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Impact of railway line coal dust of NTPC, Sipat on soil physical properties and yield of rice crop

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Abstract
The experiment was conducted on the Mari go round railway line of NTPC, Sipat, Bilaspur (C.G.) with the object to study the effect of coal dust on soil physical properties and yield of rice crop 2018-19. The experiment was laid out in a factorial randomized block design with three factor and three replications with total one hundred forty four soil sample. The soil physical properties includes bulk density which was higher at nearby site (10 m) of the studied area while particle density and porosity percentage were higher at closer site (10 m site) of the area. The particle density of the analyzed soil sample was higher at 10 m site and lower at control site. Porosity percentage was inversely related with the bulk density. Soils of the nearby site (10 m) of the studied area were sandy clay to silty clay loam. The factor A and factor B of the studied area showed non-significant result in case of all three properties i.e., bulk density, particle density and porosity percentage. The yield of rice crop and their straw were low at nearby site (10 m) of the studied area.

Keywords: MGR line, porosity percentage

1. Introduction
Coal is a black brown colored sedimentary rock substance and also known as black diamond. Carbon is a main constituent of coal and it contains some variable elements which include sulphur, oxygen, hydrogen and nitrogen. Coal is a result of decomposition of the dead plant which is decayed in the peats under the high heat, pressure and temperature over the thousand years, these dead plant and other organic substances are decomposed by the microorganism in different climatic situations and in different strata of the earth. Coal is a nonrenewable source of energy.

Coal is used as a primary and chief source of the electricity production worldwide and act as a primary source of the energy. The extraction or mining of the coal gives high benefits to any country but it has certain limitations and drawback in the form of illness, various health and environment related problems which includes premature death, lung diseases and environmental pollutions. Coal is the biggest source of the CO_2. It is responsible for the greenhouse effect and global warming, as a result of that sudden change in the climate of the earth.

Coal ash is an ultimate byproduct of the coal burning (Fay and Golomb, 2002) [3]. Ash is a mineral or inorganic residual component of the coal and it is noncombustible in nature. Addition of the ash provides some nutrients to the soil which improve the yield of the crops. Coal is primary fossil fuel for the different power station involved in the power generation in India and its main byproduct is fly ash which is about 15-30% of the total residue of the coal. Fly ash particle causes some serious ill effect to human health, plant and animal when dumped in soil (Page *et al.*, 1979 and Borm, 1997) [11, 1]. Road and coal dusts from various sources have different effects on plant. Some have positive effect which promotes the root growth and other has negative effect which retards the root growth and it also has different impacts on soil microbial population. Soil organic carbon in soil has direct relation with the fertility of the agricultural soil.

2. Materials and methods

2.1 Geographical locations

National Thermal Power Corporation Limited, Sipat comes under the Sipat block of district Bilaspur in Chhattisgarh state lies under Chhattisgarh plain agroclimatic zone at 22.13° N latitude and 82.29° E longitude with an altitude of 264 meter from mean sea level. It is situated 22 km away from Bilaspur on Bilaspur – Balouda Road.

2.2 Selection of study area

The experimental sites for the soil sampling were selected from three different locations around the coal transported railway track. Soil samples were collected from three different locations (cultivated land, forest land and mixed land) between the Dipika village and NTPC, Sipat, Bilaspur, where transportation of coal by trains occurs. The loading and unloading of coal occurs inDipika and NTPC, Sipat respectively. Samples were collected from both left and right side of the railway track. Samples were collected from 10 meter, 500 meter, 1000 meter and 1500 meter away from the track in all the three selected location. Sample collected from 1500 meter will treated as control.

2.3 Methodologies for soil analysis

The research includes four soil physical properties i.e. bulk density, particle density, porosity percentage and soil texture analysis. The bulk density of the soil was analyzed by core sampler method, particle density analyzed by pycnometer method, soil texture analysis by International Pipette method (Piper, 1966) [12] and porosity percentage by indirect method using particle density and bulk density.

3. Results and discussion

3.1 Impact on bulk density, particle density and porosity percentage of the soil

Table: 3.1 depicted that the bulk density, porosity percentage and particle density of the factor A and factor B was found non-significant. In case of factor C, the maximum bulk density (1.40 Mg/m^3) and particle density (2.60 Mg/m^3) were recorded at 10 m site of the studied area while it was found lower at control site (1.28 Mg/m^3 bulk density and 2.34 Mg/m^3 particle density). The porosity percentage was maximum (49.68) in control site (1500 m) which was statistically at par with 1000 m site (47.16) the and minimum at 10 m site (40.09). Similar results were reported by Ghosh *et al*. (2010) [4], Kohli and Goyal (2010) [8], Mohapatra and Goswami (2012) [10], Sharma and Kalra (2012) [14] and Mishra *et al*. (2017) [9].

Table 3.1: Bulk density, particle density of and porosity percentage the soil under different zones and distances of study area

Tr. No.	Treatment detail	Bulk density (Mg/m^3)	Particle density (Mg/m^3)	Porosity percentage
Factor A- Location at railway track				
1	Crop zone	1.36	2.49	46.13
2	Forest zone	1.31	2.46	46.60
3	Mixed zone	1.35	2.44	43.64
CD (5 %)		NS	NS	NS
Factor B- Side from railway track				
1	Right Side	1.33	2.44	46.21
2	Left side	1.35	2.49	44.71
CD (5 %)		NS	NS	NS
Factor C- Distance from railway track				
1	10 m	1.28	2.60	40.09
2	500 m	1.32	2.51	44.90
3	1000 m	1.37	2.42	47.16
4	1500 m	1.40	2.34	49.68
CD (5 %)		0.082	0.120	3.9

3.2 Impact on soil texture

The analyzed result of the soil sample as showed in Table: 3.2 that the silt and sand content were higher at the closer site (10 m) of the Mari go round railway track which turn soil into loamy, sandy loam and silty loam. The loamy and sandy loamy nature of the soil may be due to the minute particles which were present more at 10 m site while in far point of the study area clay and silt content was more. The soil texture reported by Gore (1994) [5], Ghosh *et al*. (2010) [4], Mohapatra and Goswami (2012) [10] and Sharma and Kalra (2012) [14] were similar.

Table 3.2: Textural classification of soil of the studied area

Treatments	Direction	Distance	Relative percentage of soil particles and textural class			
			Sand	Silt	Clay	Textural class
Location-1 (cultivated / crop land)	Right side from railway track (Khanda and Parsahi)	10 m	33.44	20.8	45.76	Silty Clay soil
		500 m	26.4	13.8	59.8	
		1000 m	24.52	31.08	44.4	
		1500 m	39.24	21.7	39.06	
	Left side from railway track (Baniyadih and Juhali)	10 m	47.68	17.44	34.88	Clay Soil
		500 m	31.20	30.10	38.70	
		1000 m	23.84	31.36	44.80	
		1500 m	35.04	18.56	46.40	
Location -2 (forest land)	Right side Nirtu forest	10 m	62.92	12.36	24.72	Sandy Clay Loam
		500 m	57.32	12.80	29.87	
		1000 m	33.40	26.64	39.96	Silty Clay Soil
		1500 m	52.61	17.23	30.15	Sandy Clay Soil

	Left side Nirtu forest	10 m	65.85	08.53	25.60	Sandy Clay loam
		500 m	32.16	29.68	38.16	Clay Soil
		1000 m	47.92	17.36	34.72	
		1500 m	53.44	16.92	29.62	Sandy clay loam
Location -3 (mixed land)	Right side Newasa area	10 m	57.00	12.90	30.10	Sandy clay Soil
		500 m	66.08	8.48	25.44	
		1000 m	68.16	11.94	19.90	Sandy loam Soil
		1500 m	57.20	17.12	25.68	Sandy Clay Loam
	Left side Newasa area	10 m	71.16	8.24	20.60	Sandy Clay Soil
		500 m	59.00	16.40	24.60	Sandy Clay Loam
		1000 m	58.52	12.44	29.03	
		1500 m	71.24	12.31	16.43	Sandy Loam Soil

3.3 To evaluate the impact of coal dust on rice yield of farmer's field

The yield of rice crop near (10 m) the railway line was less (36.86 q/ha) than the far (42.62 q/ha) other sites of the studied area. The rice yield at 500 m site (40.96 q/ha) and 1000 m site (41.96 q/ha) showed statistically at par result with the maximum. The straw yield was maximum at 1500 m site (46.27 q/ha) which was statistically at par with 500 m site (44.60 q/ha) and 1000 m site (45.71 q/ha) while significantly higher than 10 m site (38.63 q/ha). The yield of rice crop near (10 m) the mari go round railway line was less than the far other sites of the study area. In general yield of a crop is depends on number of factors in production system. Out of them, plant physiological activities, soil type and its fertility, water and fertilizer management, variety, sowing method, time of sowing, plant population, plant protection measures etc are main factors. Similar results were reported by Gupta *et al*. (2002) [6], Chakrabarti *et al*. (2014) [2], Huang *et al*. (2015) [7], Zhan *et al*. (2016) [15] and Sett (2017) [13].

Table 3.3: Grain yield and straw yield of the rice crop of the studied area

Treatment no	Treatment detail	Grain Yield (q/ha)	Straw yield (q/ha)
Factor B - Side from railway track			
1	Right	40.01	43.33
2	Left	41.18	44.27
	CD (5%)	NS	NS
Factor C- Distance from railway track			
1	10 m	36.86	38.63
2	500 m	40.96	44.60
3	1000 m	41.96	45.71
4	1500 m	42.62	46.27
CD (5 %)		3.65	3.74

4. Summary and Conclusion

- Cropped zone of the studied area contains more particle density. Forest zone had less bulk density and high porosity percentage. Mixed zone had less particle density and porosity percentage. The soils near to railway line were sandy loam to silty clay loam.
- Left side of the studied area contains more bulk density and particle density while right side contains more porosity percentage.
- The closer site of the studied area (10 m site) had more particle density and bulk density than the far control site (1500 m). The porosity percentage was higher at control site (1500 m).
- Grain and straw yield of rice was more at far distance (1500 m) and right side of the studied area.

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