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INFLUENCE OF *WASTEWATER* ON SEED GERMINATION AND GROWTH PARAMETERS OF *ABELMOSCHUS ESCULENTUS*

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ABSTRACT
Manufacturing units of concrete railway sleepers at Bodhgaya releases large quantities of wastewater after product generation. The present experiment was steered to observe the toxic effect of *wastewater* produced from a manufacturing unit of concrete railway sleepers at Bodhgaya. Effluent samples were collected from manufacturing unit and were subjected to various physico-chemical tests using the standard methods. The physico chemical parameters of wastewater were tested and most of them were found to be higher than permissible limits. Six different concentrations (0, 10, 20, 40, 60, 80,100%) of each effluent were made by using distilled water along with ground water as control and lady's finger (*Abelmoschus esculentus)*is used as an experimental model. Results clearly shown that ground water irrigation (T_1 treatment) treated plant showed the best result regarding plant characteristics such as germination percentage (100 %), shoot length (13.4) fresh weight (1.31g) and dry (0.26 g) weight of plant, and moisture (81.41 g). On the contrary, mixed effluent from tank 7 (T_7 treatment) showed the lowest result of germination percentage (0%), shoot length (7.12) fresh weight (0.73 g) dry weight (0.15) and moisture of plant (78.1 g). All parameters decreased with increase in respective effluent concentration. The study concludes that effluents from concrete railway sleepers unit can be used for irrigation purpose after proper dilutions only. Care should be also taken before using the wastewater generated from concrete railway sleepers for irrigation purpose.

KEYWORDS: Concrete sleeper, Germination, Growth, *wastewater.*

INTRODUCTION

The disposal of wastewater is a key problem confronted by cities with inadequate space for land based treatment and disposal. The discharge of wastewater is an inevitable in the process of industrial developments, which lead to the contamination of both soil and water (Reddy and Baghel, 2010, Reddy, 2013, Parmar and Reddy, 2014). As a result, the water basins and top soil is becoming major sinks for industrial pollutants that affect the environments and agronomic lands. The fitness of irrigation water depends upon numerous factors, for instance, water quality, soil type, plant features, irrigation technique, drainage, weather and the local environments. The interaction of these factors islikely to vary either positively or negatively in relation to salt accumulation and degree of harmful effect on soil properties and crop growth. Furthermore, presence of certain ions in water (calcium, sulphate, potassium and nitrate) is favorable for crop growth (Shannon and Grieve, 1998, Gupta and Mondal, 2015). Many on times, the wastewater is used for the irrigation purposes. Bodh Gaya (*Bihar*, India) is situated on the banks of Falgu River at 84.40 to 85.50 towards East and the latitude is 24.50 - 25.100 towards North. *Daya Engineering Works* Pvt. *Ltd*. is an important *Manufacturer* and *Supplier* of *Concrete sleeper*, *railway concrete sleeper*, *track sleepers.* Due to water shortage in this district, farmers are using wastewater in the agricultural practices. The current research work deals with the effect of wastewater that generated from the industrial unit of *railway concrete sleeper* on germination of Bhindi *(Abelmoschus esculentus*) which is cultivated abundantly in study area and is very demanding vegetable species for food purposes.

MATERIALS AND METHODS

Collection of wastewater

Wastewater was collected in pre-cleaned plastic bottle from M/s Daya Engineering Works (Sleeper) Ltd, Rampur, Gaya-823 001, Bihar (India). The effluents were stored at 4^0C to avoid any fluctuations of physiochemical properties. Various physio-chemical characteristics were analyzed at the departmental laboratory of Magadh University, Bihar (India). The wastewater sample was examined for various physico-chemical features as per the standard methods described by APHA (2012). Seeds of *Abelmoschus esculentus* were obtained from Varad Agri Tech Limited (VATL), Hyderabad, TS (India). Healthy and homogeneously similar seeds were selected and were exposed to six different concentrations (0, 10, 20, 40, 60, 80, and 100%) and ground wateris used as a control. The experiment was placedin the

petri dishes (covered with filter paper) with 10 seeds (n=3) in each treatment of effluent concentrations along with control. The observations on seed growth parameters were recorded up to period of 21 days.

Determination of Growth parameters

The shoot length and root length of the seedlings were measured with ruler and conveyed in centimeters. Determination of fresh weight and dry weight, of seedlings were collected at the end of experiment (21 days). Harvested seedlings were washed with sterile-distilled water using a sieve to avoid loss of plant parts. Blotting papers were used to dry the seedlings and the fresh weight measured using K-Roy weighing balance. Prestige POTG 9 PC 800-Watt Oven was maintained at 65o C and was used to dry the fresh seedlings for 2 days followed by measurement of dry weight. The moisture percentage was obtained as the difference between the fresh weight and dry weight of the plantlets multiplied by 100 over the fresh weight (Pajevi *et al.*, 2004). The data produced from the study were subjected to students 't'test using Microsoft t test in Excel 2013 for unequal variance.

RESULTS

The physico chemical characteristics of wastewater from *railway concrete sleeper* at Industrial Area of Bodh Gaya are presented in the Table no 1. Results clearly indicated that all the studied parameters were exceeded the BIS standards for Category (E).

Table.1. Physico chemical characteristics of wastewater from *railway concrete sleeper* at Industrial Area of Bodh Gaya

Parameters	BIS std. for Category (E)	Mixed Effluent
pH	6.0 to 8.5	8.9
DO (mg/l)	7	1.1
TDS(mg/l)	2100	3324
TSS (mg/l	200	324
Electrical Conductance at 25°C, µS, Max	2250	4325
Sulphate (SO4 2--) (mg/l	1000	82
Chloride(Cl-) (mg/l)	600	2632

Germination studies

The results clearlydisplayed that the percentage germination of *Abelmoschus esculentus* significantly ($P< 0.05$) decreased with increase in concentration of wastewater except at 10% level of concentration, where there was a slight insignificant decrease compared to control (Table.2). From the Table 2 and Fig.1, it is clearly seen that in 40%, 60%, 80% and 100% effluent concentration for the initial four days there was no seed germination but on 5th day one seed got germinated in T4 and T5 (40%, 60%).

Table.2. Effect of wastewater from *railway concrete sleeper* on seed germination (N=3)

	Effluent % in distilled water						
Days	0%	10%	20%	40%	60%	80%	100%
Day I	0	0	0	0	0	0	0
Day II	1	1	0	0	0	0	0
Day III	2	2	1	0	0	0	0
Day IV	5	3	2	0	0	0	0
Day V	7	4	3	1	1	0	0
Day VI	8	5	4	2	1	0	0
Day VII	10	8	5	2	2	0	0

However, no seed germination was observed in T6 and T7 (80% and 100%) groups. Growth parameters such as shoot length, root length, fresh weight, dry weight and moisture content of the crop were also significantly ($P < 0.01$) decreased with increase in the concentration of wastewater.

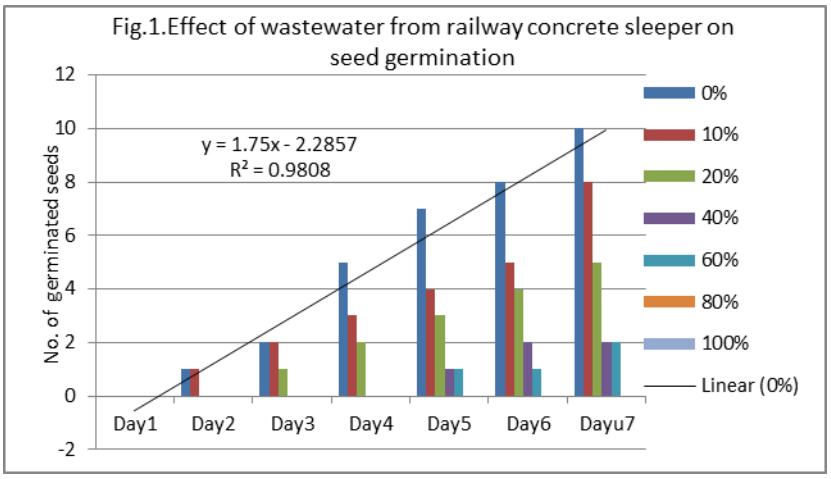
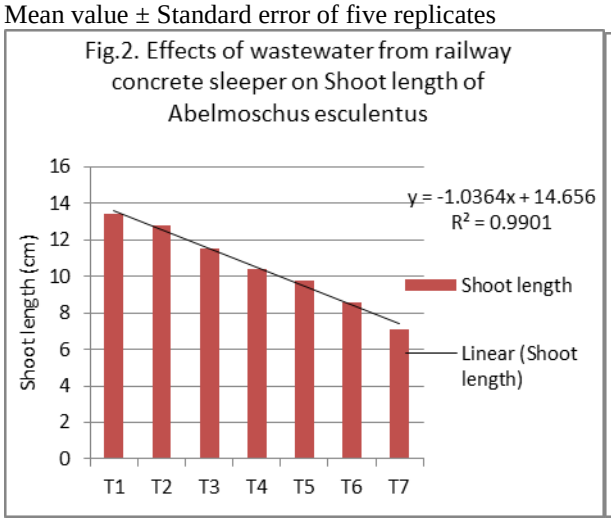
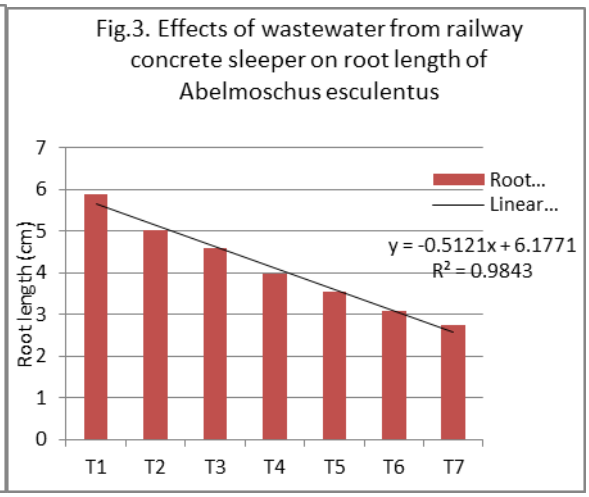


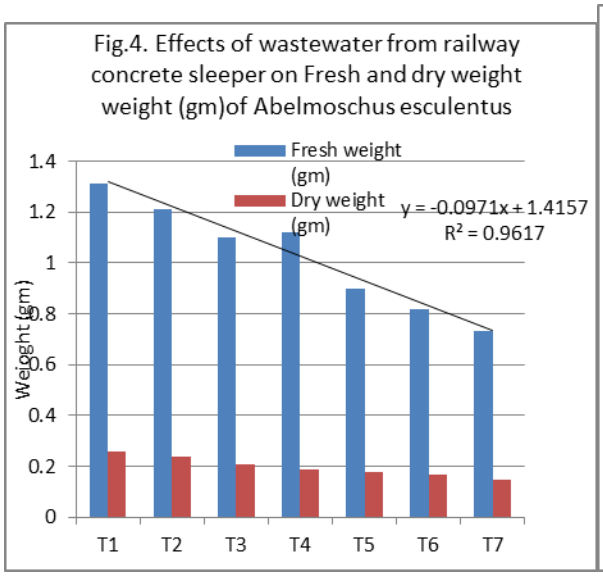
Table. 3. Effect of wastewater from *railway concrete sleeper* on growth parameters (n=3)

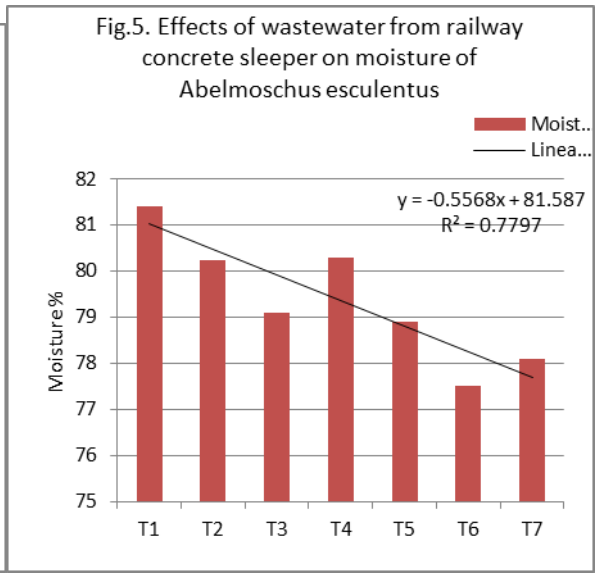
	Effluent % in distilled water						
Parameters	0%	10%	20%	40%	60%	80%	100%
Shoot Length (cm)	13.4± 0.26	12.8 ±0.23	11.5± 0.26	10.4 ± 0.29	9.78 ± 0.33	8.57 ± 0.27	7.12 ± 0.21
Root Length (cm)	5.89± 0.12	5.04 ± 0.31	4.59± 0.24	3.98± 0.19	3.55± 0.21	3.1± 0.11	2.75± 0.13
Fresh Weight (g)	1.31± 0.1	1.21 ± 0.11	1.1± 0.14	1.12± 0.1	0.9 ± 0.11	0.82± 0.14	0.73± 0.14
Dry Weight (g)	0.26 ±0.03	0.24 ± 0.01	0.21 ± 0.01	0.19 ± 0.01	0.18 ± 0.01	0.17 ± 0.01	0.15 ± 0.03
Moisture%	81.41± 0.8	80.23± 0.32	79.1± 0.23	80.28± 0.6	78.9 ± 0.4	77.5± 0.7	78.1 ± 0.6

Mean value ± Standard error of five replicates









DISCUSSION

The results of physico-chemical characteristics of *railway concrete sleeper* effluent clearly show that all the studied parameters were exceeded the BIS standards for irrigation purpose (Category, E). It can be endorsed to the high pH, TDS, Electrical conductivity and low sulphate concentrations of the effluent, which is affected the germination and growth of the plant species. Deterioration of water *quality has become* an international *concern*, as anthropogenic pollutants are usually the cause of major *water quality degradation* around the world (Reddy, P.B., 2013, 2016). The excessive level of certain wastewater parameters could be toxic that retarded the growth of the experimental plant. The outcomes of current study may be proved useful in agriculture for large-scale irrigation of diluted effluent.

The results of the present findings showed that germination and best seedling growth was occurred in control group. In 80% and 100% waste concentration, it was observed that not a single plant seed is germinated. Panaskar and Pawar (2011), studied the effects of textile mill effluent on growth of *Sorghum vulgare* and *Vigna aconitifolia* seedlings and found best seedling growth in 20% effluent concentration. Pandey *et al.*, (2007) studied the effect of various concentrations (0%, 25%, 50%, 75% & 100%) of distillery effluent on seed germination of wheat (*Triticum aestivum*), pea (*Pisum sativum*) and lady's finger (*Abelmoschus esculentus*) on seeds germination and found that germination percentage decreases with increasing concentration of effluent in all the experimental seeds.

Ravi *et al.*, (2014) studied the effects of textile dye on seed germination and growth of seedling of soybean crop and found that the 100% effluent directly inhibits all the growth parameters evenly. The study of Tanee and Jude (2017), revealed that detergent and sawdust are useful in hydrocarbon reduction and growth of *Abelmoschus esculentus L* (Okra) in a petroleum-contaminated soil in Nigeria. In contrast, Panaskar and Pawar (2011), found beneficial results at lower concentration (20%, 40%) of tannery effluents on seed germination and seedling growth of some important crops like wheat, jowar, maize, black gram, green gram, red gram, lentil and horse gram. However, an increase in effluent concentration showed decrease in seed germination and shoot elongation. Our results are in agreement with Salian *et al.*, (2018) who investigated the effects of brewery wastewater obtained from different phases of treatment plant on seed germination of chickpea (*Cicer arietinum*), maize (*Zea mays*), and pigeon pea (*Cajanus cajan*) and found that all growth parameters decreased with increase in effluent concentration.

CONCLUSIONS

The water parameters of concrete railway wastewater at Bodhgaya for irrigation purpose were exceeded the standard limit has negative impact on germination and seedling growth of *Abelmoschus esculentus*. The huge extensive and intense research proves the potential toxicity of various industrial and municipal effluents over soil and aquatic biodiversity. Hence, a pre-treatment stage is very essential for wastewater remediation. From this study, it is concluded

that if properly treated, diluted effluents are used for crop development, the problem of dumping of effluents,and water needs for irrigationcan be solved.

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