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Full Length Research Paper

The Effect of *Aloe Vera* Juice to Control the Physical, Chemical and Biological Parameters of Soils and Protect the Life of Earthworm

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Abstract

Earthworm is life of soils. It regulates soils productivity, humidity and concentration of water, oxygen, minerals, temperature and pH. The life of earthworm is getting destroyed by application of artificial insecticides, pesticides, herbicides, fertilizers, various types of wastes and acid rain. These killer substances change physical, chemical and biological properties of soils and generate corrosive atmosphere for earthworm. These pollutants change the concentration of natural minerals which are present in soils by increasing the acidic character of soils. The acidic soils develop microbiological corrosion cell with earthworm and it oxidize carbohydrate, protein and fat into CO_2, H_2O, NH_3, glycerol and organic acid. Corrosion reaction increases the temperatures of soils and finally kill earthworm. Heavy metals and gaseous pollutants come into soil by different medium which produce corrosive effect for earthworm. Pyrite ores of industrial area enter into soil to form acid and that acid is corroding earthworm. These foreign materials contaminate soil and reduce the fertility of soil. *Aloe vera* juice is applied to control the pH values of soils and protect the life of earthworm. The experimental work shows that *Aloe vera* has capability to control the physical, chemical and biological parameters of soils and it also enhances the fertility and productivity of soil and protects the life of earthworm by corrosive pollutants. For this work soil samples are taken from the coal area of Jhariya district (in Dhanbad), steel plant area Chas in Bokaro district, urban area of Chak Beyriya in district of Patna and village area of Fulwariy-Tajpur in district of Chapra.

Keywords: Soils, Earthworm, Biological corrosion cell, Pollutants, pH, *Aloe vera*.

INTRODUCTION

Earthworms are very important components of soils because they can regulate fertility of soils (Bloomfield et al., 2006) its humidity (Baxter et al., 1975) and pH (Balthaor et al., 1985). But these organisms are destroyed (Arias-Estevem et al., 2008) by interaction of industrial's pollutants, effluents, flues, hazardous wastes, municipal wastes, households wastes, hospital wastes, artificial fertilizers, pesticides, insecticides, herbicides, rodenticides, particulates, corrosive gases, acid rain and global warming. These substances are mostly acidic and basic in character and they can form a microbiological corrosion cell (Chem et al., 2007) with earthworms' thus biological corrosion reaction starts with these species and in this way their morphology can be changed which leads to the destruction of these organism in soils (Celis et al., 2002). These harmful substances change physical, chemical and biological properties of soils. They can disturb pH values and minerals composition of soils (Dekker et al., 2004).

The major sources of corrosive pollutants, effluents, flues and hazardous wastes are chemical industry, acid manufacture, sugar, coal mines, washery, coke manufacture, distillery, electroplating, paint manufacture, petroleum refinery, plastic manufacturer, pulp and paper industry, steel industry, tannery, textile processing, electronic equipment, city waste, fertilizer industry, pesticides and herbicides industry, mining and ore processing, metallurgy, chemical industry, alloys,

leather, electrical power plant, nuclear reactor, soap and detergent industry, synthetic rubber, medicines, cosmetics, adhesives, explosives, salts, food processing, automobile industry, bricks making industry, rice and flour mills, glass and ceramic industry, cement industry which are contaminating soils.

The above mentioned industries release directly and indirectly harmful hazardous wastes into ponds, lakes, canals, rivers, sea and ocean and these pollutants can contaminate soils (Eggleton et al., 2004), atmosphere (Eriksson et al., 2007) and water sources (Feng, 1990). Ponds, canals, rivers and ground water are used for irrigation of soils and this polluted water sources create corrosive environment for earthworms (Feng et al., 2006).

The inorganic pollutants are oxide of carbon, oxide of nitrogen, oxide of sulphur, oxide of halogen, hydride of sulphur, hydride of halogen, ammonia and organic pollutants are aldehyde (formaldehyde, acetaldehyde) and ketone (acetone), carboxylic acid (formic acid and acetic acid), pyridine, alcohol (methyl alcohol, ethyl alcohol), thiol (methylthiol, ethylthiol), methyl isocyanide, amines (methylamine and ethylamine) released by various industrial and nonindustrial sources. The concentrations of these pollutants are increased into atmosphere and they absorb moisture to convert into acids (Ghanem et al., 2007). These acids convert into cloud and come into soils by rain. These acids produce not only bad effects on soils and earthworms but also change the pH value of soils.

This work focused on protection of earthworm and maintained the fertility of soil and their important components. The soil toxicity has be controlled by application of *Aloe Vera*. It can also save the life of earthworm.

Acid rain can play important role for destruction of soils' organisms (Gurses et al., 2004) and adversely affect pH of soils (Lombardi et al. 2006). Soils possess natural minerals like Na, K, Fe, Cu, Zn, P, N_2, O_2 and the composition of these minerals are reduced by acid rain. The concentration of CO_2, CH_4 and water vapor are increased in atmosphere so the earth's temperature is raised and it creates problems for the survival of soils organisms.

Particulates come into atmosphere due to large scale industrialization, urbanization, deforestation, agriculturalization, infrastructure development works, mining and minerals processing works, stones breaking works, constructions works, making of railway tracks etc. These particulates contain heavy metals Fe, Cr, Co, Ni, Cu, Zn, Mo, As, Pb, Bi, and soot's of carbon, sulphur and fly ash. These metals are deposited on the surface of different components of environment and enter into soils directly and indirectly through various sources. These heavy metals contaminate soil and alter soils physical, chemical and biological properties. They also develop hostile environment for soil organisms (Wick et al., 2007) and change its pH values.

METHODOLOGY

Collecting soils of different region like mining area (Jhariya in district of Dhanbad), industrial area (Chas in district of Bokaro), urban area (Chak Beyriya in district of Patna) and village area (Fulwariy-Tajpur in district of Chapra) and examine their pH values, concentration of minerals and oxygen and temperature. Earthworms are dispersed in different types of soils in the absence and presence of *Aloe Vera* and their physical, chemical and biological activities were observed at mention concentrations of *Aloe Vera*, temperatures and times. The pH values of soils are recorded in different areas absence and presence of *Aloe Vera* juice at intervals of time. Earthworm's biological corrosion activities are calculated at 24hrs, 48hrs, 72hrs, 96hrs and 120hrs.

RESULTS

Analysis of pH values of soils in different regions and their values are mentioned in Table 1. It is observed that mining area soils are more acidic with respect of other areas. The number of earthworms aided in various types of pH values of soils are counted at different intervals of time and the results are depicted in table 1 and figure 2. Results of table 1 and figure 2 indicated that mining area soil killed more earthworms. The acidic soils developed bio-electrochemical cell with earthworms and oxidized its amino acids and carbohydrates into ammonia, water and carbon dioxide. Fat dissociated in form glycerol and organic acids in presences of acids which oxidized into alkane and carbon dioxide. The bio-electrochemical cell occurs with earthworm and its mechanism as it is shown in figure1.

Anodic reaction with ammonia acids

$$NH_2CH_2COOH + 2\,H_2O/H^+ \rightarrow 2CO_2 + NH_3 + 6H^+ + 4e$$

Cathodic reaction

$$2H^+ + 2e \rightarrow H_2$$

Anodic reaction with carbohydrate

$$C_6H_{12}O_6 + 6H_2O/H^+ \rightarrow 6CO_2 + 24H^+ + 24e$$

Cathodic reaction

$$2H^+ + 2e \rightarrow H_2$$

Anodic reaction with Fats

$$C_3H_5(OCOR)_3 + H_2O/H^+ \rightarrow C_3H_5(OH)_3 + 3RCOOH$$

Fat Glycerol Fatty acid

$$RCOOH \rightarrow RCOO^- + H+$$

$$2RCOO^- \rightarrow R\text{-}R + 2CO_2 + 2e$$

Cathodic reaction

$$2H^+ + 2e \rightarrow H_2$$

Bioelectrochemical reaction mechanism for earthworms indicated that they are corroded in acidic

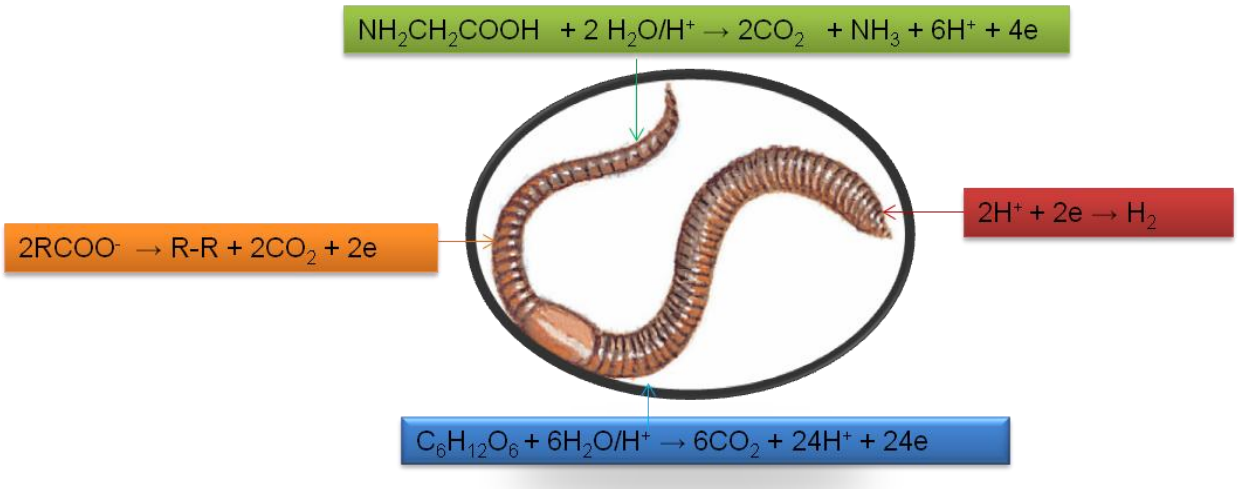

Figure1. Bioelectrochemical corrosion reaction with earthworm

Table1. pH values of soils without *Aloe vera* juice in presence of earthworm

Soils of different regions (150g)	pH value	Earthworm Number	24hrs	48hrs	72hrs	96hrs	120hrs
Mining area (Jhariya in Dhanbad)	5.6	25	18	15	11	6	1
Industrial area (Chas,Bokaro)	6.2	25	20	17	14	12	9
Urban area (Chak Beriya)	6.4	25	22	19	16	13	10
Village area (Fulwariya, Chapra)	6.7	25	24	23	20	18	15

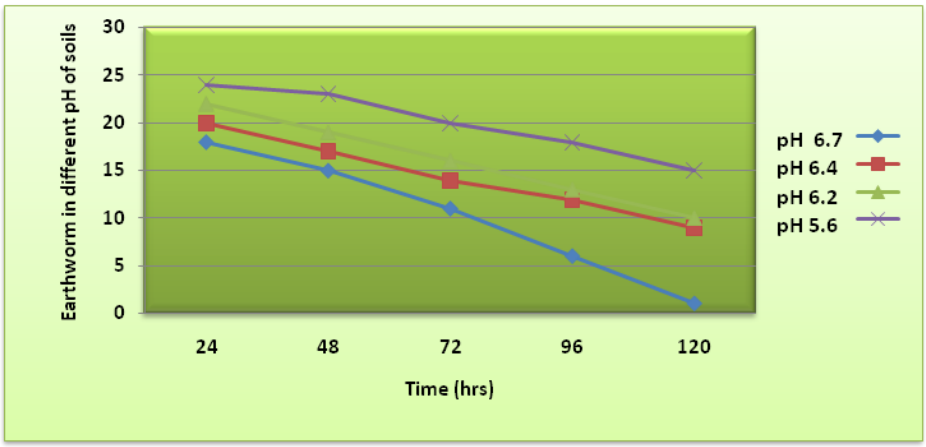

Figure 2. Numbers of earthworm in different pH of soils Vs. time (hrs)

medium. *Aloe Vera* is used to control corrosive nature of soils. The solution of *Aloe Vera* was aided into different pH values of soils at variation of times and it results were recorded in table 2 and figure 3. The results of table 2 indicated that pH values of soils increased after addition of *Aloe Vera* and it minimized biological corrosion reaction. It is observed that number of earthworms increased after addition of Aloe Vera. It suppressed the concentration of H^+ ions and controlled formation of biological corrosion cell.

Earthworm's weight was measured in absence and presence of Aloe Vera into different pH values of soils

Table 2. pH values of soils with *Aloe vera* in presence of earthworm

Soils of different regions (150g)	pH	No. of Earthworms	24hrs	48hrs	72hr	96hrs	120hrs
Mining area (Jhariya in Dhanbad)	6.0	25	24	27	29	32	35
Industrial area (Chas,Bokaro)	6.5	25	25	30	34	37	45
Urban area (Chak Beriya)	6.8	25	27	33	38	47	51
Village area(Fulwariya, Chapra)	6.9	25	28	37	42	50	65

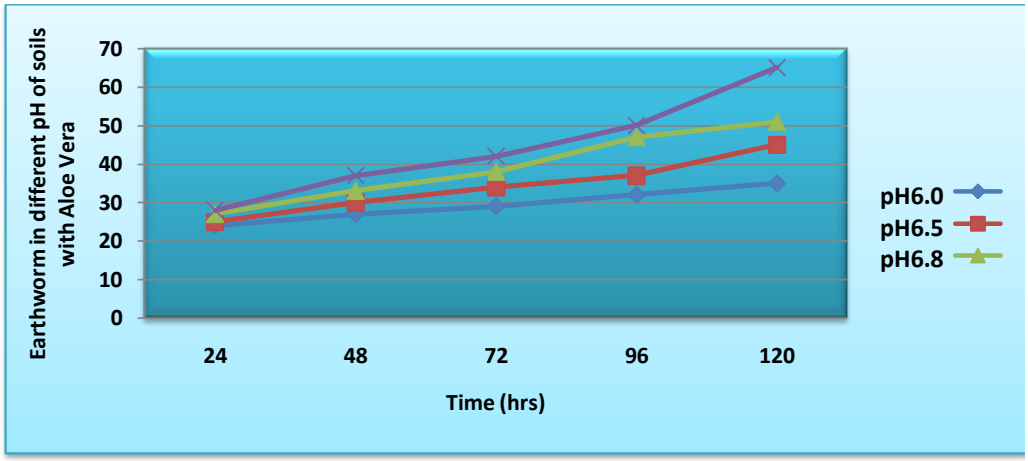

Figure3. Earthworm in different pH of soils with *Aloe Vera* Vs. thime (hrs)

Table 3. Earthworm position in different soils without and with *Aloe vera*

Soils	Mining area	Industrial area	Urban area	Village area
pH	5.6	6.2	6.4	6.7
Wt. of earthworm(mg) without Aloe vera	5.103	5.103	5.103	5.103
Wt. of earthworm (mg) without Aloe vera after 24hrs	3.124	4.231	4.534	4.786
Wt. of earthworm (mg) with Aloe vera after 24hrs	3.956	4.645	4.812	5.367

and its results are depicted in Table 3 and figure 4. It is noticed that its weight varies in different nature of soils. The weight of earthworm's increased in *Aloe Vera* mixed soils with respect of unaided soils. The figure 5 indicated that after addition of Aloe Vera earthworms improved their physical and biological properties.

Heavy metals entered into soils by different sources and its compositions are recorded in Table 4. They reacted with soils to acidic and basic compounds which generated corrosive atmosphere for earthworms and increased temperature of soils reducing humidity, concentration of oxygen, water and others natural minerals. Heavy metals concentrations were analyzed after addition of *Aloe Vera*; it is observed that their concentrations were decreased after addition of *Aloe Vera*.

CONCLUSION

Earthworms are life of soils. Soil's physical, chemical and biological properties depend on availability of earthworms. Their availabilities are reducing by application of large scale artificial fertilizers, pesticides,

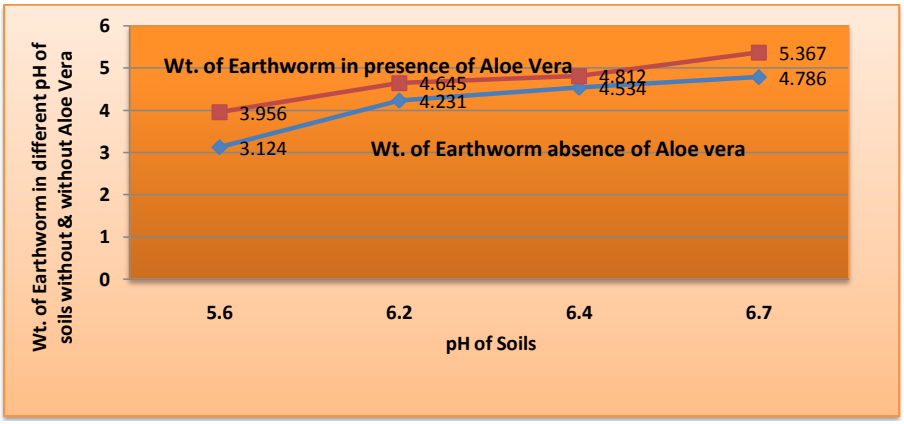

Figure 4. Weight of earthworm absence and presence of Aloe Vera Vs. pH

Figure 5. Earthworm kept in *Aloe Vera* aided soil

Table 4. Concentration of external minerals into Soils

Minerals (in PPM)	Mining area soils	Industrial area soils	Urban area soils	Village area soils
Fe	632	328	125	59
Ni	423	231	101	23
Cr	124	89	25	12
Pb	78	67	21	5
As	142	134	57	10
Zn	76	55	32	8
Cu	112	99	34	10
Mo	78	64	7	2
Bi	34	23	00	00
Aloe Vera (100ml) 120hrs	Mining area soils(250g)	Industrial area soils(250g)	Urban area soils (250g)	Village area soils (250g)
Fe	341	211	75	29
Ni	159	131	47	10
Cr	77	43	5	2
Pb	30	18	7	4
As	99	105	22	6
Zn	44	13	14	00
Cu	69	49	11	00
Mo	19	25	1	00
Bi	9	8	00	00

insecticides, herbicides and rodents. The other pollutants like industrials effluents, household waste, biological wastes, municipals wastes, mining water, particulates and harmful chemical and gases come into soils directly and indirectly by different sources and contaminate soils destroying earthworms. These pollutants altered the pH values of soils and produced question mark on the survival of earthworm. *Aloe vera* is used as remedy for soils by corrosive pollutants. The experimental results show that *Aloe vera* has capability to control pH of soils, temperature, humidity, concentration of oxygen and composition of minerals and it creates ecofriendly atmosphere for soils and increasing the number of earthworms as well as their productivity.

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