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Effect of phosphorus management on yield, nutrient uptake by sesame and post-harvest soil fertility under rainfed condition

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Abstract
A field experiment was conducted on clayey soil having low status of organic carbon and available phosphorus, high of available potassium and medium of available sulphur at Targhadia (Dist. Rajkot) during *kharif* season of 2011-12 to 2016-17 to study the effect of phosphorus management on yield, nutrient uptake by sesame and post-harvest soil fertility under rain fed condition. The experiment comprising of different twelve treatments laid out in Randomized Block Design with three replications. The effect of phosphorus management treatments on plant height as well as on number of branches per plant were remained non-significant, whereas, number of capsules per plant were found significant in pooled results. The effect of phosphorus management on seed yield of sesame was found significant during three successive year and in pooled results, maximum seed yield (1035 kg/ha) were recorded under application of 50 kg P_2O_5/ha through SSP and which were statistically at par with application of 25 kg P_2O_5/ha through SSP. Whereas, the lowest seed yield (765 kg/ha) was recorded under control treatment i.e. RDN-50 kg N/ha.The effect of phosphorus management on stalk yield of sesame crop was found non-significant in all three successive years. However, it was found significant in pooled result. The uptake of N, P, K and S by sesame significantly influenced due to different P-fertilization treatments. The highest uptake of N (21.7 kg/ha), P (5.05 kg/ha), K (21.29 kg/ha) and S (5.28 kg/ha) by sesame was recorded when it was fertilized with 50 kg P_2O_5 through SSP. The available phosphorus, potash and sulphur status in the soil after harvest were significantly influenced due to different treatments. However, effect of different treatments on organic carbon status, pH and EC of the soil was found non-significant.

Keywords: Sesame, phosphorus management, yield, uptake, post-harvest fertility

Introduction
Sesame is a yearling plant and one of the oldest oilseed plants that is compatible with hot and semi-hot areas and consists of a high-percent oil (45%) and protein (19% - 25%). Sesame is an important oilseed crop in the tropics and subtropics, however most of its cultivated area is in developing countries, where it is usually grown by small holders. Sesame crop has an important advantage because it could be grown under fairly high temperature, low water supply and low levels of other inputs. The use of chemical fertilizers has been doubled during the last two decades.

Beside nitrogen, phosphorus is the second most important plant nutrient and is key element in the process of conservation of solar energy into chemical energy. The optimum supply of phosphorus to the plant stimulates root development and growth, thereby helps to establish seedling quickly and also hastens maturity as well as improves the quality of crop. Several other gross quantitative and qualitative effects on plant growth are attributed to phosphorus fertilization. The phosphorus management in sesame improves yield quantity and quality of produces and reduces the incidence of diseases, pests and cost of cultivation. Thus the concurrent application of organic manures and bio-fertilizers are frequently recommended for improving biological, physical and chemical properties of soil and to get agricultural produces with good quality and pollutants free. Phosphorus management continues to gain importance to maintain soil health for suitable production of good quality sesame.

Material and Methods
The experiment was carried out on sesame during *kharif* seasons of 2011-12 to 2016-17at Dry Farming Research Station, Junagadh Agricultural University, Targhadia (Dist: Rajkot, Gujarat, India). The physical characteristics of soil were measured viz. field capacity (34.25) wilting point (17.26), apparent specific gravity (1.38%), infiltration rate (10.15 mm/hr), maximum WHC (58.55) and soil texture (clayey). The chemical characteristics of soil were also measured according to soil depth.

The soil characteristics of depth (0-15 cm) had pH 7.85, Electrical Conductivity (EC): 0.47m.mhos, Organic Carbon (OC): 4.95%, available P_2O_5: 26.53 kg/haand available K_2O: 448 kg/ha and available S 17.14 mg/kg. The experiment included total 12 treatments viz. T_1 –Control (RDN -50 kg N/ha), T_2 –25kg P_2O_5/ha through DAP, T_3–25kg P_2O_5/ha through SSP, T_4–25kg P_2O_5/ha through RP,T_5 - 25kg P_2O_5/ha through RP + PSB 1kg/ha, T_6–50kg P_2O_5/ha through DAP, T_7–50kg P_2O_5/ha through SSP, T_8– P_2O_5/ha through RP, T_9–50kg P_2O_5/ha through RP + PSB 1kg/haT_{10} - S equal to 25 kg SSP through Gypsum, T_{11}–S equal to 50 kg SSP through Gypsumand T_{12}–40kg K_2O/ha each replicates thrice in random block design with the plot size of (a) Gross: 5.0 m x 3.6 m (b) Net: 4.8 m x 2.4 m. The spacing and seed rate were 45.0 cm X 10.0 cmand 3.00 kg\ha, respectively. The fertilizer was given as per treatments.

Results and Discussion

Seed yield

Results given in Table 1.1 indicated that effect of phosphorus management on seed yield of sesame were found significant during year 2013-14, 2014-15, 2015-16, 2016-17 and in pooled results.

The data also revealed that significantly the highest seed yield (856 kg/ha) was recorded under T7(application of 50 kg P_2O_5/ha through SSP) in pooled results of four successive years, which was statistically at par with T2, T3, T6 and T11. Whereas, significantly the lowest seed yield (690 kg/ha) was recorded under T_1(control i.e. RDN-50 kg N/ha).These result is in agreement with Javia *et al* (2010) [4].

Stalk yield:

Results given in Table 1.2 indicated that effect of phosphorus management on stalk yield sesame crop were found significant in year 2013-14 and pooled results.

The data revealed that significantly the highest stalk yield (1971 kg/ha) was recorded under T11(S equal to 50 kg SSP through Gypsum) in pooled results of four successive years, which remained at par with T7, T3, T6 and T2. Whereas significantly the lowest stalk yield (1673 kg/ha) was recorded under T8 (50kg P2O5/ha through Rock phosphate).Similar result was also obtained by Javia *et al*. (2010) [4], Katwate *et al.* (2011) [2] and Suchhanda Mondal (2016) [7].

Growth parameters and yield attributes:

The pooled results given in Table 1.3 revealed that the effect of phosphorus management treatments on plant height as well as on number of branches per plant were remained non-significant. While, number of capsules per plant was found significant in pooled results.

The data further indicated that the significantly the highest number of capsules per plant (87.2) was recorded under T7 (application of 50 kg P_2O_5/ha through SSP) in pooled results of four successive years, which was statistically at par with T3 (application of 25 kg P_2O_5/ha through SSP).These result similar with Katwate *et al.* (2011) [3] and Shelke *et al*. (2014) [6].

Uptake of nutrients

The data presented in table 1.4indicated that that uptake of N, P, K and S by sesame significantly influenced due to different P-fertilization treatments. The highest uptake of N (21.7 kg/ha), P (5.05 kg/ha), K (21.29 kg/ha) and S (5.28 kg/ha) by sesame was recorded when it was fertilized with 50 kg P_2O_5 through SSP (T_7).These result similar to Javia *et al*. (2010) [4] and Suchhanda Mondal (2016) [7].

Post-harvest soil fertility status

The results given in table 1.5 indicated that available phosphorus, potash and sulphur status in the soil after harvest were significantly influenced due to different treatments. However, effect of different treatments on organic carbon status, pH and EC of the soil was found non-significant. Application of phosphorus @ 25 and 50 kg/ha through different sources improved its available status in soil. The highest value (35.26 kg/ha) of available phosphorus in soil was recorded with application of 50 kg phosphorus through SSP (T_7). The maximum value of available potash (492 kg/ha) was recorded with application of 40 kg K_2O/ha. The highest value of sulphur status in the soil (29.46 mg/ kg) was recorded with T_{11} (sulphur equal to 50 kg P_2O_5/ha SSP through gypsum).

The results given in table 1.7 revealed that DTPA extractible micronutriments Fe and Zn status in the soil after harvest were significantly influenced due to different treatments. However, Mn and Cu status in the soil were remained unaffected. The highest status of Fe (10.11 mg/ kg) and Zn (0.71 mg/kg) were found with application of 50 kg phosphorus through SSP (T_7).Javia *et al.* (2010) [4].

Economics

Economic response of sesame to phosphorus management was worked out on the basis of pooled result and presented in Table 1.7. The data indicated that application of 25 kg P_2O_5/ha through SSP gave the highest net return of Rs.38088/ha with B: C ratio of 3.91.These findings are in agreement with the results obtained by Bajpai (2000), Sharma (2005), Hanumanthappa *et al.* (2008) [1] and Javia *et al.* (2010) [4].

Table 1.1: Effect of various treatments on seed yield of sesame

Treatments	Seed Yield (kg/ha)				
	2013	2014	2015	2016	Pooled
T_1 –Control (RDN -50 kg N/ha)	608	713	697	840	690
T_2 –25kg P_2O_5/ha through DAP	582	846	726	1046	770
T_3–25kg P_2O_5/ha through SSP	651	887	807	1128	837
T_4–25kg P_2O_5/ha through RP	440	770	694	1014	702
T_5–25kg P_2O_5/ha through RP + PSB 1kg/ha	561	778	657	951	710
T_6–50kg P_2O_5/ha through DAP	498	852	747	1130	775
T_7–50kg P_2O_5/ha through SSP	512	995	862	1191	856
T_8–50kg P_2O_5/ha through RP	480	788	657	985	700
T_9–50kg P_2O_5/ha through RP + PSB 1kg/ha	477	824	663	1029	719
T_{10}–S equal to 25 kg SSP through Gypsum	422	868	749	906	709
T_{11}–S equal to 50 kg SSP through Gypsum	558	870	666	1128	774
T_{12}–40kg K_2O/ha	611	831	639	923	724

S.Em.±		45	47	45	58	32
C.D. at 5%		132	138	132	170	92
C.V.%		14.7	9.8	10.9	9.8	11.0
Y	S.Em.±					18
C.D. at 5 %						53
YXT	S.Em.±					47
C.D. at 5 %						133

Table 1.2: Effect of various treatments on stalk yield of sesame

Treatments	Stalk Yield (kg/ha)				
	2013	**2014**	**2015**	**2016**	**Pooled**
T_1 –Control (RDN -50 kg N/ha)	1432	2377	1418	2253	1797
T_2 –25kg P_2O_5/ha through DAP	1186	2562	1447	2346	1808
T_3–25kg P_2O_5/ha through SSP	1201	2778	1563	2407	1906
T_4–25kg P_2O_5/ha through RP	1189	2469	1476	2346	1795
T_5–25kg P_2O_5/ha through RP + PSB 1kg/ha	1273	2500	1331	2160	1743
T_6–50kg P_2O_5/ha through DAP	1085	2562	1649	2438	1855
T_7–50kg P_2O_5/ha through SSP	1201	2963	1881	2099	1957
T_8–50kg P_2O_5/ha through RP	964	2500	1389	2130	1673
T_9–50kg P_2O_5/ha through RP + PSB 1kg/ha	1259	2500	1403	2191	1765
T_{10}–S equal to 25 kg SSP through Gypsum	1033	2654	1620	2145	1788
T_{11}–S equal to 50 kg SSP through Gypsum	1374	2778	1534	2531	1971
T_{12}–40kg K_2O/ha	1102	2531	1374	2253	1740
S.Em.±	86.5	149.9	117.8	137.0	60
C.D. at 5%	253.6	NS	NS	NS	169
C.V.%	12.6	9.99	13.5	10.4	11
Y S.Em.±					35
C.D. at 5 %					98
YXT S.Em.±					120
C.D. at 5 %					NS

Table 1.3: Pooled data of growth parameters and yield attributes of sesame (2013-16)

Treatments	Plant height (cm)	No. of branches per plant	No. of capsules per plant
T_1 –Control (RDN -50 kg N/ha)	134	3.18	55.6
T_2 –25kg P_2O_5/ha through DAP	130	3.18	64.3
T_3–25kg P_2O_5/ha through SSP	138	3.17	80.9
T_4–25kg P_2O_5/ha through RP	135	3.35	67.6
T_5–25kg P_2O_5/ha through RP + PSB 1kg/ha	137	3.12	69.1
T_6–50kg P_2O_5/ha through DAP	134	3.25	69.3
T_7–50kg P_2O_5/ha through SSP	136	3.22	87.2
T_8–50kg P_2O_5/ha through RP	133	3.05	67.5
T_9–50kg P_2O_5/ha through RP + PSB 1kg/ha	132	3.25	66.0
T_{10}–S equal to 25 kg SSP through Gypsum	137	3.10	67.2
T_{11}–S equal to 50 kg SSP through Gypsum	132	3.12	63.6
T_{12}–40kg K_2O/ha	128	3.02	59.6
S.Em.±	2.25	0.13	2.90
C.D. at 5%	NS	NS	8.16
C.V.%	4.51	14.0	14.7
Y S.Em.±	1.30	0.07	1.67
C.D. at 5 %	3.74	0.21	4.71
YXT S.Em.±	3.48	0.25	5.80
C.D. at 5 %	9.81	NS	NS

Table 1.4: Effect of different treatments on uptake of N, P, K and S (kg/ha) by sesame

Treatments	N	P	K	S
T_1 –Control (RDN -50 kg N/ha)	13.76	3.28	12.91	3.29
T_2 –25kg P_2O_5/ha through DAP	16.40	3.87	15.15	3.90
T_3–25kg P_2O_5/ha through SSP	21.10	4.87	19.42	4.99
T_4–25kg P_2O_5/ha through RP	15.87	3.75	15.27	3.84
T_5–25kg P_2O_5/ha through RP + PSB 1kg/ha	16.92	3.94	16.04	4.06
T_6–50kg P_2O_5/ha through DAP	19.71	4.55	19.01	4.76
T_7–50kg P_2O_5/ha through SSP	21.70	5.05	21.29	5.28
T_8–50kg P_2O_5/ha through RP	15.93	3.74	15.13	3.83
T_9–50kg P_2O_5/ha through RP + PSB 1kg/ha	17.60	4.07	16.54	4.20
T_{10}–S equal to 25 kg SSP through Gypsum	15.81	3.72	15.53	3.86
T_{11}–S equal to 50 kg SSP through Gypsum	20.99	4.81	20.07	5.04
T_{12}–40kg K_2O/ha	18.54	4.26	17.46	4.43

S.Em.±		0.81	0.18	0.57	0.17
C.D. at 5%		2.32	0.52	1.59	0.49
C.V.%		12.25	11.13	11.54	10.79
Y	S.Em.±	0.47	0.10	0.33	0.10
C.D. at 5 %		1.34	0.30	0.92	0.28
YXT	S.Em.±	1.26	0.27	1.13	0.27
C.D. at 5 %		3.56	0.75	NS	0.75

Table 1.5: Post harvest soil fertility as affected by different treatments

Treatments	pH	EC dS/m	Org. C. g/kg	Avail. P_2O_5 Kg/ha	Avail. K_2O Kg/ha	Avail. S mg/kg
Initial value	7.85	0.471	4.95	26.53	448	17.14
T_1 –Control (RDN -50 kg N/ha)	7.89	0.452	4.85	26.96	444	17.39
T_2 –25kg P_2O_5/ha through DAP	7.90	0.459	4.92	29.01	455	19.34
T_3–25kg P_2O_5/ha through SSP	7.79	0.436	5.16	32.31	472	22.17
T_4–25kg P_2O_5/ha through RP	7.84	0.444	5.01	27.72	451	19.78
T_5–25kg P_2O_5/ha through RP + PSB 1kg/ha	7.94	0.422	5.05	28.34	458	20.03
T_6–50kg P_2O_5/ha through DAP	8.01	0.454	4.95	33.01	478	22.13
T_7–50kg P_2O_5/ha through SSP	7.92	0.444	5.27	35.26	492	24.25
T_8–50kg P_2O_5/ha through RP	7.87	0.488	5.06	32.61	457	20.44
T_9–50kg P_2O_5/ha through RP + PSB 1kg/ha	7.88	0.444	5.13	33.67	461	21.16
T_{10}–S equal to 25 kg SSP through Gypsum	7.92	0.446	5.17	31.71	464	26.77
T_{11}–S equal to 50 kg SSP through Gypsum	7.86	0.488	5.19	32.82	466	29.46
T_{12}–40kg K_2O/ha	7.95	0.445	5.09	27.52	498	19.05
S.Em.±	0.09	0.031	0.18	1.51	15.1	2.29
C.D. at 5%	NS	NS	NS	4.45	42.3	6.48

Table 1.6: Post harvest soil fertility (micro nutrients) as affected by different treatments

Treatments	Fe	Zn	Mn	Cu
T_1 –Control (RDN -50 kg N/ha)	7.85	0.55	9.43	2.36
T_2 –25kg P_2O_5/ha through DAP	8.01	0.56	9.56	2.39
T_3–25kg P_2O_5/ha through SSP	8.67	0.61	10.64	2.66
T_4–25kg P_2O_5/ha through RP	9.59	0.67	11.19	2.80
T_5–25kg P_2O_5/ha through RP + PSB 1kg/ha	8.27	0.58	10.88	2.72
T_6–50kg P_2O_5/ha through DAP	8.48	0.59	11.02	2.75
T_7–50kg P_2O_5/ha through SSP	9.89	0.69	11.17	2.79
T_8–50kg P_2O_5/ha through RP	10.11	0.71	11.34	2.83
T_9–50kg P_2O_5/ha through RP + PSB 1kg/ha	8.35	0.58	10.24	2.56
T_{10}–S equal to 25 kg SSP through Gypsum	8.42	0.59	10.64	2.66
T_{11}–S equal to 50 kg SSP through Gypsum	9.41	0.66	10.72	2.68
T_{12}–40kg K_2O/ha	9.71	0.68	11.20	2.80
S.Em.±	8.11	0.57	10.48	2.62
C.D. at 5%	0.19	0.01	1.26	0.31

Table 1.7: Economics of various phosphorus management treatments in sesame

Treatments	Seed yield kg/ha	Stalk yield kg/ha	Total income Rs/ha	Cost of cultivation Rs/ha	Net income Rs/ha	B:C ratio
T_1 –Control (RDN -50 kg N/ha)	690	1797	42299	11835	30464	3.57
T_2 –25kg P_2O_5/ha through DAP	770	1808	47104	13052	34052	3.61
T_3–25kg P_2O_5/ha through SSP	837	1906	51173	13085	38088	3.91
T_4–25kg P_2O_5/ha through RP	702	1795	43018	12113	30905	3.55
T_5–25kg P_2O_5/ha through RP + PSB 1kg/ha	710	1743	43472	12233	31239	3.55
T_6–50kg P_2O_5/ha through DAP	775	1855	47428	14282	33146	3.32
T_7–50kg P_2O_5/ha through SSP	856	1957	52339	14335	38004	3.65
T_8–50kg P_2O_5/ha through RP	700	1673	42837	12391	30446	3.46
T_9–50kg P_2O_5/ha through RP + PSB 1kg/ha	719	1765	44023	12511	31512	3.52
T_{10}–S equal to 25 kg SSP through Gypsum	709	1788	43434	11942	31492	3.64
T_{11}–S equal to 50 kg SSP through Gypsum	774	1971	47336	12048	35288	3.93
T_{12}–40kg K_2O/ha	724	1740	44310	12608	31702	3.51
Selling Price Rs/kg):	Seed: 60.00	Stalk: 0.50				
Cost of input Rs/kg):	Urea: 06.30	DAP: 24.86		SSP: 08.00	KCl: 11.60	
	Gypsum: 00.85	Rock phosphate: 3.00		PSB: 120.00		

Conclusion

The farmers of North Saurashtra Agro climatic zone (AES-VI) growing rainfed sesame are advised to fertilize the crop with 25 kg P_2O_5/ha through SSP along with recommended dose of nitrogen (50 kg N/ha) for gettinghigher yield and maximum net return.

References

1. Hanumanthappa M, Dalavai BL. Dry matter production nutrient uptake and economics of sesame (*Sesamum indicum* L.) as influenced by organic manure and fertilizer levels. Mysore Journal of Agriculture Science. 2008; 42(4):629-634.
2. Katwate MT, Thorve SB, Jadhav JD. Grain yield as influenced by varieties and fertilizer level in sesame (*Sesamum indicum* L.) Advance Research Journal of CropImprovement. 2011; 2(1):1-6.
3. Katwate MT, Thorve SB, Jadhav D. Grain yield as influenced by varieties and fertilizer level in sesamum (*sesamum indicum* L.) Advance Research Journal of Crop Improvement. 2011; **2**(1):1-6.
4. Javia RM, Vora VD, Sutaria GS, Akbari KN, Padmani DR. Effect of nutrient management on productivity of sesame and soil fertility of sandy loam soils under rainfed condition. An Asian journal of soil science. 2010; 5(1):80-82.
5. Sharma PB. Fertilizer management in sesame (*Sesamum indicum* L.) basedintercropping system in tawa command area. Journal of Oilseed Research. 2005; 22(1):63-65.
6. Shelke RI, Kalegore NK, Wayase KP. Effect of Levels of Phosphorus and Sulphur on Growth, Yield and Quality of Sesame (*Sesamum indicum* L.). World Journal of Agricultural Sciences. 2014; 10(3):108-111.
7. Suchhanda Mondal. Efficiency of sulphur source on sesame (*sesamum indicum* l.) in red and lateritic soil of west bengal. International Journal of Plant, Animal and Environmental Sciences. 2016; 6(2):2231-4490.
8. Thanki JD, Patel AM, Patel MP. Effect of date of sowing, phosphorus and biofertilizers on growth, yield and quality of summer sesame (*Sesamum indicum* L.). Journal of Oilseeds Research. 2004; 21(2):301-302.