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Study on fungi associated with metropolitan waste water used for irrigation on soil in sokoto metropolis.

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Study of fungi associated with metropolitan waste water used for irrigation on soil in sokoto was carried out within sokoto metropolis using culture method, microscopic and biochemical identification. Water samples were collected from the upstream, midstream and down stream section of the stream while three soil samples each were collected adjacent to the water sampling sites using Random sampling technique. The samples were aseptically collected in sterilized bijour bottles and are transported to the Microbiology Laboratory of the Department of Natural Sciences of the Polytechnic of Sokoto State for analysis. Soil samples within the study area were found to be loamy-sand and the texture was moderately bulky in density(1.70g). The predominantly isolated fungal pathogens were *Aspergillus niger* (26.8%) *Rhizopus stolonifer* (20.1%),*Mucur racemosus* (17.2%) and the least in occurence were *Penicillium citrinum* and *Aspergillus fumigatus* with (11.8%) each. It can therefore be concluded that the waste water used in irrigating the soil contributes to the contamination of the irrigated soil with fungal pathogens mentioned earlier. The study recommends that farmers should be enlightened on the need to purify the waste water prior to use and other ameliorating measures to reduce risk of contamination should be imposed by the authorities in the study area.

Keywords: Soil, Waste water, Fungi and Stream

INTRODUCTION

Urban and peri-urban food production using waste water for irrigation is an important resources for meeting the challenges of rapidly growing cities in sub-sahara Africa (FAO, 1997)Waste water and soil both are the rich habitats containing variety of microorganism, fungi is one of them (Mueller & Bills, 2004). The agents provide many valuable services to mankind and in the soil ecosystem and are knownto cause different types of diseases in plants, animals and human (Manoch, 1998; Sheppard *et al*., 2004). In addition, the organisms produce chemicals which alter the tastes and odours of water (Kelly *et al*., 2003). The continuous irrigation of soils with wastewater results in dramatic change in the soil nutritional status,in which may favored certain fungal groups while hampering the growth of others. Specific groups of saprotrophic fungi like the white-rot fungi may exploit the availability of carbon sources present in wastewater and are favored by mineral-N scarcity. Rousidou *et al*., (2010) reported that growth of some important plant pathogens is inhibited by the addition of waste water in the soil. According to him the

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development of saprophytic fungi was significantly higher in the wastewater irrigated soils, whereas photosynthetic rates and the amount of the total root-soluble carbohydrates decreased significantly after application of wastewater.

The health hazard associated with the presence of pathogenic fungiin the watercan pose health risks to the farmers and communities who are expose to the waste water and consumption of produce irrigated with waste water. (Pescod, *et al*., 1992). Fungal pathogens identified to be associated with waste water used for irrigation include*Aspergillus, Fusarium* and*Mucur species.*

Soil health is correlated with the soil biota as they provided essential nutrients to the soil and plants by different processes (Kibblewhite *et al*., 2008).Various potentially toxic elements including heavy metals are present in wastewater and these toxic elements at elevated concentration are known to affect soil microbial populations and their associated activities. When wastewater is applied to soil, it reduces the permeability of soil. It affects the micro flora of soil (McGrath *et al*., 1988; Chaudhari *et al*., 1993). Inspite of the risk associated with utilizing urban waste water to produce crop in the urban city of Sokoto and its sarroundings environmental impacts have not been adequately studied and reported. Continue use of waste water for irrigation may results to many health and environmental problems. It is against this backdrop that the presence study was embark on to isolate and identify the different types of fungal pathogens associatedwith waste water and soil used for irrigated in Sokoto metropolis.

MATERIALS AND METHODS

Study area and Collection of Soil and Wastewater Samples.

Sokoto is the capital city of Sokoto State, lies between latitude 13° 3' 49^0N, longitude 5° 14' 89^0E and at an altitude of 272 m above the sea level. The metropolis coversextreme North Western part of Sokoto North and Sokoto South local government areas, some parts of Kware LGA from the North, Dange Shuni from the South and Wamakko LGA to the West. Sokoto metropolis has an estimated population of 427,760 (NPC/FRN, 2007). The occupation of the city inhabitants which include Farming, Trading, Commerce, has a reasonable proportion of the working population in private and public sectors (MOI, 2008). The Sokoto township is in dry Sahel surrounded by sandy terrain and isolated hills. Rainfall starts late from June and ends early, in September but may sometimes extend into October. The average annual rainfall is 550 mm with peak in the month of August. The highest temperature of 45°C during the hot season are experienced in the months of March and April. Harmattan, a dry cold and dusty condition is experienced between the months of November and February (Abdullahi *etal*., 2009; Udo and Mamman, 1993). Modern Sokoto city is a major commerce centre in leather crafts and agricultural products (MOI, 2008).

Water samples were collected from the upstream, midstream and downstream section of the sites (KD, KK and GB)using Random sampling technique. Samples were aseptically collected in sterile bijour bottles. Similarly, three soil samples each at 10cm, 20cm and 30cm depth were collected adjacent to the water sampling sites. The water and soil samples were transported to the Microbiology Laboratory of the Polytechnic of Sokoto State for analysis.

Culture and Identification

Ten fold (10) serial dilution was used and a loop Sample each of water and soils was micropipetted and inoculated into Potato Dextrose Agar (PDA) medium prepared according to the manufacturers' instruction. The plates were incubated at 25^oC for 72hours. Colonies were observed and counted as prescribed by Adesemoye *et al*., (2006). Microscopic identification followed immediately after staining with lactophenol cotton blue and comparing with standard manuals of Mycology.

Data Analysis

Data obtainedfrom this study were analyzed using tables for descriptive analysis, three factor where also analysed using Chi-square(x^2) test and Correlation coefficient. Vaiable are compared for statistical significance at critical probability of P = 0.005 interval.

RESULTS

300 soil samples collected at different location and at variable depth were examined by mycological culture and microscopic identification of fungal pathogens. 197 samples were positive for one or more species of fungi.A total of eight fungal species were isolated with *Aspergillus niger* being more predominant.The fungal species which includes *Aspergillusniger*, *Rhizopus stolonifer* and *Mucur racemosus* were more abundant in soil samples while *Penicilliumcitrinum*, *Aspergillusfumigatus,Curvularia* and *Fusarium* were less in occurence. The highest prevalence fungal pathogens were *Aspergillus niger* (26.8%),*Mucur racemosus* (20.3%) and *Rhizopus stolonifer* (20.1%). This followed by *Penicilliumcitrinum* (11.8%), *Aspergillusfumigatus* (11.8%) and the less frequently isolated pathogens were *Curvularia* (7%) and *Fusarium* (4%)

The results also indicates that GB has the highest fungal diversity (n = 70) with *Curvularia*specie only isolated from KK soil irrigated samples. The study revealed that

Table 1. Fungal species isolated from soil irrigated with waste water in Sokoto Metropolis

Isolate	KK n=65	KD n=62	GB n=70	Total 197	Percentage (%)
A. nige 17	16	19	52		26.8%
R. stolonifer 15	08	15	38		20.1%
A. fumigates 04	09	10	23		11.8%
M. racemosus __	21	18	39		20.3%
Curvularia	14	__	__	14	7.0%
P. citrinum 15	04	04	23		11.8%
Fusarium	__	04	04	08	4.0%

Chi-Sq = 62.742, DF = 10, P-Value = 0.000. 3 cells with expected counts less than 5

Table 2. Fungal species isolated from waste water in Sokoto Metropolis.

Isolate	KK n=51	KD n=58	GB n=66	Total 175	Percentage (%)
A. niger	17	16	19	52	29.7%
A. flavus	15	08	15	38	21.7%
A. fumigates	04	09	10	23	13.1%
R. stolonifer	__	21	18	39	22.3%
Curvularia	15	04	04	23	13.1%

Chi-Sq = 62.742, DF = 10, P-Value = 0.000. 3 cells with expected counts less than 5

Aspergillusspecies, *Rhizopus* and *Pennicillium* occured in all the three soil samples Collected from differentSites, while Curvularia was found only one soil samples site. Results shows that *Fusarium and Mucur*wer isolated from two soil samples sites but were absent in other sample site.

Similarly of the 180 wastewater samples collected from different sites, 175 were positive for fungal pathogens.Fungal pathogens isolated from the irrigation wastewater samples at different locations of theSokoto metropolis indicates that*Aspergillusniger* (29.7%),*Rhizopus stolonifer* (22.3%) and *Aspergillus flavus* (21.7%)were the most in abundant and predominantly isolated pathogens. while *Aspergillusfumigatus* (13.1%) and *Curvularia*(13.1%) were the least in occurence. Table 2 showed fungal species isolated from waste water at different irrigation site of sokoto metropolis.

DISCUSSION

In the present study,the Total Viable Counts (TVC) indicates that there were more fungal load in both soil and waste water samples after 48 hours period of incubation compared to recommended value as reported by Baxter-Potter and Gilliland, (1988). The mean total fungi were high for samples and in comparison with international standard, any water contaminated to this level is neither good for domestic use nor is it supposed to be discharged directly into the environment without treatment (Makinde.*et al.,* 2006). *Aspergillusniger*, *Aspergillusflavus*, *Aspergillusfumigatus* were the dominantly isolated species in all the samples. Wastewater contains many effluents and heavy metals. Aspergillus niger has ability to tolerate the heavy metals present in wastewater so its number is more in wastewater (Michael et al., 2000). Some of the species isolated from wastewater are reported to be well known agents of mycosis such include*Aspergillusflavus* and *Aspergillusfumigatus*. This genus was reported to have been associated with wastewater in various parts of the world (Moallaei *et al*., 2006).

The soil samples collected from polluted sites of the wastewater irrigation areas influence the population density of pathogenic fungi such as *Aspergillus niger* and *Aspergillusfumigatus.*The predominantly isolated pathogens were *Aspergillusniger, Rhizopus stolonifer*,*Mucur racemosus*, *penicilliumcitrinum*, *AspergillusfumigatusCurvularia* and *Fusarium*. Similarly Ogunwonyi *et al.,* (2008) found *A. niger* as dominated fungi among fungi isolated from soil samples from Obafemi Awolowo Universty Ife. This is also in agreement with the finding of Sharma (2010) who reported*A. niger*and *A. fumigatus* as predominanted pathogens among fungal species isolated from soil samples at Ramgham in India. The difference between the sampled sites in terms of richness of fungal isolates is closely related to the heavy

metal pollution present in wastewater.Similarly, the total contamination counts were high in waste water than soil. This could be associated with hygienic conditions of the cultivation site. The result obtained is in consonant with the finding of Ibeyessie (2007), who study the vegetable production by waste and non waste water, the presence of wide range of fungal organisms in these products showed a relationship between the microbial quality of the water used for the vegetables and the extent of human and other animals defecation, agricultural activities as well as domestics waste discharges in the only river (River Rima) and its' tributaries that is the only source of water for irrigation in the area apart from metropolitant waste water.

Based on this study, there is need for continous monitoring of some pathogenic enteric of soil particularly fungi along waste water stream use for irrigation behind the metropolis. There is need for the improvement upon this work possibly by taking not only one stream but many across the metropolis. Peoples should be enlightened on the dangers associated with environmental pollution by appropriate authorities.

CONCLUSION

The present study has built initial knowledge on fungal diversity in polluted water and soil environments. At the end, it can be concluded that the usage of untreated wastewater in agricultural land put harmful effects on soil and its biodiversity. For the safety of environment particular care should be adopted. To treat the wastewater to the level recommended.

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