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Research Article

STUDY OF THE EFFECT OF ORGANIC MANURE AND EARTHWORM (*PHERETIMA POSTHUMA*) INOCULATION ON QUALITY OF COAL MINE SOIL

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ABSTRACT
Open cast coal mines produces underground soils that contains are devoid of organic humus and high degree of salts that make it unsuitable for vegetation. The physic-chemical characteristics, bacterial population and heterotrophic respiration of coal mine soil with and without organic manure of FYM and Poultry litter (PFM) supplemented with earthworm (*Pheretima posthuma*) inoculation have been studied over the incubation period of 30 days. Amended soil indicated enhanced pH , % carbon , amount of N,K and P with respect to Control.FYM and earthworm treated soil indicated highest (53.74 18.14 103 cfu/g) bacterial count and heterotrophic respiration (21.7 0.13 mg/ha/hr) followed by poultry farm litter with earthworm amended soil. The least values were obtained in unamended soil. Earthworm amended soil enhanced bacterial load and heterotrophic respiration in both FYM and PFL amended coal mine spoiled soil.

Key Words: *Coal Mine Spoiled Soil, Physicochemical Characteristics, Bacterial Load and Heterotrophic Respiration*

INTRODUCTION
Coal mining in India involves extraction of coal from earth bed and damages the quality of top soil by removing it for excavation of coal mines. This practice damages the environment besides causing serious damage to the microflora and fauna of the soil.
The Jharkhand state occupies an important position in the coal mining activities. All coal mines are open cast which produce large quantity of overburden of underground soil and spoiled soil bed which are dumped in open. These dumped spoils are exposed to heat during summer of May –June and rain of July-September month resulting in withering and leaching of the soil nutrients, loss of microbes and microbial enzyme activities. The microflora such as bacteria fungi and actinomycetes as well as fauna like earthworm reported to play very significant role in mineralization of dead organic matter in soil (Lee, 1985). Thus, mine soil spoil needs organic inputs like microflora and fauna as well as organic matter. These inputs could supply substantial amount of nutrients coupled with improved biological activities (Lal, 1991 and Winding, 1997).
There are reports available which showed the beneficial effect of earthworm on the soil through increasing microbiological effect of earthworm on the soil through increasing microbiological population and soil metabolism (McLean *et al.*, 2006). However combined effect of earthworm and organic manure amendments are limited. This study was aimed to investigate the effect of evolution on some major physiochemical properties such as change in pH, % C, Amount of N, P and K as well as heterotrophic respiration (evolution of CO_2) on the coal mine spoiled soil.

MATERIALS AND METHODS
The old dumped spoiled mine soil was collected randomly from Sikni colliery mines in Latehar district ($23^0$50’ N lat. and $84^0$15’E log.) of Jharkhand during the month of August 2011. The Farm yard manure (FYM) and Poultry farm litter (PFM) were obtained from Goel dairy farm and Yakoob Poultry farm respectively. The earthworm was collected from Chianki Farm house of Birsa Agriculture University, Kanke, Ranchi.

The powdered form of 400 g FYM and PFM was mixed thoroughly with 2.o kg of fine sieved spoiled mine soil taken in three sets in polythene packet. Three sets of unamended soil was also taken and kept in the experiment as control (C1). These sets of soil were kept in room temperature and 80 % humidity was maintained by sprinkling distilled water at regular interval. One set of sample was inoculated with earthworm (Pheretima *posthuma*) (F1 and P1) and other two sets (F2 and P2) were maintained without worm inoculation. After inoculation the soil sample were examined after 7^{th}, 15^{th} and 30^{th} days for physicochemical, bacterial load and heterotrophic respiration.

Physicochemical Analysis

For the entire sample physiochemical studies were done for pH and % C, amount of Nitrogen, phosphorus and potassium. For this study soil was crushed air dried and sieved through 2 mm sieve. pH was determined through digital pH meter,% of carbon was measured by the method adopted by Walkey and Black(1934). Amount of soil phosphorus, was determined by Olsen *et al.*, (1954) method. Nitrogen amount was determined by Lee (1999) method and amount of potassium was determined by Chapmann and Pratt (1979) method.

Microbiological Analysis

Bacterial load of all the treatments were studied by dilution plate count method using Muller Hilton broth medium and expressed in cfu/g soil (ICMSF, 1978).

Heterotrophic Respiration Analysis

Heterotrophic analysis in the form of soil respiration (evolution of CO_2) was measured by alkali trap method (Carter, 1993).

RESULT AND DISCUSSION

The data of the experiment for pH, %C, N, P and K have been presented in Table 1; the data of bacterial load and heterotrophic respiration were presented in Table 2 and 3 respectively along with their standard deviation (SD). The spoiled soil amended with 20 % FYM and PFM showed an enhancement in pH. The maximum enhancement (7.21±0.5) of pH was recorded in FYM + worm (F1) in 15^{th} day old incubation. The minimum (5.16±0.12) of pH was recorded in control in 30^{th} day of incubation. PFM + worm (P1) showed enhanced pH but lesser than F1. Effect of F1 and P1 were more pronounced than F2 and P2. The amendment of soil with or without FYM and PFM has changed the soil pH from near acidic to neutral or near alkaline indicating that amendment has created a favorable condition for microbial growth. The percent organic carbon level of the spoiled soil was recorded the maximum amount in PFM+ worm(P1) amended soil (0.84±0.03) followed by FYM+ worm(F1) amended soil (0.81±0.16) in 30 days of incubation and lowest was recorded in control(0.05±0.14) in 30 days of incubation. Per cent organic carbon level increased from 7^{th} day to 15^{th} days in both amended and unamended soil thereafter declined on the 30^{th} days of incubation. Amount of nitrogen phosphorus and potassium was also recorded to be increased from 7^{th} days to 15^{th} days and maximized in 30^{th} days of incubation in FYM+ worm amended treatment followed by PFM+ worm amended treatment. In FYM and PFM amended treatment (F2 and P2) amount of N, P and K was recorded lesser than F1 and P1 treatment in similar incubation period but more than control. The maximum bacterial population (53.74±18.13 $x10^3$ cfu/g) was recorded in F1 at the end of 30^{th} days of incubation followed by P1 in the same incubation period. Minimum bacterial population was recorded in control on the same days of incubation. In F1 and P1 the bacterial population count steadily increased from day 7^{th} to 30^{th} days of incubation. The bacterial count was found highly significant in all the amended treatment with respect to control. In amended soil (C) bacterial population decreased from 3.6 ±1.16 to 2.7±0.02 $x10^3$ cfu/g) from 7^{th} days to 30^{th} days of incubation.

Microbial respiration (CO_2) evolution in $mg/m^2/hr$) exhibited enhanced in all amended treatments in comparison to control. Highest (21.70 ±1.31 $mg/m^2/hr$) CO_2 evolution was recorded in F1 followed by P1 amended soil in the 30^{th} days of incubation. Least CO_2 evolution (5.2 ±0.16 $mg/m^2/hr$) was recorded in control in the same days of incubation. In both amended with worm and without worm the soil respiration was recorded increased from 7^{th} days to 30^{th} days of incubation.

Table 1: mean and SD value of Physico-chemical analysis

S. No.	Treatments → / Days → / Properties	C			F1			F2			P1			P2		
		7	15	30	7	15	30	7	15	30	7	15	30	7	15	30
1	PH	5.41 ± 0.02	5.32 ± 0.03	5.16 ± 0.12	6.71 ± 0.31	7.21 ± 0.15	6.93 ± 0.36	6.63 ± 0.16	7.12 ± 0.43	7.34 ± 1.06	6.90 ± 0.36	7.06 ± 0.21	6.69 ± 0.54	6.53 ± 0.61	7.73 ± 0.33	7.41 ± 0.16
2	% C	0.16 ± 0.003	0.07 ± 0.03	0.05 ± 0.14	0.61 ± 0.03	0.83 ± 0.02	0.81 ± 0.16	0.34 ± 0.26	0.38 ± 0.21	0.38 ± 0.46	0.7 ± 1.01	0.79 ± 2.01	0.84 ± 0.03	0.54 ± 0.02	0.58 ± 0.01	0.59 ± 0.06
3	N(kg/ha)	0.2 ± 0.6	0.23 ± 1.02	0.22 ± 0.20	1.67 ± 0.13	1.91 ± 0.07	2.18 ± 0.19	0.98 ± 0.03	1.03 ± 0.41	1.47 ± 0.39	1.61 ± 0.12	1.78 ± 0.18	1.69 ± 0.24	1.52 ± 0.21	1.61 ± 0.01	1.64 ± 0.21
4	P(kg/ha)	3.48 ± 0.05	4.10 ± 0.04	4.03 ± 0.01	17.06 ± 0.01	18.26 ± 0.02	18.36 ± 0.01	12.06 ± 0.03	12.21 ± 0.05	12.20 ± 0.03	16.28 ± 0.15	17.66 ± 0.02	17.59 ± 0.19	11.71 ± 0.03	11.98 ± 0.18	11.91 ± 0.13
5	K(kg/ha)	79.73 ± 0.03	81.69 ± 0.34	84.01 ± 0.01	98.40 ± 0.03	104.36 ± 0.02	111.40 ± 1.01	86.18 ± 0.03	84.33 ± 0.17	82.80 ± 0.71	91.40 ± 0.12	97.0 ± 0.01	103.0 ± 0.01	88.01 ± 0.21	84.16 ± 1.61	80.20 ± 0.31

Table2: Bacteriological population (10^3 cfu/g soil) means ± SD

S. No.	Days	C	F1	F2	P1	P2
1	7	3.6 ± 1.16	41.7± 13.70	29.9± 2.16	36.4± 1.43	19.3± 3.7
2	15	3.1± 0.02	48.3± 12.60	29.6± 11.06	41.3± 11.13	25.6± 6.21
3	30	2.7± 0.02	53.74± 18.13	37.8± 9.11	47.35± 16.10	39.53± 10.14

Table 3: soil respiration (CO_2 evolution) in mg/m^2/ hr) mean ± SD

S. No.	Days	C	F1	F2	P1	P2
1	7	7.3± 0.13	15.4± 1.01	9.2± 1.17	12.1± 0.16	6.0± 1.13
2	15	6.5± 1.02	18.1± 2.11	12.7± 0.01	16.3± 0.02	9.2± 0.12
3	30	5.2± 0.16	21.7± 1.31	18.3± 0.03	20.7± 0.01	11.2± 0.12

In control (C), however, CO_2 evolution decreased in the same incubation periods. All the treatment sets showed significantly higher CO_2 evolution in comparison to control. The soil amended with FYM was reported to be improves the physicochemical properties (Lee, 1985). Nowadays poultry farm manures also has shown similar results. It is established fact that earthworm play an important role in the development of organic matter and nutrients turnover (Winding *et al.*, 1979). In neutral soil pH % C and N amount present in soil microbial respiration was reported to be optimum (Ross and Roberts, 1970). Pierzynski *et al.*, (1994) have reported that soil microbe's population significantly declined in mined soil in comparison to non mined soil. Similar observation was obtained in the present study.

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REFERENCES

Carter MP (1993). Soil sampling and methods of analysis. *Lewis Publishers*, Toronto.

Chapman HD and Pratt PF (1979). Methods de analisis para suelos, plantasyaguas. Editorial Trillas, Maxico.

Herry M, Singer AC, Kumaresan D, Bodoross L, Parese NS, Prosser JI, Thompson IP and Murell JC (2008). Effect of earthworms on the community structure of active methanotrophic bacteria in a landfill cover soil. *The ISME Journal* **2** 92-104.

ICMSF (1978). Inern Comm Microbiol. Specific for foods. Microorganisms in food. Their significance and methods of enumeration 2nd Edition University of Toronto press, Toronto.

Lal R (1991). Soil conservation and biodiversity. In: The biodiversity of microorganisms and invertebrates its role in sustainable agriculture. Howksworth, DL (Edition), CAB International **89**-104.

Lee KE (1985). Earthworms. Their ecology and relationship with soil land use. *Academic Press Sydney* 441.

Lin C, Tong X, Lu W, Yan L, Wu Y, Nie C and Long J (2004). Environmental impact of surface mining on mined land, affected streams and agricultural land in the Dabaoshan mine region, South China. *Land Degradation and Development* **16** 463-474.

Mc lean, MA Migse- Klean S and Bormann BT (1994). Baises of chamber methods for measuring soil CO_2 efflux demonstrated with a laboratory apparatus. *Ecology* **75** 2460-2463.

Olsen SR, Cole CV, Watanabe FS and Dean LA (1954). Estimation of available phosphorus in soils by extraction with sodium bicharbonate. *USDA Circular* **75** 2460-2463.

Pierzynski GM, Schnoor JL, Banks MK, Tracie JC, Litch LA and Erickson LE (No Year). Vegetative remediation at super faunal site, mining and its environmental impacts: Royal Society of Chemistry 49-69.

Ross DJ and Roberts HS (1070). A study of activities of enzymes hydrolyzing sucrose and starch and oxygen uptake in a sequence of soils under tussock grassland. *Journal of Soil Science* **19** 186-196.

Walkey A and Black IA (1934). An examination of the Degtjareff method for determining organic carbon in soils. Effect of variations in digestion condition and of inorganic soil constituents. *Soil Science* **63** 251-263.

Winding A, Ronn R and Hendrikson NB (1997). Bacteria and protozoa in soil microhabitats as affected by earthworms. *Biology and Fertility of Soils* **24** 133-140.