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Physicochemical and biological properties of sewage irrigated soils in Warangal (Dt.), Telangana, India

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ABSTRACT

The characterization of sewage irrigated soils in Warangal city, was undertaken during July 2014 to June 2015. Various physico chemical and biological characteristics were assessed and analyzed to understand the pollution in the soil. Soil colour varied from light red to dark brown. The field capacity, % of pore space, conductivity was maximum during winter. The p^H range was 7.0 to 7.5 slight alkaline natures. The chemical characters like total alkalinity, chlorides, phosphorus, nitrates, sulphates were maximum during summer. The maximum organic matter percentage in sewage sample is 7.66%. Marginal variation in the chemical constituents were recorded between sewage irrigated and control soils. The heavy metals (Cd, Cr, Mn, Zn, Pb, Co, Cu) concentrations were very meager in these soils. In sewage irrigated soils, the bacterial populations were maximum during March and April.

Key words: Sewage Irrigated Soils, Physico Chemical and Biological Characterization, Heavy Metals.

INTRODUCTION

Rapid Industrialization and Urbanization is introducing potentially harmful chemical and biological substances into the hydrological and soil water systems. The subject of soil contamination around the cities encompasses much what we know about soil resources and biological effects of contaminants and change in a ecosystem effected by contaminants. Now-a-days disposal of sewage water and sludge on agricultural land is becoming a wide spread practice. They contain large amounts of toxic pollutants and they could be retained and accumulated in soils. A considerable amount of work has been done with chemistry of toxic elements on soils and their toxicity to their biological systems. Anderson and Nilsson (1973), Lee and Foster (1991),Dermendashe *et al* (1995), Jeevan Rao *et al* (2003), Gitipour *et al,* (2007),Srinvas and Sastry (2007), Thomas *et al* (2007), ** In this regard, the attempt has been made to investigate the physico chemical and biological characteristics of sewage irrigated soils in Warangal City.

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MATERIAL AND METHODS

The soils from the sewage irrigated soils adjacent to sewage canals at Kumarpally sewage canal and sewage canal passing near Bhadrakali Temple were selected and surface soils were collected for analysis, for the comparison, same type of soil near sewage is served as control. The soils were air dried and crushed to parts in 2mm screen. The physical, chemical and biological characteristics were analyzed as methods suggested by Trivedy *et al,* (1987), the data obtained and presented in Table and figures (1-11).

Study Area:

Warangal, historically known as Orugallu, is a historic city the capital of erstwhile Kakatiya dynasty who ruled this area from 12^{th} to 14^{th} century. It is about 140 Km. Away from Hyderabad, well connected by rail and road from all major cities in Telangana state, India. It lies between Latitude17°58'8.04"N, longitude 79°35'8.04"E. The Liquid solid wastes and industrial effluents generated from Warangal city area are mostly dumped

Table 1 Physical Characteristics of Polluted and Control Soils in Warangal, Telangana State, India

Month / year	Site	Temp (ºC)	B.D	F.C %	% P.S.	P.W.C	Con
JULY 2014	1	26	1.26	32.3	52.5	6.55	0.15
	2	28	1.34	40.4	49.4	6.72	0.52
	3	28	1.27	29.3	52.1	6.55	0.53
AUG	1	25	1.3	26.7	49.6	6.69	0.89
	2	26	1.18	50.2	55.5	7.76	0.31
	3	27	1.2	26.7	54.8	7.31	0.44
SEP	1	27	1.35	39.4	29.1	7.31	0.21
	2	29	1.06	37.8	56.3	7.07	0.57
	3	30	1.25	28	49.1	7.72	0.59
OCT	1	28	1.42	21.2	46.5	7.13	0.92
	2	30	1.46	20.4	44.9	8	2.21
	3	28	1.38	32.7	47.8	7.52	1.32
NOV	1	28	1.25	18.7	52.8	8.31	1.21
	2	30	1.44	19.6	52.8	7.03	1.78
	3	33	1.47	30.7	44.5	6.83	0.83
DEC	1	28	1.35	29.8	62.3	7.17	3.91
	2	30	1.42	30.8	46.5	6.89	5.12
	3	28	1.4	38.4	47.2	7.03	0.93
JAN 2015	1	29	1.29	37.6	51.3	8.07	1.16
	2	28	1.32	35.6	50.2	8.69	0.97
	3	30	1.36	32.5	48.7	8.01	1.32
FEB	1	31	1.24	27.6	53.3	7.45	1.37
	2	32	1.22	36.2	62.3	7.89	1.28
	3	30	1.19	20.3	55.1	6.86	0.68
MAR	1	32	1.42	29.2	46.5	7.97	1.92
	2	33	1.27	27.8	52.1	7.21	1.35
	3	31	1.25	22.2	52.8	7.35	1.14
APR	1	37	1.38	28.6	47.9	8.04	1.62
	2	36	1.4	29.5	47.2	7.76	1.63
	3	37	1.42	21.7	46.8	7.17	0.76
MAY	1	38	1.39	27.9	47.6	8.05	1.95
	2	38	1.52	18.7	42.7	8.06	0.75
	3	38	1.29	18.2	41.6	7.66	1.13
JUN	1	39	1.32	29.7	50.2	8.35	1.72
	2	37	1.46	27.9	34.9	7.66	1.32
	3	37	1.32	22.3	47.5	7.72	0.98

Parameter Temperature (ºC) Bulk Density gm/cm3
Field Capacity (%) Percentage of Pore Space
Permanent Wilting Coefficient Conductivity(mMho/cm3)

in open land fill in low lying areas. This is creating an important source of soil pollution. Today, in Warangal city, the accelerated pace of development, rapid industrialization and growing human population are responsible for enormous amounts of sewage and industrial effluents every year and these waste materials are increasing tremendously.

The following sites were selected for the study:
Site 1. The soil sample collected from sewage canal near Kumarpally.
Site 2. The soil sample collected from sewage near Bhadrakali temple.
Site 3. The control soil sample collected from near sewage.

RESULTS AND DISCUSSION

The physical properties of the soils from July, 2014 to June, 2015 was presented in Table-I. From the table it is evident that the maximum soil temperature of 38-41^{0}C

Figure-1. Total alkalinity concentration in polluted and control soils

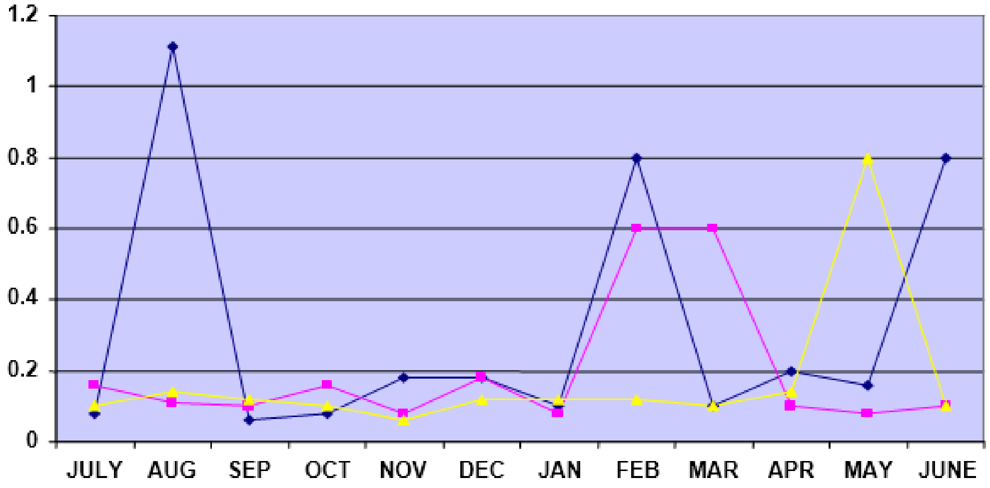


Figure-2. Chloride concentration in polluted and unpolluted soils

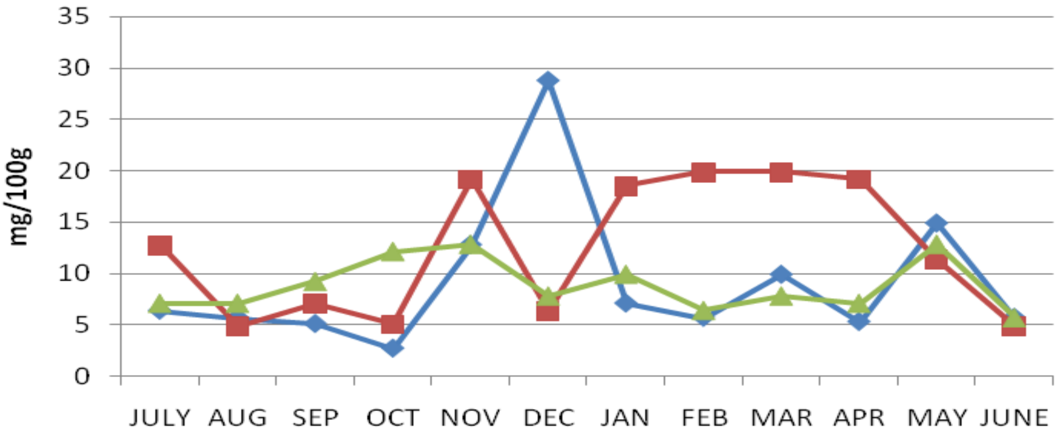
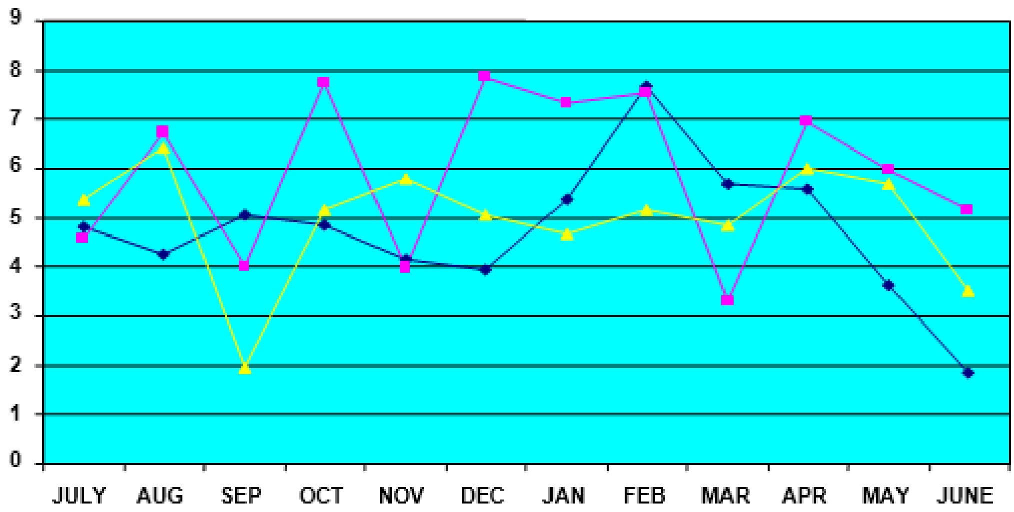


Figure-3. Organic matter % in polluted and control soils



was recorded in the months of May and June, while minimum in August. The colour of the soils in sewage irrigated soils varied from light red to dark brown, while at control soil it was always red. Narwal *et al* (1993), Olaniya (1998), Singh and Chandel (2006) stated Composition of some city waste waters and their effect on soil characteristics The bulk density of the soils was maximum in site (1) 1.42 ,(2)1.52 gm/cm^3 during

Figure-4. Nitrates concentration in polluted and unpolluted soils

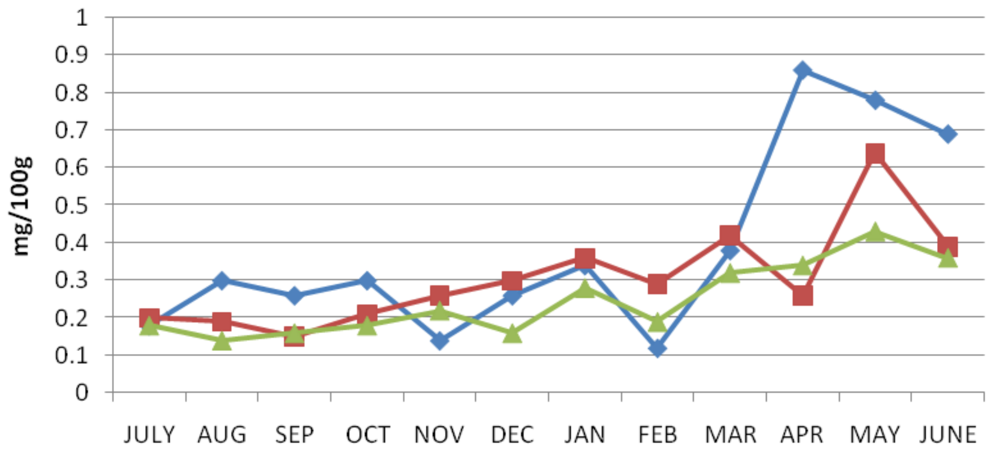


Figure-5. Phosphates concentration in polluted and control soils

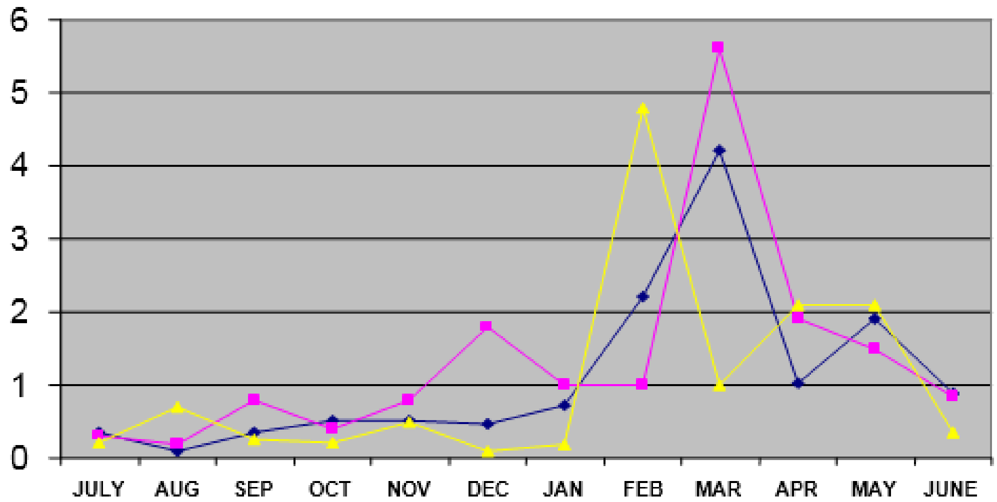
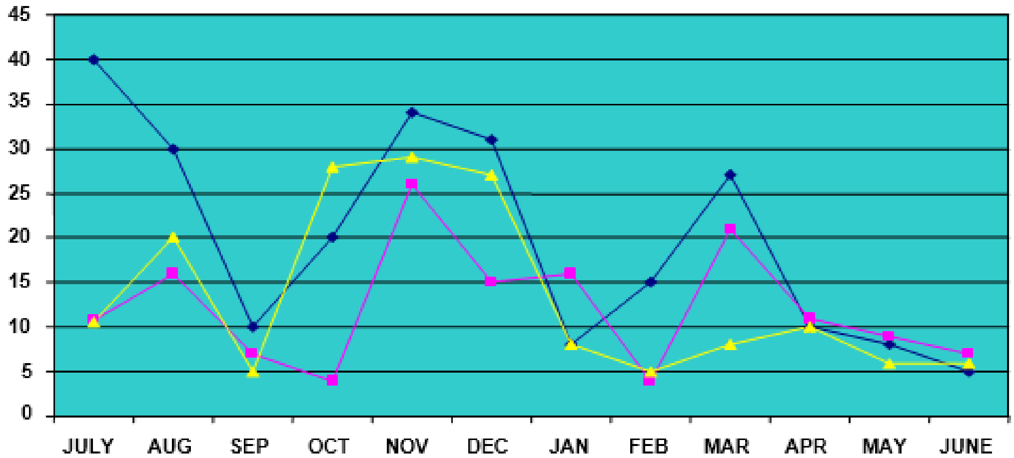


Figure-6. Sulphates concentration in polluted and control soils



October and November. The field capacity was high in 39.4%, 50.2% in polluted soils and 38.4% in control soils. No remarkable changes were recorded in the values of wilting co-efficient compared in polluted and unpolluted soil this range of variation in the control soil was 6.55 to 8.0. Similarly the percentage of pore space also showed maximum during winter and minimum in Rainy Season. Conductivity was measured and found

Figure-7. Calcium concentration in polluted and unpolluted soils

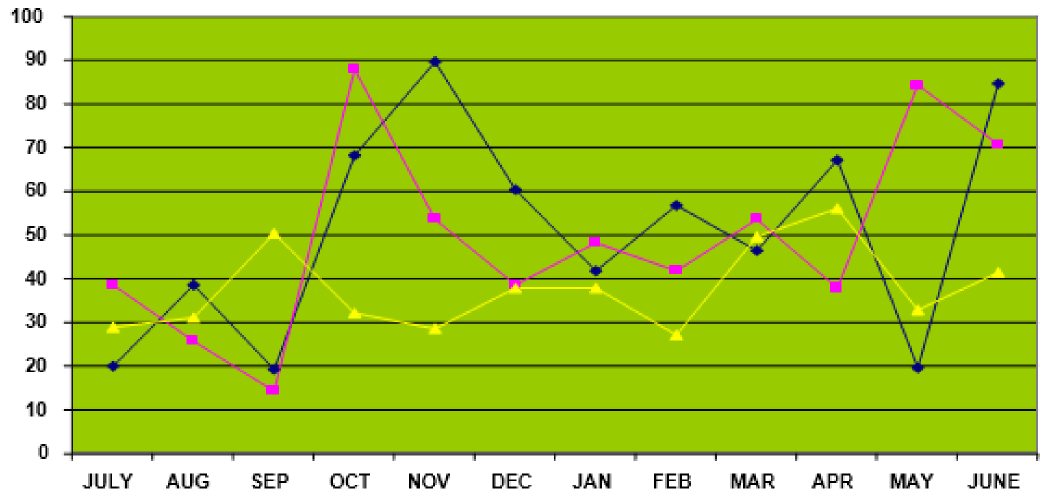


Figure-8. Magnesium concentration in polluted and control soils

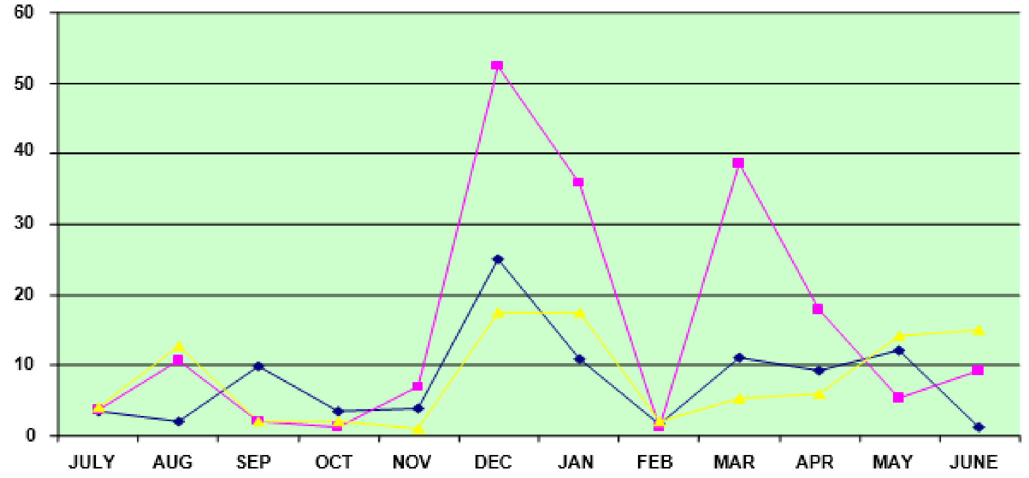
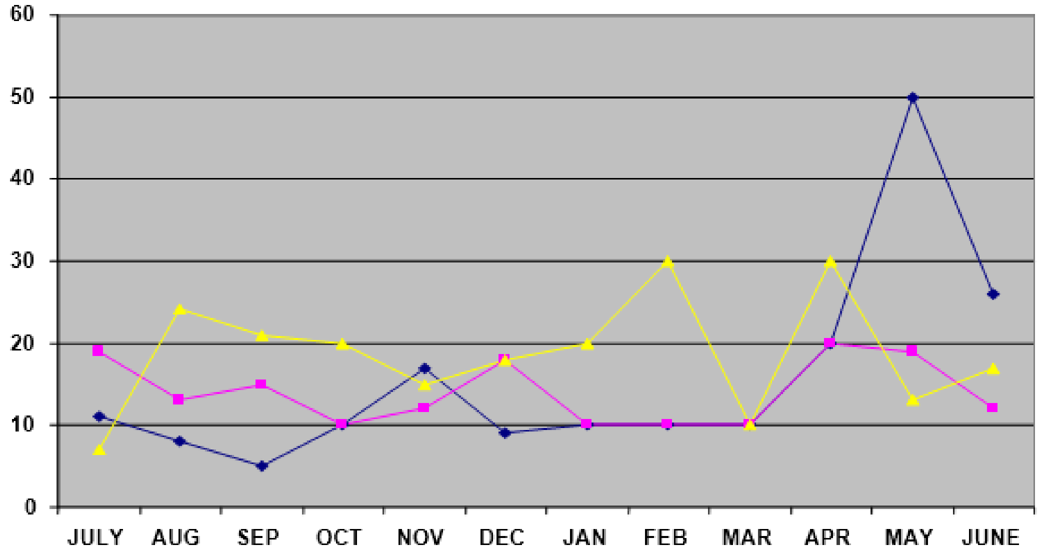


Figure-9. Potassium concentration in polluted and control soils



to be maximum in 1.95, 5.1 and 1.32 mMho/cm^3 in polluted and control soil.

The Chemical characterization of soils were analyzed and the data depicted in figures (1-11). Soil data on pH indicated that the range was in between 6.5 – 7.5 indicating the neutral nature of the soil. The total alkalinity, chlorides, phosphates and nitrates are maximum during summer months (March to May) and minimum in rainy months (July to October) Eaton (1990), Sharma and Minhas (2004) Srivastava *et al* (1988) signified the responses of soils contaminated with drainage and industrial effluents. While Yadava *et al* (1989) recorded the marginal range of chloride concentration found no significant relationship with that of characteristics. Nannipieri *et al* (1980) characterized different sewage soils and found remarkable changes in their nitrogen contents. Broadbent (1977) reported the role of ammonia in nitrification and de nitrification of the soils receiving the municipal water. Calcium, magnesium were shown their minimum and maximum range was site (1)19.2 to 89.8, (2) 14.4 to 88.0 (3)27.3 to 56.1 mg /100g during rainy season and minimum in summer. No remarkable changes were recorded in these characters in between sewage sites (1 and 2) and control soils. Bremner and Doughlas (1971) analyzed more than hundred sewage irrigated soils and emphasized the role of calcium and magnesium and inhibiting the soil urease activity The basic nutrient in the soil, sulphate was maximum in site (1) 40NTU, site (2) 26 NTU in polluted and site (3) 20 NTU in control soils. Brady (1995) studied the general relationship between potassium content of plant and available soil potassium in polluted

Figure-10. Bacteria population in polluted and control soils

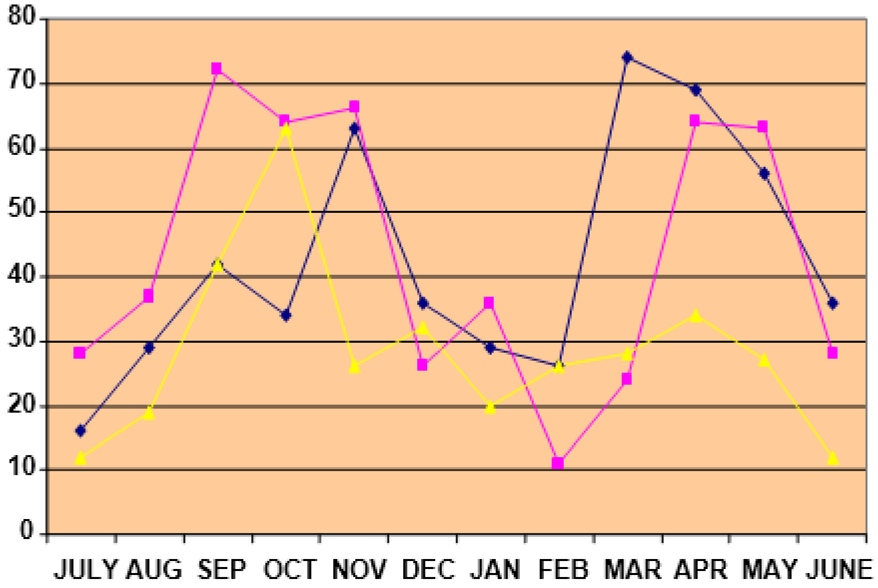
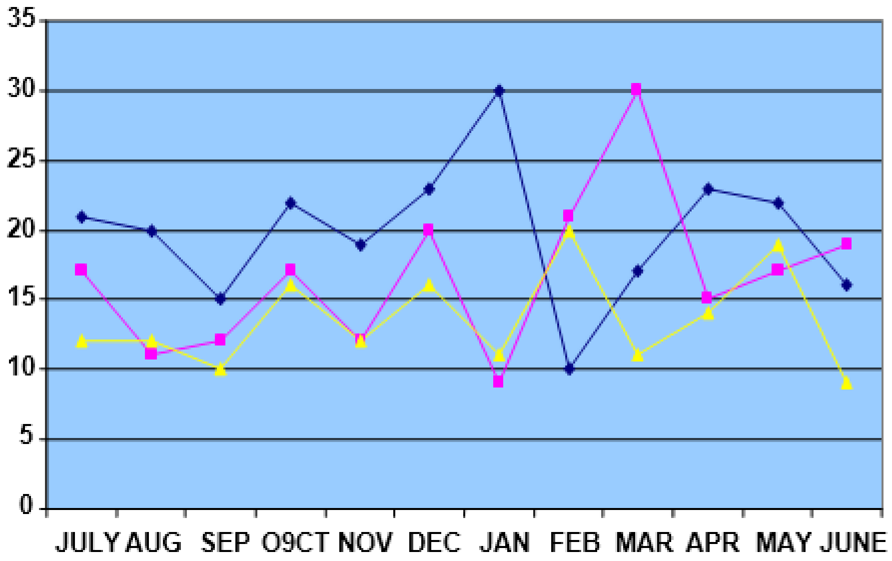


Figure-11. Fungal population in polluted and control soils



and un polluted soil. Potassium range in study site (1) 5 – 26ppm, site (2) 10 -50ppm in polluted soils and site (3) 1-30 ppm in control soils. Marginal variation in these chemical constituents were recorded in between sewage irrigated soils and control soils. The organic matter percentage range was 1.86-7.66%, 3.31-7.86% and 1.97-6.41% in polluted and control soils (figure). Bellakki and Badanur, (1998), stated decomposition of organic residues by microbial activity in different sewage soils. The heavy metals such as cadmium, cobalt, chromium, lead, manganese, zinc were analyzed and found to be very meager in their concentrations (Mudassar 2004, Bhanuprakash *et al* 2010).

The soil micro-organisms which determines the form and arrangements of the soil were enumerated and presented in figure 2 (a & b). Ibiebebe *et al* (1985). The number of bacterial populations were maximum site (1) 74, site (2) 72, and site (3) 63 in sewage irrigated and control soils figure. The fungal colonies were maximum during summer .The fungal colonies minimum and maximum range was (1) 10-30,(2) 9-30 and (3) 9-20 in polluted and control soils figure. Jimenz *et al* (2002) Kulkarni *et al* (2007) stated influence of agro waste amendment on soil microbial population in relation to plant growth response.

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

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