	Soil	S X Soil
	P	S	P X S				P	Soil	P X Soil	SEm(±)	0.79	0.56	1.12
SEm(±)	0.89	0.79	1.78			SEm(±)	0.89	0.56	1.26	CD (P=0.05)	3.17	2.93	5.27
CD (P=0.05)	3.21	3.17	4.34			CD (P=0.05)	3.21	2.93	5.11	Soil X P X S:SEm(±): 2.92			CD (P=0.05): 6.52

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