SUMMARY

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The released water from domestic and industrial sources after used is known as wastewater which contain large amount of organic and inorganic substances. Waste water originated from industrial sources is also known as industrial effluent. The discharge of untreated industrial effluent is one of the most significant factors for pollution of aquatic ecosystem and irrigating lands. In India, disposed and diverted effluent is used for irrigation of crops, grown in adjoining agricultural fields, as it is a good source of fertilizers beside irrigation facility.

The cottage industries of woolen carpet, rug and durries have grown very rapidly in various part of the world. These industries utilize chemical and water in large quantity. The untreated waste water is let out as effluent to aquatic and terrestrial system around the industrial complex. Land application of effluent in agricultural fields has a lot of implications in agro-ecosystems. It poses a serious threat to soil ecosystem, especially with regard to development of plant and animal diseases due to alteration of physico-chemical properties of soil, influencing nature of soil microflora including the pathogenic

ones. Subsequently the pathogenesis, incidence and severety of soil borne diseases are considerably affected.

In view of the above, the effect of land application of effluent, released from scouring, dyeing and processing of woolen carpet company situated at Khamaria, District Ravidas Nagar, Bhadohi, on soil microflora and wilt disease of tomato caused by *Fusarium oxysporum* f. sp. *lycopersici* have been studied following the standard microbiological techniques.

The results obtained, pertaining to the various aspects of studies, are summarizes below :

Physico-chemical analysis of the samples of effluent and tube-well water and control and treated soil were done during the course of investigation. Effluent showed higher pH, electrical conductivity, total solids, BOD, COD, Total alkalinity, carbonate, chloride, phosphate, nitrate-N, Ammonium-N, total nitrogen, sodium, potassium, calcium, chromium VI and dye contents than tube-well water. Bulk density of treated soil is more than the control soil. The porosity of the soil decreased as the bulk density increased. The water holding capacity and porosity of control soil is slightly higher than the

treated soil. The electrical conductivity of treated soil is more than the control soil. The chromium VI, exchangeable sodium, chloride sulphate, carbonate, ammonium nitrogen contents were more in treated soil where as exchangeable potassium, calcium, magnesium phosphorus, nitrate nitrogen and total nitrogen contents were high in control soil. The pH of all the soil samples were found to be alkaline. Organic matter and moisture content were relatively high in treated soil than the control.

The number of fungal species were recorded higher in control than the treated soil samples. The dominant species recorded in both the soil samples were *Acrophialophora fusispora*, *Alternaria alternata*, *Aspergillus flavus*, *A. luchuensis*, *A. nidulans*, *A. niger*, *A. sulphureus*, *A. terreus*, black sterile mycelium, *Cladosporium cladosporoides*, *Curvularia lunata*, *Fusarium oxysporum* f. sp. *lini*, *Fusarium oxysporum* f. sp. *lycopersici*, *Penicillium chrysogenum*, *P. citrinum*, *P. frequentans*, *P. granulatum*, *P. rugulosum*, *Trichoderma harzianum*, *T. viride* and white sterile mycelium. *Aspergillus terreus*, *F. oxysporum* f. sp. *lini*, *F. oxysporum* f. sp. *lycopersici* and white sterile mycelium were recorded in very high frequency from both the soil samples.

The total number of fungi g^{-1} dry soil was higher in control than treated soil. However the number of bacteria g^{-1} dry soil was higher in treated soil than the control. It was found to be more in July and August and less in May and June. The bacterial population was observed to be higher than that of actinomycetes in both the soil samples. However the number of actinomycetes g^{-1} dry soil was higher in control soil.

The pathogen *Fusarium oxysporum* f. sp. *lycopersici* was isolated from wilted tomato plants on Czapek dox + yeast, Potato dextrose agar and PCNB (selective) media and was maintained in plates and culture tubes for various kinds of studies after satisfying Koch's postulate. The per cent incidence of wilting of tomato was recorded from control and effluent irrigated fields. A greater incidence of wilting of tomato was observed in control field. The per cent incidence of wilting increased as the time progressed.

The population of the pathogen *Fusarium oxysporum* f. sp. *lycopersici* was recorded in high per cent frequency than other fungi. The maximum population of the pathogen was recorded on rhizoplane of the wilted plants. The population of the pathogen increased gradually with progression of times.

Colony interaction between the test pathogen and some dominant microorganism, isolated from control and treated soil samples, were studied in dual culture. The maximum inhibition in radial growth of *Fusarium oxysporum* f. s.p. *lycopersici* was exhibited by *Trichoderma harzianum* followed by *A. niger*, *S. rochi* and *T. viride*. *Cladosporium cladosporoides* exhibited minimum inhibitory effect against the test pathogen.

The volatile metabolites, emanating from the cultures of the test microorganisms, inhibited the radial growth of the test pathogen. After 48 hours incubation, the metabolites of *Trichoderma harzianum* caused the highest inhibition in radial growth followed by *Streptomyces rimosus*, *Penicillium frequentans*, *S. rochi*, *T. viride*, *A. niger*, *A. terreus*, *P. citrinum*, *A. luchuensis*, *A. flavus*, Yellow colour bacteria and colour less bacteria. *Cladosporium cladosporoides* caused little inhibition. The inhibitory effect in most of the cases decreased gradually with increase of the incubation period.

The non volatile metabolites were found to be more effective than the volatiles ones. The culture filtrates of *Aspergillus luchuensis*, *A. niger* and *Streptomyces rimosus* and *S. rochi* were most effective in inhibiting the hyphal growth of *Fusarium oxysporum* f. sp.

lycopersici. The effectiveness of culture filtrates was recorded in following order. *Aspergillus luchuensis*, *A. niger*, *Streptomyces rimosus, S. rochi* (SR_1), *A terreus*, *A. flavus*, *Trichoderma harzianum*, *Penicillium citrinum*, *Cladosporium cladosporoides*, *P. frequentans*, *T. viride*, *Alternaria alternata*, Colourless bacteria and yellow colour bacteria.

The effect of culture filtrates on mean radial growth of the test pathogen was studied in different concentrations. At 5% the maximum inhibition of the test pathogen was caused by *Aspergillus luchuensis* fallowed by *A. niger*, *A. terreus*, *Streptomyces rimosus* and *S. rochi* (SR_1) and minimum in case of *A. flavus* and *Penicillium frequentans*. At 20% concentration maximum inhibition was recorded by *A. luchuensis* followed by *A. niger*, *S. rimosus*, *S. rochi* (SR_1) and *A. terreus* and the minimum inhibition was by *P. frequentans*.

All the fungicides tested *in vitro* caused partial or complete inhibition of radial growth of the test pathogen at each concentration. Out of nine fungicides bavistin, benlate and MEMC completely checked the growth of the pathogen at all the concentrations. The toxicity of these fungicides at 500 ppm in descending order was bavistin, benlate, MEMC, Thiram, folfat, blue

copper, mancozeb, brassicol and dithane M-45. The effectiveness of these fungicides increased with the increase in the concentration of the fungicides amended with the culture medium. Benzene hexa chloride (B. H. C.) exhibited maximum inhibition of growth of the pathogen *in vitro* which was followed by ekalux thiodone and monocil. None of the insecticides could arrest the growth of the pathogen completely.

Effect of effluent on mean radial growth of some dominant microflora including test pathogen was studied. None of the concentration of effluent was very effective against microorganisms including *Fusarium oxyspourm* f. sp. *lycoperisis*. At 5% concentration *Penicillium frequentans* showed maximum inhibition followed by *Aspergillus terreus*, *A. luchuensis*, *P. citrinum* and *Streptomyces rimosus* while *Trichoderma harziunum* and *T. viride* exhibited minimum inhibitory effect. It was observed that the maximum inhibition, in radial growth was recorded in case of *A. luchuensis* whereas the minimum in case of *T. harzianum* at 20% concentration.

All the heavy metals inhibited the radial growth of the pathogen as well as of other test micro organisms. None of the heavy metals caused complete inhibition of radial growth of any microorganisms at any used concentrations. However, gradual

increases in the inhibition of mean radial growth was recorded with increase in the concentration of heavy metals. Cadmium, was found to be most effective against the pathogen where as Zn was found to be least effective. The effectiveness of the heavy metals against the test pathogen, recorded at 200 ppm, was in the following order CD > N_1 > Cr > Pb > and Zn.