

PROCEEDINGS OF
KERALA ENVIRONMENT CONGRESS 2012

FOCAL THEME
AGRICULTURE AND ENVIRONMENT

16th, 17th & 18th August 2012
at RGCB Auditorium, Thiruvananthapuram



Organised by



CENTRE FOR ENVIRONMENT AND DEVELOPMENT
THIRUVANANTHAPURAM

In Association with

Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram

Sponsored by

Ministry of Environment and Forests, Government of India
&
Kerala State Council for Science, Technology and Environment

Effect of Adding Secondary and Micronutrients in improving the Soil Productivity Parameters in the Sandy Soils of Onattukara Region

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INTRODUCTION

Onattukara is the traditional sesame cultivating area of Kerala occupying the taluks of Karunagappally, Karthikappally and Mavelikkara in Kollam and Alleppy districts adjacent to the fragile Kuttanad ecosystem. In Onattukara the soil is deficient in major and micronutrients. Factors such as low water and nutrient holding capacities, prevalence of macropores in soil, high percolation rate add up to the problem of low productivity of oil seed crops such as sesame in this area. The present paper focuses on the influence of the addition of sulphur and boron in improving the soil quality parameters and also enhancing the productivity of sesame in Onattukara sandy soil of Kerala.

MATERIALS AND METHODS

The study was conducted in the Instructional farm of Onattukara Regional Agricultural Research Station, Kayamkulam. The area is located at 90°30' N latitude and 76°20' East longitude at an altitude of 3.05m above mean sea level. The soil belongs to typical Oxy aquic quartzite Psamment sub group. The levels of sulphur tried were 0, 7.5, 15.0 and 30 kg S ha⁻¹ and the levels of boron tried were 0, 2.5, 5.0 and 7.5 kg B ha⁻¹ which were applied as gypsum and borax respectively. There were 16 treatment combinations with two replications.

RESULTS AND DISCUSSION

Effect of treatments on the soil quality parameters

Soil nutrient status in a locality reveals its production potential for maintaining crop sustainability (Table 1). Parameters such as organic carbon (0.30%), available phosphorus (6.5 kg ha⁻¹), available potassium (62 kg ha⁻¹), exchangeable calcium (0.48 cmol kg⁻¹), exchangeable magnesium (0.03 cmol kg⁻¹), available sulphur (10.2 kg ha⁻¹), available boron (0.18 ppm), pH (5.1), EC (0.3 d Sm⁻¹) were estimated prior to crop raising and we can see that the soil is low in available nutrients. Application of

sulphur and boron resulted in general increase in the nutrient status of Onattukara sandy soil (Table 2).

Table 1
Available nutrient status of Onattukara soil after the application of secondary and micronutrients

Treatments	Organic carbon (%)		Available P (kg ha ⁻¹)		Available K (kg ha ⁻¹)	
	First crop	Second Crop	First crop	Second Crop	First crop	Second Crop
S ₀ B ₀	0.245	0.207	7.50	6.50	62.74	65.40
S ₀ B ₁	0.252	0.212	10.40	9.45	101.92	108.60
S ₀ B ₂	0.260	0.220	12.20	10.26	122.08	133.75
S ₀ B ₃	0.280	0.229	17.10	15.10	128.80	149.05
S ₁ B ₀	0.295	0.250	18.10	16.66	123.50	116.65
S ₁ B ₁	0.298	0.265	22.00	20.00	140.00	134.33
S ₁ B ₂	0.409	0.285	22.60	21.60	142.54	149.00
S ₁ B ₃	0.418	0.295	21.40	20.40	155.00	157.55
S ₂ B ₀	0.402	0.210	21.70	20.70	132.16	125.50
S ₂ B ₁	0.413	0.328	20.50	18.80	141.68	132.70
S ₂ B ₂	0.425	0.335	21.90	19.90	143.06	140.50
S ₂ B ₃	0.436	0.349	21.80	19.80	166.50	171.45
S ₃ B ₀	0.458	0.362	23.80	21.80	137.60	138.45
S ₃ B ₁	0.470	0.379	24.70	22.90	196.32	160.45
S ₃ B ₂	0.479	0.385	25.40	23.80	196.00	162.50
S ₃ B ₃	0.495	0.399	25.50	23.90	204.48	172.00
F-S.B	2.67*	2.77*	5.16**	8.86**	4.75**	5.45**
CD - S.B	0.1130	0.3841	4.88	3.046	65.65	32.418

The organic carbon content of the soil was significantly influenced by the application of different levels of sulphur and boron. T₁₆ (S₃B₃) recorded the highest value of 0.479 per cent. The trend was similar in the second crop also. The highest value of 0.399 per cent was recorded by T₁₆ (S₃B₃). Hence we can say that sulphur and boron might have favored the enrichment of soil organic matter. As evidenced by the significant effect on the biometric characters of the crop, the organic matter status in the soil might have been improved by the nutrient application and enhanced crop growth. A significant and positive correlation between boron and organic matter was reported by Kher and Isher (2006).

Table 2
Available nutrient status of Onattukara soil after the application of secondary and micronutrients

Treatments	Available sulphur (kg ha ⁻¹)		Available Boron(ppm)	
	First crop	Second Crop	First crop	Second Crop
S ₀ B ₀	20.00	16.55	0.259	0.320
S ₀ B ₁	25.60	17.55	0.350	0.716
S ₀ B ₂	24.98	24.45	0.393	1.230
S ₀ B ₃	26.50	25.95	0.486	1.720
S ₁ B ₀	36.20	30.60	0.263	0.405
S ₁ B ₁	32.00	26.90	0.717	1.100
S ₁ B ₂	35.00	38.85	1.100	1.470
S ₁ B ₃	34.00	31.95	1.640	1.690
S ₂ B ₀	38.00	45.50	0.392	0.465
S ₂ B ₁	39.25	40.40	1.080	0.830
S ₂ B ₂	33.67	44.00	1.360	1.530
S ₂ B ₃	40.52	41.95	1.790	2.160
S ₃ B ₀	42.83	50.75	0.356	0.473
S ₃ B ₁	46.22	47.0	1.068	0.889
S ₃ B ₂	40.00	45.60	1.675	1.160
S ₃ B ₃	44.00	53.40	2.210	2.270
F-S.B	9.67**	6.60**	11.70**	6.56**
CD - S.B	10.20	11.637	0.698	0.7950

Available phosphorus content of soil was favorably influence by the application of these secondary and micronutrients. In a soil with inherent phosphorus content as low as 6.5 kg ha⁻¹ rated as very low among soil fertility parameters, application of these nutrients resulted in increase in phosphorus content to as much as 25.50 kg ha⁻¹ and 23.90 kg ha⁻¹ in the first and second year respectively. Soluble sulphate from gypsum might have promoted the displacement of phosphate in soil and thus increased its availability.

With regard to the availability of potassium, a critically low nutrient in this type of soil we can see an increase as 204.48 kg ha⁻¹ and 172 kg ha⁻¹ for both the years respectively. This may be due to the displacement of potassium by calcium present in gypsum. The positive influence of sulphur and boron in making potassium available to plants is further evident from the lowest values shown by those treatments which received neither of these nutrients. In both crops the values were respectively 62.74 kg ha⁻¹ and 65.40 kg ha⁻¹. Chaurasiya *et al.* (2009) reported that the available nutrients

were significantly influenced by the application of sulphur at increasing rate from 0 to 40 kg S ha⁻¹. Sulphur in gypsum might have favorably influenced the availability of this nutrient in soil and increasing levels enhanced its availability. The readily soluble sulphate radical from gypsum might have promoted the increase in the available sulphur status of the soil. The solubility of gypsum is 1.6 g litre⁻¹. With increase in the levels of sulphur, an increasing trend in soil status was also observed. More over a synergistic relationship between sulphur and boron was also observed. T₁₄(S₃B₁) recorded the highest value of 46.22 kg ha⁻¹ followed by T₁₆(S₃B₃) in the case of the first crop whereas the same treatment recorded the value of 53.40 kg ha⁻¹ in the second crop.

Boron content of the soil was estimated by hot water extraction method. Increasing level of applied boron showed an increasing trend with regard to the availability and the highest value of 2.21 ppm was recorded by T₁₆. The same trend was repeated in the second crop also with a highest value of 2.27 ppm. Renukadevi *et al.* (2004) reported that B@ 2 kg ha⁻¹ increased the available boron status of soil.

Effect of Secondary and Micronutrients on the Yield and Yield Attributes of Sesame

Application of secondary and micronutrients in the form of sulphur and boron resulted in a definite increase in crop yield during both the seasons (Table 3).

Table 3
Effect of secondary and micronutrients on the yield of sesame

Treatments	Seed yield (kg ha ⁻¹)		
	I crop	II Crop	Pooled data
S ₀ B ₀	585.94	537.50	561.72
S ₀ B ₁	1104.17	1113.17	1108.67
S ₀ B ₂	1057.29	1055.73	1056.51
S ₀ B ₃	940.11	1020.56	980.33
S ₁ B ₀	734.38	732.81	733.59
S ₁ B ₁	1010.38	1041.40	1025.89
S ₁ B ₂	968.75	938.54	953.65
S ₁ B ₃	1091.15	1084.38	1087.76
S ₂ B ₀	953.12	1063.54	1008.33
S ₂ B ₁	979.17	1055.72	1017.44
S ₂ B ₂	1127.61	1128.65	1128.13
S ₂ B ₃	1028.65	1034.89	1031.77
S ₃ B ₀	953.12	948.95	951.04
S ₃ B ₁	1377.61	1172.94	1275.27
S ₃ B ₂	895.83	894.27	895.05
S ₃ B ₃	1460.94	1407.30	1434.12
F-SXB	13.77**	28.31**	25.66**
CD(SXB)	156.255	91.938	30.52

The highest value of 1460.94 kg ha⁻¹ was recorded by T₁₆ (S₃B₃) followed by T₁₁ (S₃B₁) which were on par with each other. The lowest value of 585.94 kg ha⁻¹ was recorded by T₁ (S₀B₀). In the case of the second crop also the same trend was observed. The highest value of 1407.30 kg ha⁻¹ was recorded by T₁₆ (S₃B₃) and was significantly superior to other treatment combinations. This was followed by T₁₄ (S₃B₁). The lowest value of 537.50 kg ha⁻¹ was recorded by T₁ (S₀B₀).

CONCLUSION

Sustaining soil productivity is the major challenge before the policy makers and planners and the stake holders in the years ahead in feeding the forthcoming generations. Onattukara sandy soil, identified as problem soil in the soil map of Kerala needs a definite nourishment with essential nutrients especially that of the secondary and micronutrients so as to sustain the crop productivity. Application of sulphur and boron has been found to improve soil attributes as well as the yield of sesame in this soil.

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