BIOCHAR
AN ALTERNATIVE METHOD FOR STUBBLE BURNING

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ABSTRACT

At present, the air pollution of Delhi NCR added up by the stubble burning has become a serious environmental hassle, which has put the air quality index of Delhi in the category 'severe'. While blaming the farmers for this trouble, it is a choice of wise to understand the underlying root causes resulting in the stubble burning. In this decisive situation to bring up a solution for this issue, this review suggests the production of biochar from agricultural residue and utilization of the same for carbon sequestration and greenhouse gas mitigation, as a rectifying measure of stubble burning effects.

INTRODUCTION

Biochar is granular material obtained by heating crop residue at 400°C to 600°C in a kiln-shaped structure in the absence of oxygen. It is used as fertiliser to improve soil health and water-holding capacity of agriculture land. India is the second-largest agro-based economy wherein crop cultivation is taken all around the year, producing a large amount of agricultural waste, including the crop residue otherwise the stubbles. The prime means of disposing of the stubbles, in North India, is being the stubble burning that has popped out as a major issue of environment issue, severely affecting the air quality.

This steers to serious health threats and ultimately global warming. Though the GOI had sought to restrict this problem through various measures and campaigns to promote sustainable stubble management, the issue is not yet under control rather alarming rise in air pollution added by the stubble burning is the only result. The burning of stubbles causes various ill effects that are deleterious to human health, soil health, soil-dwelling organisms, ecosystem, and environment.

BIOCHAR – A PANACEA FOR STUBBLE BURNING

Biochar can serve as a potential ingredient to remediate the problem caused by the stubble burning. There are many reports available presenting the scope of biochar in improving soil nutrient status, plant productivity and mitigation of greenhouse gases and are discussed in this section. Biochar is a charred, organic, solid, porous, fine-grained, carbon-rich product obtained from the thermochemical conversion, called pyrolysis, under the condition of low or no oxygen.It is a material of comparably higher carbon content than that of its parent material, high stability and surface area of 0.5-450 m2 g - 1. It is reported to contain nutrients such as phosphorus, potassium, calcium and magnesium; and micronutrients namely copper, iron, manganese and zinc. The carbon, nitrogen content and the carbonnitrogen ratio of biochar ranged from 33.0 to 82.7 per cent, 0.10 to 6.0 per cent and 19 to 221, respectively. The biochar can be used as a soil amendment that has been reported to improve soil water and nutrient retention, soil surface area, earthworm and beneficial microorganism population.

	Biochar350	Biochar700	Low pH soil	High pH soil
Total C (%)	65.51	83.88	0.87	0.98
Total N (%)	3.82	0.66	0.10	0.12
Inorganic C (%)	0.02	0.05	ND[d]	ND
C:N ratio	17.20	128.00	8.30	8.30
pH (H_2O)	7.81	10.80	3.70	7.60
Biomass C ($\mu g\ g^{-1}$)	ND	ND	62.9	110.70
$\delta^{13}C$ value	−12.00	−12.29	−27.70	−27.90
AEC ($cmol^-/kg$)[a]	38.20	17.90	ND	ND
PCEC ($cmol^+/kg$)[b]	77.60	47.50	ND	ND
ECEC (3.7) ($cmol^+/kg$)[c]	4.50	1.40	ND	ND
ECEC (7.6) ($cmol^+/kg$)[c]	43.50	24.20	ND	ND

[a] AEC: Anion exchange capacity.
[b] PCEC: Potential cation exchange capacity.
[c] ECEC: Effective cation exchange capacity.
[d] ND: Not determined.

BENEFITS OF BIOCHAR TO THE SOIL

As a soil amendment, biochar alters the soil surface area, bulk density, pore distribution and water holding capacity adsorb both organic and inorganic contaminants and reduce nutrient leaching. It serves as a slowreleasing reservoir of nutrients in the soil. The combined application of biochar and compost had reported increased activities of β-glucosidase, FDA hydrolysis and doubled activities of soil alkali phosphatase, protease, and enzymes involved in carbon, nitrogen and phosphorous cycles. As the soil extracellular enzymes are the proximate agents of organic matter decomposition and nutrient cycling, the increased activities of the above enzymes promote the soil nutrient status. It was reported that the blended application of biochar, compost and fertilizer increased the soil N-NH_4, N-NO_3, P and K to 1.3, 1.8, 1.3, 1.7 folds, respectively.

Benefits of biochar to the plants

In general, the biochar application (exclusive or with compost and fertilizers) to the soil showed numerous positive effects on various plant metabolisms through which increased yields in various crops. Such effects of biochar on the plants were illustrated as a review concerning the vegetable crops. The usage of biochar in the vegetable crops is comparably lower and the vantages of biochar can be explored to maximize the growth and yield of vegetable crops. An increase in the plant available water (PAW) in watermelon and cowpea was noticed which was attributed by the improved available soil moisture (ASM) brought in by the biochar application at 25 t ha-1 , at a depth of 10 cm. In lettuce, improved leaf traits such as increased number of leaves plant-1 , length; width and area of leaves were found with combined application of biochar and compost to the unfertilized soil .The total plant biomass increased in cowpea with biochar application at 25 t ha-1 at a depth of 10 cm, which was due to improved tap root growth and uptake of water from finebiochar pores .Similarly, an increase in the plant dry weight was reported in lettuce with the exclusive application of biochar . The increased yield with the biochar application in various crops is apparently due to the improved soil fertility and water retention.

CONCLUSION

The large-scale rice-wheat crop rotation system practiced in India has resulted in the generation of significant quantity of crop stubble often more than the quantity of grains harvested . A considerable portion of these stubbles is usually burnt on-field to clear the farm for the next planting, thus releasing toxic pollutants to the atmosphere which leads to the deterioration of air quality. In contrast to burning, the stubbles can be exploited to yield economically valuable and environmentally friendly substances such as compost or biochar.