



INFLUENCE OF BIOCHAR AS A SOIL AMENDMENT ON YIELD AND QUALITY OF MAIZE IN ALFISOLS OF THOOTHUKUDI DISTRICT OF TAMILNADU, INDIA

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ABSTRACT: The effect of soil applied biochar with recommended dose of fertiliser and biofertiliser was investigated on maize in Alfisols of Thoothukudi District. The field experiment was laid out in a randomized block design with combination of two levels of fertiliser (75% & 100% Recommended Dose of Fertiliser) and biochar (5 t ha⁻¹ & 7.5 t ha⁻¹) with biofertiliser (Azophos 4 pockets ha⁻¹) replicated as thrice. Application of biochar with recommended dose of N, P₂O₅ and K₂O fertiliser increased the yield components of maize viz., hundred grain weight (38.9g), cob length (23.5cm), cob weight (310g), grain yield (8100 kg ha⁻¹) and stover yield (12,150 kg ha⁻¹) and also quality trait such as crude protein content. Higher yield and quality was obtained from the combination of 5 t ha⁻¹ plus 100 per cent recommended dose of N, P₂O₅ and K₂O plus biofertiliser on maize.

Keywords: Biochar, Fertiliser, Biofertilizer, Alfisols, Black carbon

INTRODUCTION

Response of crops to biochar application rate is essential for devising suitable strategy for long term carbon sequestration. In dry land tracts of Thoothukudi District are erratic rainfall distribution, drought and low carbon status. To Increase the soil fertility status, application of biochar as a soil amendment being considered to be of relevance to carbon sequestration. So we propose a new approach to C sequestration in terrestrial eco systems through the application of biomass derived – black C (biochar) to soil, which offers both a large and long term C sink. Black carbon can produce significant benefits when applied to agricultural soils in combination with some fertilisers [7]. In northern Laos grain yield of upland rice was increased; it can be attributed with application of biochar at low P availability and improved the response to N and NP chemical fertiliser treatments [1]. The three rates of biochar @ 10, 50 and 100 t ha⁻¹ produced from green waste with nitrogen application @ 100 kg ha⁻¹ recorded higher yield of radish and improving N use efficiency of the plant [3] and also the lowest application of biochar @ 10 t ha⁻¹ increases 42% yield compared with the unamended control in radish. Therefore the present study was to determine the effect of soil applied Biochar on yield and quality of maize in Alfisols of Thoothukudi district.

MATERIALS AND METHODS

A field experiment for yield and quality of maize was investigated with different levels of biochar, fertilisers and biofertilisers during September 2011 – January 2012. The experimental soil was sandy clay loam in texture with the pH, EC, CEC and organic carbon content of 6.2, 0.45 ds m⁻¹, 16 c mol (p+) kg⁻¹ and 0.43 % respectively. The soil was low in KMnO₄- N (223.4 kg ha⁻¹), medium in olsen - P (11.32 kg ha⁻¹) and low in NH₄OAc- K (270.7 kg ha⁻¹). The recommended dose of nutrients for maize as 135: 62.5: 50 kg N, P₂O₅ and K₂O hectare⁻¹. The treatment combinations comprises two levels of recommended dose of fertiliser and two levels of biochar and biofertiliser in 15 treatments viz., T₁- (control), T₂- (5 t ha⁻¹ biochar), T₃- (7.5 t ha⁻¹ biochar), T₄- (75 % RDF), T₅- (100 % RDF), T₆- (75 % RDF + biofertiliser), T₇- (100 % RDF + biofertiliser), T₈- (5 t ha⁻¹ biochar + 75 % RDF), T₉- (5 t ha⁻¹ biochar + 100 % RDF), T₁₀- (7.5 t ha⁻¹ biochar + 75 % RDF), T₁₁- (7.5 t ha⁻¹ biochar + 100 % RDF), T₁₂- (5 t ha⁻¹ biochar + 75% RDF + biofertiliser), T₁₃- (5 t ha⁻¹ biochar + 100 % RDF+ biofertiliser), T₁₄- (7.5 t ha⁻¹ biochar + 75% RDF+ biofertiliser), T₁₅- (7.5 t ha⁻¹ biochar + 100 % RDF + biofertiliser) with two replications were statistically analysed with randomized block design.

RESULTS

The result of the Initial soil physical, physico chemical, chemical properties, yield and quality of maize and their correlation status was presented in Table 1, Table 2 and Table 3.

Yield parameters (hundred grain weight, cob length and cob weight)

The combinations of biochar with biofertiliser are significantly influences the yield components of maize viz., hundred grain weight, cob length and cob weight was presented (Table 2).

Among the treatments, application of biochar @ 5 t ha⁻¹ biochar plus 100% recommended dose of N, P₂O₅ and K₂O plus biofertiliser (T₁₃) were recorded the highest hundred grain weight (38.9 g), cob length (23.5 cm) and cob weight (310 g) over other treatments and control. Yield parameters such as hundred grain weights, cob length and cob weight were correlated highly significant with each other.

Table 1. Initial Physico – chemical properties of the soil

S.No	Soil Parameters					
	Particle size distribution (A)		Physical properties (B)		Physico – chemical properties (C)	
1.	Coarse sand (%)	21.2	Bulk density (Mg m ⁻³)	1.30	Soil reaction (pH)	7.70
2.	Fine sand (%)	12.4	Particle density (Mg m ⁻³)	2.34	EC (dSm ⁻¹)	0.43
3.	Silt (%)	32.1	Water holding capacity (%)	41.4	CEC (c mol (p ⁺) kg ⁻¹)	12.3
4.	Clay (%)	33.8	Pore space (%)	36.4		
5.	Textural class	Sandy Clay Loam				
S.No	Chemical Properties (D)					
1.	Organic carbon (g kg ⁻¹)	5.43	7.	NH ₄ Oac - K (kg ha ⁻¹)		214
2.	Total nitrogen (%)	0.052	8.	Exchangeable Ca (c mol (p+) kg ⁻¹)		3.80
3.	Total phosphorus (%)	0.017	9.	Exchangeable Mg (c mol (p+) kg ⁻¹)		1.83
4.	Total potassium (%)	0.283	10.	DTPA extractable Zn (mg kg ⁻¹)		0.39
5.	Alk - KMnO ₄ - N (kg ha ⁻¹)	232	11.	DTPA extractable Fe (mg kg ⁻¹)		2.99
6.	Olsen - P (kg ha ⁻¹)	24.8	12.	DTPA extractable Cu (mg kg ⁻¹)		1.61
7.	NH ₄ Oac - K (kg ha ⁻¹)	214	13.	DTPA extractable Mn (mg kg ⁻¹)		0.89

Table 2. Hundred grain weight (g), Cob length (cm) and Cob weight (g) Grain yield (kg ha⁻¹) and Stover yield (kg ha⁻¹) of maize in Alfisols

Treatment	Hundred grain weight (g)	Cob length (cm)	Cob weight (g)	Grain yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Crude protein (%)
T ₁	17.2	15.0	155	2538	4061	5.0
T ₂	24.8	16.9	173	4600	7360	5.6
T ₃	22.8	16.4	164	4850	7760	5.2
T ₄	24.9	17.2	172	4850	6790	5.6
T ₅	28.8	18.4	210	5075	7105	6.4
T ₆	27.1	17.8	208	5000	7000	5.9
T ₇	32.0	18.7	216	5125	7175	6.2
T ₈	34.8	22.0	280	7150	10725	8.3
T ₉	34.9	22.4	304	7275	10913	8.5
T ₁₀	34.1	20.5	266	7450	11175	7.4
T ₁₁	34.2	20.1	246	7625	11438	6.9
T ₁₂	35.0	23.0	306	7700	11550	9.3
T ₁₃	38.9	23.5	310	8100	12150	9.9
T ₁₄	33.9	19.2	229	7600	11400	6.6
T ₁₅	34.6	21.6	276	7725	11588	7.7
Mean	30.5	19.5	234	6178	9213	7.0
SEd	2.1	2.3	4.8	26	35	0.15
CD (p=0.05)	4.5	4.1	6.1	55	65	0.31

(Values are mean of triplicate samples)

Grain and stover yield

Application of biochar with NPK fertilisation significantly increased the grain and stover yield (Table 2) of maize. While comparing the biochar treatment, it was evident that application of biochar to maize crop was significantly higher with combination of different levels of fertiliser. In the treatment combination, the treatment received biochar @ 5 t ha⁻¹ biochar plus 100% recommended dose of fertiliser N, P₂O₅ and K₂O plus biofertiliser (T₁₃) recorded the higher grain and stover yield of 8100 and 12,150 kg ha⁻¹ respectively.

Quality

The result of crude protein content in maize was presented in Table 2. The combination of 5 t ha⁻¹ biochar plus 100 % N, P₂O₅ and K₂O fertiliser and biofertiliser increased the quality of maize.

Table 3. Correlation of yield and quality parameters of maize in alfisols

Parameters	Hundred grain weight (g)	Cob length (cm)	Cob weight (g)	Grain yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Crude protein (%)
Hundred grain weight (g)		0.93**	0.92**	0.95**	0.91**	0.87**
Cob length (cm)	0.93**		0.99**	0.90**	0.89**	0.98**
Cob weight (g)	0.92**	0.99**		0.89**	0.99**	0.83**
Grain yield (kg ha ⁻¹)	0.95**	0.90**	0.89**		0.99**	0.83**
Stover yield (kg ha ⁻¹)	0.91**	0.89**	0.87**	0.99**		0.82**
Crude protein (%)	0.87**	0.98**	0.97**	0.83**	0.82**	

(** highly significant at 1%)

DISCUSSION

Yield parameters

The effect of combinations of biochar with biofertiliser are significantly influences the yield components of maize viz., hundred grain weight, cob length and cob weight was presented (Table 2). The result of application of biochar @ 5 t ha⁻¹ biochar plus 100% recommended dose of N, P₂O₅ and K₂O plus biofertiliser (T₁₃) were recorded the highest hundred grain weight (38.9 g), cob length (23.5 cm) and cob weight (310 g) over other treatments and control. Similar findings was observed by [2] reported that application of biochar @ 10 t ha⁻¹ recorded higher grain production in maize, wheat and also in rye grass.

Grain and stover yield

In the treatment combination, the treatment received biochar @ 5 t ha⁻¹ biochar plus 100% recommended dose of fertiliser N, P₂O₅ and K₂O plus biofertiliser (T₁₃) recorded the higher grain and stover yield of 8100 and 12,150 kg ha⁻¹ respectively. This results accordance with [4] also recorded that the lowest application of biochar @ 10 t ha⁻¹ increases 42 % yield compared with the unamended control in radish. The yield increases can be attributed largely to the ability of the biochar to increase N availability and [5] found that the cumulative maize yield to double after three repeated biochar application of 7 t ha⁻¹ over 2 years in a degraded ultisols of Kenya. The enhancement in grain and stover yield may be ascribed to increased translocation of organic material in the biochar with fertiliser treated plant increased single cob length, single cob weight, hundred grain weight due to increased source sink relationship.

Quality

The result of crude protein content in maize was presented in Table 2. Crude protein is an important factor for the quality of maize. Application of organic and inorganic nutrient combinations on quality parameters indicated that protein content of maize grain. This might be due to increase the available of nitrogen and its uptake and storage in grain. Potassium uptake by maize has also marked due to biochar with fertiliser application. [6] who reported that different types of biochar applied in soil influencing high K uptake by maize. [8] Reported that potassium can play a role in quality development of maize, when supplement K⁺ fertilisation was applied to maize, it produced on increase in grain protein content and amino acid content and [9] also supporting this high protein concept.

CONCLUSION

It could be concluded that application of prosopis biochar @ 5 t ha⁻¹ plus 100% recommended dose of fertiliser with biofertiliser increased the yield and crude protein content of maize in Alfisols of Thoothukudi District. And also this biochar has porous media which can sorbs nutrient against leaching and also improve the native carbon status. This carbon which is improves the native fertility.

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