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The influence of Hingoli and Nanded districts sugarcane industry effluent on physicochemical properties and mycoflora of soil

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Sugarcane industry play important role in the economic development of country but the effluent releases from industry posses aquatic and terrestrial pollution and causes health problem. It will change the soil physicochemical levels and soil mycoflora. In the present work, sugarcane industry polluted soil and non polluted soil were collected from the surrounding areas of sugarcane industry. The higher values of physicochemical properties examined and 19 fungi were isolated from these polluted soil samples, the growth of fungi were almost doubled as compared to non polluted soil. The Aundha Nagnath place showed most effectiveness from sugarcane effluents as compared to other locations.

Keywords : Sugarcane industry, Effluent, Soil mycoflora

Soil is an important system of terrestrial ecosystem, and direct discharge of industrial effluents especially that without treatment may have deeply influence on physico-chemical and biological properties of soil related to soil fertility (Narasimha *et al*, 1999). Discharge of effluents from various industries like sugar industry effluents (Nagaraju *et al*, 2007), petrochemical industry (Andrade, 2002) and dairy factory effluents (Nizamuddin *et al*, 2008) influences the physico-chemical properties of soil. This is due to organic waste that may contribute to maintain or increase the organic matter and nutrient content in the soil (Bollag *et al*, 2002).

The most important crop from which sugar can be produced in commercial quantity is sugarcane. India is a largest sugar producing country. Today sugarcane is grown in over 110 countries. In 2008 an estimated 1,743 million metric tons were produced worldwide, with about 50% production occurring in Brazil & India (Solomon, 2008). These sugar industries are playing important role in the economic development of Maharashtra. But the effluent released from the sugar industries produced a high degree of organic pollution in both aquatic & terrestrial ecosystem. Sugar factory effluent produces obnoxious odour & unpleasant colour when released into the water environment without proper

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treatment. Farmers have been using these effluents for irrigation and found that the growth and yield of crops and soil health were reduced. Along with the effects of various industrial effluents on seed germination, growth and yield of crop plants have captivated the attention of many workers (Ozoh and Oladimeji, 1984; Rehman *et al,* 2002; Street *et al,* 2007). In the present study an attempt was made to find out impact of effluents of sugar industries on physico-chemical properties and fungal population of soil.

Materials and Methods

Collection of soil samples: Soil samples were collected from the surrounding areas of sugar industries (250 mtr) of Basmath, Aundha Nagnath, Dongarkada (Dist. Hingoli) and Ardhapur, Dist. Nanded (Maharashtra). Soil samples without effluent discharged served as control was collected from adjacent site (1000 mtr away) of sugar industries. Soil samples both with and without effluent were used for determination of physico-chemical properties and isolation of soil fungi. All the soil samples were air dried and mix thoroughly to increase homogenicity.

Physico-chemical analysis of soil: The physical properties of the soil samples were determined in accordance with standard analytical methods (Subramanyam and Sambamurthy, 2002). Whereas, chemical properties organic carbon and organic matter were calculated by rapid titration method (Walkey and Black, 1934), total nitrogen was found by Microkjaldal distillation method (Jackson, 1958), potassium was found by flame photometry and phosphorous was analysed (Rao, 1993).

Isolation of soil fungi: Isolation of soil fungi (all the effluent and without effluent) was done on peptone dextrose agar medium containing rose bengal and streptomycin (Martin, 1950) by soil plate method (Warcup, 1950). Three replicates were maintained for each sample. After inoculation, plates were incubated at 25±2^{o}C. After 7 days of incubation, developed colonies were identified with the help of available literature (Gillman, 1957; Subramanian, 1971; Barnett and Hunter, 1972).

Results and Discussion

It is evident from the data presented in table 1 that the pH of the polluted soil was increased from 7.70 (Basmat) to 8.10 (Dongarkada). In case of non-polluted soil it was 7.30 (Basmat) to 7.55 (Aundha Nagnath). Higher water holding capacity (%) was observed in test soil (Ardhapur-59.66%) than the non-polluted soil (Dongarkada-52.84%). Increased water holding capacity in polluted soil may be due to the accumulation of organic waste in sugarcane industry effluents (Alvarez-Bernal *et al*, 2006). Percentage of organic carbon, organic matter, total nitrogen, potassium and phosphorus (mg/100gm) was higher in all the polluted soils than non-polluted soil samples. The highest amount of organic carbon and organic matter was found in polluted soil collected from Aundha Nagnath. The total nitrogen, potassium and phosphorus were found to be more in polluted soil collected from Ardhapur. The results were confirmed with the results of Reddi and Narsimha (2012); Alvarez-Bernal *et al*, (2006). They found similar results in case of soil polluted by leather industry effluents.

It is clear from the data depicted in the table 2 revealed that mycofloristic composition of effluent affected soil samples of different industrial areas significantly. Maximum numbers of fungal species were recorded from Aundha Nagnath, effluent samples followed by Basmat, Ardhapur and Dongarkada. *Aspergillus* species including *Aspergillus flavus, A. fumigates, A. terrus* were found dominant in all the areas where the soil was collected. The similar results were observed by Awasthi *et al*, (2011) in case of soil polluted by sugar industry effluents.

In the present study, sugarcane industry effluents discharged into the soil showed higher water holding capacity then non polluted soil. Similar results were reported by Reddi and Narasimha, (2012). However, increased water holding capacity may be due to the accumulation of organic waste in the polluted soil. Similarly, soil discharged with effluents from cotton ginning mills (Jyothsna Devi and Narasimha, 2007) increased the water holding capacity. Increase in pH of the polluted soil is because of release of effluents with basic in nature containing some alkalis released from sugarcane industry. Nanda Kumar, (1990) have shown the discharge of effluents from tannery increased the soil pH slightly. Other parameters percentage like organic matter, Total nitrogen, potassium and phosphorus of polluted soil samples were more than non polluted soil samples of all the locations. From the observations (Table 2) all the *Aspergillus* species and maximum numbers of fungal species were isolated from the sugar industry effluent polluted soil sample from Aundha Nagnath region. Similar results were obtained by Awasthi *et al*, (2011). The polluted soil samples from Ardhapur, Basmat and Dongarkada region polluted soil sample shown relatively minimum numbers of fungal species than Aundha place. The fungal growth was almost double in polluted soil as compared to non polluted soil. This is supported by work of Dodar and Tabatabai, (2003) they have reported that the discharge of effluents from dairy increased the soil organic matter. Two fold higher microbial populations were observed in the test soil i. e. polluted soil. It may be due to the presence of high organic matter contents in basic effluents.

Table 1: Physico-chemical analysis of polluted and non-polluted soils

Parameter	**Ardhapur**		**Basmat**		**Dongarkada**		**Aundha Nagnath**	
	PS	**NPS**	**PS**	**NPS**	**PS**	**NPS**	**PS**	**NPS**
Colour	Blackish brown	Black	Brown	Black	Brown	Black	Brown	Black
Odour	Foul	Normal	Foul	Normal	Foul	Normal	Foul	Normal
pH	7.95	7.45	7.70	7.30	8.10	7.36	7.90	7.55
Water holding capacity (%)	59.66	52.33	57.71	52.47	57.40	52.84	58.06	52.47
Organic carbon (%)	0.43	0.36	0.39	0.34	0.41	0.36	0.44	0.38
Organic matter (%)	0.741	0.620	0.672	0.586	0.706	0.620	0.758	0.655
Total nitrogen (%)	7.42	3.24	6.54	4.36	6.80	3.70	6.46	3.60
Potassium (%)	0.11	0.05	0.10	0.05	0.07	0.04	0.09	0.05
Phosphorus (mg/100g)	14.20	12.50	14.60	11.40	13.20	11.50	15.40	10.60

Note: PS= Polluted soil; NPS= Non-polluted soil

Table 2: Isolation of soil fungi from polluted and non-polluted soils

S. No.	Name of fungus	Ardhapur		Basmat		Dongarkada		Aundha Nagnath	
		PS	NPS	PS	NPS	PS	NPS	PS	NPS
1	*Alternaria* sp.	+	+	-	+	-	-	+	-
2	*A. flavus* Link ex Fries	+	+	+	+	+	+	+	+
3	*A. fumigatus* Fresenious	+	-	+	-	+	-	+	-
4	*A. nidulans* (Eldam) Winter.	-	+	+	+	-	-	+	+
5	*A. niger* Van Tieghem.	+	-	+	-	-	+	+	+
6	*A. terrus* gr.	+	+	+	+	+	-	+	-
7	*Cladosporium* sp.	+	-	+	-	-	-	+	-
8	*Curvularia lunata* Boedijin.	-	+	+	+	-	+	+	+
9	*Drachslera* sp.	+	+	+	+	+	-	-	+
10	*Fusarium* sp.	+	-	+	+	+	-	+	-
11	*Paecilomyces* sp.	-	+	+	-	-	+	+	+
12	*Penicillium citrinum* Sopp.	+	-	+	+	-	-	+	-
13	*Penicillum* sp.	-	+	+	-	+	-	+	+
14	*Rhizoctonia solani* Kuhn.	+	-	+	+	+	+	+	+
15	*Rhizopus stolonifer* (Ehrenb)	+	-	+	-	+	+	+	-
16	*Ttichoderma* sp.	-	+	-	+	+	-	+	+
17	White sterile mycelium	+	-	-	-	+	-	+	-
18	Blackish brown sterile mycelium	-	-	+	-	-	+	-	+
	Total	**12**	**09**	**15**	**10**	**10**	**07**	**16**	**10**

Note: PS= Polluted soil, NPS= Non-polluted soil; + present, - absent.

Conclusion

In the present investigation the results concluded that the discharge of effluents from sugarcane industry altered the physico-chemical properties of soil and enhanced the soil mycoflora growth by double.

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