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**Anusuiya Panda**Department of Soil Science and  
agricultural Chemistry, IGKV  
Raipur Chhattisgarh, India**LK Srivastava**Department of Soil Science and  
agricultural Chemistry, IGKV  
Raipur Chhattisgarh, India**HL Sonboir**Department of Soil Science and  
agricultural Chemistry, IGKV  
Raipur Chhattisgarh, India**Gaurav Jatav**Department of Soil Science and  
agricultural Chemistry, IGKV  
Raipur Chhattisgarh, India**Vinay Bachkaiya**Department of Soil Science and  
agricultural Chemistry, IGKV  
Raipur Chhattisgarh, India**VN Mishra**Department of Soil Science and  
agricultural Chemistry, IGKV  
Raipur Chhattisgarh, India**Corresponding Author:****Anusuiya Panda**Department of Soil Science and  
agricultural Chemistry, IGKV  
Raipur Chhattisgarh, India

## Residual effect of biochar application on growth parameters of wheat

**Anusuiya Panda, LK Srivastava, HL Sonboir, Gaurav Jatav, Vinay Bachkaiya and VN Mishra**

**Abstract**

In a field trial different types of biochar, was used to investigate its potential for improving growth parameters of wheat crop (*Triticum aestivum* L.). The influence of biochar (biomass derived black carbon) on growth parameters varies based on the different sources of biochar applied with different doses of fertilizer. A field experiment was conducted at IGKV, research field using randomized block design. Biochars with different doses of fertilizer application improved plant growth parameters i.e. plant height, panicle length, number of effective grains per panicle, tillers/m<sup>2</sup> and test weight over the respective treatments having inorganic fertilizer without biochar and sole application of biochar. Regarding all growth parameters of wheat crop the high statistical results were achieved at higher fertilizer doses along with biochar application

**Keywords:** Wheat, biochar, rice, wheat, pigeonpea, fertilizers

**Introduction**

The growing global posterity is supposed to surely face the supreme challenge of food security; particularly, the advancing nations have greater threats for food security because they lack natural resources or severe degradation specifically of fertile soil and water. Soil degradation and nutrient depletion are global concerns and soil restoration techniques are greatly needed to increase soil organic matter (SOM), and stability of soil organic carbon (C) are required to increase productivity and minimize risks of soil degradation and environmental pollution. To this end, impacts of a range of agricultural, industrial by-products (waste materials) and composts have been studied as soil amendments to enhance crop productivity (Wells *et al.*, 2000 and Tejada *et al.*, 2001) [12, 10]. So keeping in consideration the importance of soil resources for the maximum crop yield and growth and management of environmental pollutions, the biochar is gaining a keen interest among the scientists as a sustainable technique to get the desired objectives. Biochar is a kind of charcoal also called black carbon made from feedstocks.

Biochar has potential to increase conventional agricultural productivity by improving physical conditions and fertility status of the soil. Biochar is porous in nature which sorbs more nutrient as compared to soil due to high internal porosity and it releases the nutrient slowly for the nourishment of plant (Bell and Worrall 2011) [3]. Application of biochar to the soils has been shown to reduce nutrient leaching and has positive effects on soil physical, chemical, and microbiological properties (Basso *et al.* 2013; Jatav *et al.* 2016; Parvage *et al.* 2013) [2, 4, 7]. Greater nutrient retention and direct nutrient addition by the biochar results higher nutrient availability for plants (Lehmann *et al.*, 2003) [6].

The recycling of nutrients through the conversion of organic wastes into biochar and their application as a soil amendmen is a sustainable practice for plant nutrients requirement and root traits. The root is the main bridge between the aboveground biomass of the plant and soil water, through which the plant uptakes nutrients from the soil medium (Sial *et al.*, 2019) [9]. This pathway is acted by many environmental issues, *viz.* water stress, low soil fertility, salt stress and metal toxicity (Sial *et al.*, 2019, Arif *et al.*, 2018) [9, 11].

Root length (RL) and root surface area (SA) are parameters that dictate the plant's capacity to uptake soil nutrients. The present investigation was taken up to assess the feasibility of conjoint application of biochar and doses of fertilizer on growth parameters of wheat. In all over the world, effect of biochar regarding soil quality and nutrient availability is least explored. For investigating the potential of biochar as an organic soil amendment in *vertisols* our study objectives were to produce biochar through pyrolysis process and check the effect of biochar on wheat growth, parameters at varying fertilizer rates.

## Materials and Methods

The experiment was conducted at the IGKV, farm Raipur, situated in central part of chhattisgarh. Field experiment was started in 2018-19 and continued to 2019-20 on the *Vertisol*. Research farm is situated on NH 6 in the eastern part of Raipur city and located between 20° 4' North latitude and 81° 39' East longitude with altitude of 293 m above mean sea level.

The biochars were prepared from rice straw, maize stover and pigeon pea stalk, at pyrolysis temperature of ~450-500°C in a small pyrolysis chamber (drum method).

### Agronomical measurements:

The plant height, number of tillers per m<sup>2</sup>, Spike length, number of grains per panicle were measured of five plants per plot at maturity.

### Test weight

The 1000 grains were drawn from the grain yield obtained from individual plot and their weight was recorded.

## Statistical analysis

Data was statistically analyzed by using. Standard error was calculated by using Microsoft Excel 2013.

## Results and Discussion

### Plant height

The maximum plant height at harvest in wheat 2018-19 and 2019-20 were recorded in treatment T<sub>4</sub> (100% RDF) which were significantly superior from the 50% and 75% RDF (T<sub>2</sub> and T<sub>3</sub>) during both the years.

Almost similar trend was noticed with the plant height recorded under pooled study. The increase in plant height may be attributed to the adequate supply of nutrients by the biochar and fertilizer application. Similar observations also reported that improved plant height and tillering due to biochar application was reported by Prabha *et al.*, (2013)<sup>[8]</sup> and Jatav *et al.*, (2018)<sup>[4]</sup>.

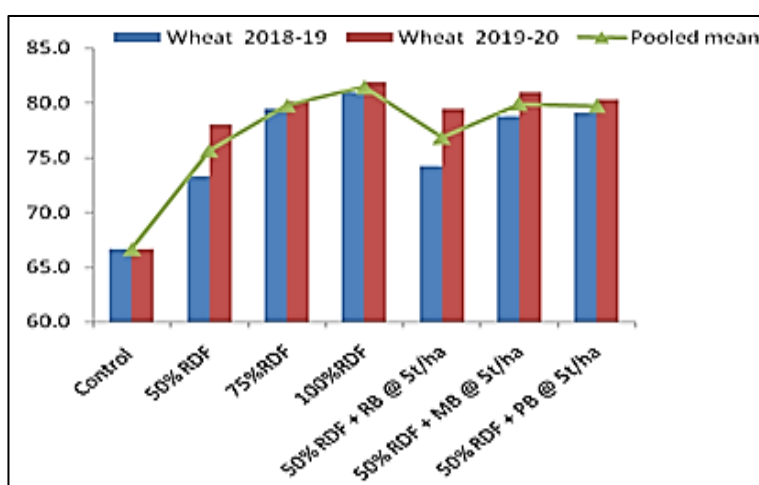


Fig 1: Residual effect of different doses of fertilizer with different types of biochar application on wheat plant height during two year

### Number of Tillers 2018-19

The maximum number of tillers were recorded in T<sub>4</sub> (100% RDF) during both the years. Different fertilizer application of biochar (T<sub>2</sub> and T<sub>3</sub>) recorded lower total number of tillers per

meter<sup>2</sup> as compared to three sources of application of RDF (T<sub>2</sub> to T<sub>3</sub>). Almost similar trends was noticed with the number of tillers per meter<sup>2</sup> under pooled study.

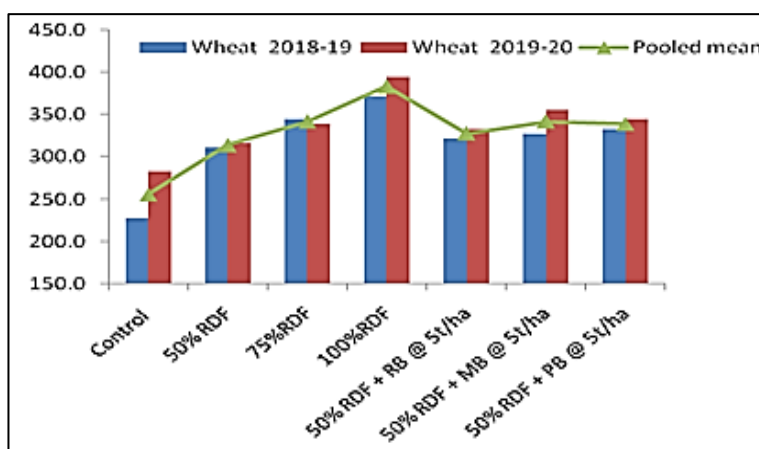
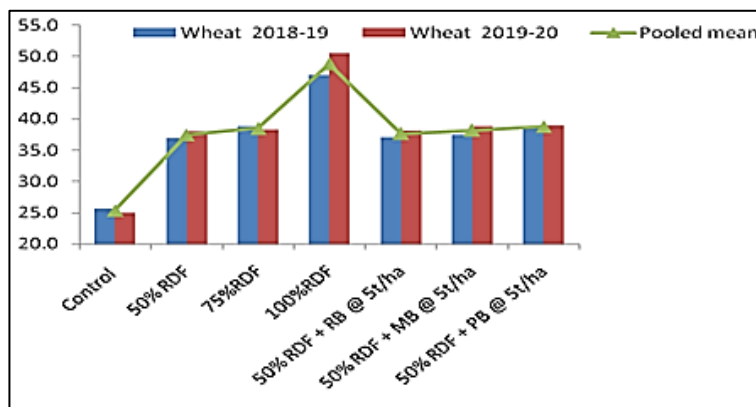


Fig 2: Residual effect of different doses of fertilizer with different types of biochar application on number of tillers per m<sup>2</sup> of wheat during two year

### Number of Grains

The maximum number of grains per spike in wheat was recorded in T<sub>4</sub>, whereas, the minimum was found in T<sub>1</sub> (control). Treatments T<sub>4</sub> (100% RDF) was increased grains per panicle over treatment T<sub>2</sub> and T<sub>3</sub> and in pooled mean.

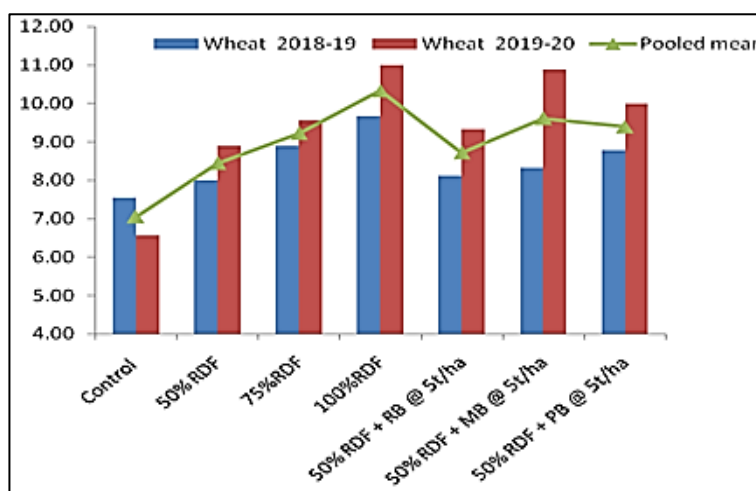


**Fig 3:** Residual effect of different doses of fertilizer with different types of biochar application on number of grains of wheat during two years

**Panicle Length**

Panicle length of wheat significantly increased with 100% RDF (Fig.4) as compared to T<sub>1</sub> (Control). Application of three sources of biochar (rice, maize and pigeon pea biochar) with 50%RDF (T<sub>5</sub> to T<sub>7</sub>) resulted in a significant increase in the length of panicle over control. However, it was at par with

each other. The maximum length of panicle (10.33 cm) was found in T<sub>4</sub> (100% RDF) over control (T<sub>1</sub>). The possible reason could be that the porous nature of biochar improved physical conditions of soil, resulting in increased rate of nutrient release in the soil. (Zang *et al.* 2000) [13].

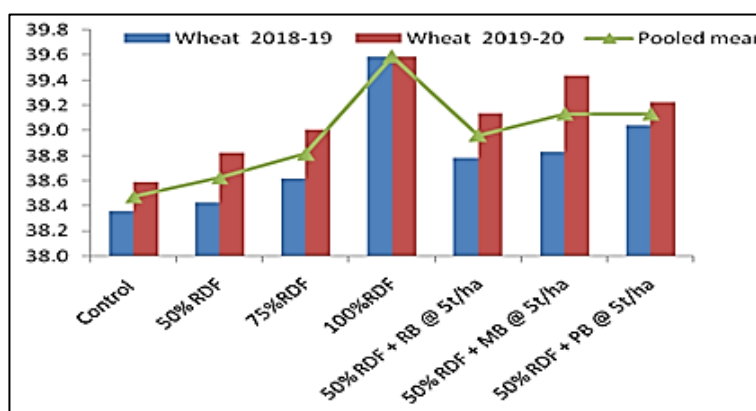


**Fig 4:** Residual effect of different doses of fertilizer with different types of biochar application on wheat panicle length during two years

**1000 seed weight**

The pooled mean of test weight (1000-grain weight) were varied from 38.48 to 39.59 g of wheat. It's evident from the

data that different treatments did not show significant effect on test weight of wheat in years 2018-19 and 2019-20.



**Fig 5:** Residual effect of different doses of fertilizer with different types of biochar application on test weight of wheat during two years

**Conclusion**

The result showed that the grain and straw yield of wheat could be increased with conjoint application of 50% fertilizer with three sources of biochar (rice, maize and pigeon pea).

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