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## RESEARCH ARTICLE

### Effects of tannery effluent on tomato plants its growth and biochemical characteristics.

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#### Abstract

Present study deals with the impact of different dilutions of tannery effluents on tomato seed germination with its growth and biochemical characteristics grown for a period of 90 days. Tomato plant grown with different effluent concentrations i.e. 0%, 20%, 40%, 60%, 80% shows effects on plant growth parameters and biochemical parameters such as; seed germination percentage, shoot and root length, number of flowers and fruits and chlorophyll. The result clearly shows that the concentrations of effluents directly affect on the growth and biochemical constituents. The heavy metal accumulation found at higher level in root when compared with control. Both chromium (cr) and cadmium (cd), found to the maximum of allowable limit approved by WHO/FAO. Accumulation of heavy metals creates chronic health problems to human and cattle through food chain in long run.

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#### Introduction:-

Presence of toxic heavy metals from various industrial activities causes damage to plants by altering major plant physiological and metabolic processes (villiers and ducruise (2011), rasico (2011) chromium mainly released in the soil from leather tanning, textile, carpet electroplating industries, mining industry and metal cleaning (baran 2005, vajpayee 2000). Among variable forms of cr, highly reactive cr (vi) was found to be toxic to plants in high concentration remaining stable for several months in the soil without changing its oxidation state (james 1984) the interactions between cr and other nutrients led to changes in nutrient content and physiological disorders with reduction of plant growth and yield. Cr is carcinogenic to humans and also causes cirrhoses and DNA damage. (kamavis dar 2010). Due to this toxicity to plants human health and environment cr toxicity has become an increasing target of studies much human diet depends directly on plant products like fruits and vegetables or indirectly as fodder given to livestock's. Accumulations of heavy metals in the edible parts of plants represent a direct pathway for their incorporation into the human food chain (florijin 1993). Cadmium is a biologically non-essential metal it is toxic both plants and human beings (shukla et al, 2007). It cause itai – itai disease, anemia, mainly in women over forty and induce homosis (low dose stimulation and high dose inhibition) in plant (calabrese and baldwin 1997, 1999). Cadmium toxicity is an important growth limiting factor for plants (akinola and ekiyoyo, 2006, mohan and hosetti, 2006). Vegetables have been proved to be an important part of the human diet because they are the derivatives of a balanced diet (carbohydrates, proteins, vitamins minerals and trace elements (dospatliiv et al, 2012). Waste water irrigation results in significant mixing of heavy metal content of agricultural land (mapanda et al., 2005). The chief cause is the waterways through which heavy metals are leached out of the soil and taken by the vegetation thus long term wastewater irrigation leads to build up of heavy metals in soils and food crops (khan et al, 2008). International and national regulation of food quality have lowered the maximum permissible levels of toxic metals in food items due to an increased awareness of the risk these metals pose to food chain contamination (radwan and salama 2006). The best method for the determination of concentration of trace elements accumulation either in vegetable or in water) applied is atomic absorption spectrophotometry AAS (mosleh et al. 2013).

## **Materials and methods:-**

### **Physicochemical parameters of the effluent:-**

The physicochemical parameters such as pH, temperature, biological oxygen demand, chemical oxygen demand, total dissolved solids, lead, chromium, cadmium were estimated by APHA. For the present study tannery industry effluent was collected from MIDC waluj aurangabad India, in 20 liter glass containers. After collection the effluent was immediately transported to the laborites for analysis samples were analyzed for various physicochemical properties following the methods given by APHA (2012) using AAS (atomic absorption spectrophotometer) used to determined heavy metals such as pb, cr, cd and other parameters pH was determined by the pH meter, ec by ec meter, TDS by gravimetric, COD by open reflex method analyst used to determined heavy metals such as pb and cr, cd and other parameters.

### **Pot culture studies:-**

For pot culture studies, garden soil, sand and cow dung were collected from botanical garden, Babasaheb Ambedkar Marathwada University. The present study was conducted with tomato (vegetable) seeds. The seeds were purchased from vegetable seed importers by keeping the high purity and quality of germination. A series of pots were filled with equal amount of soil (4:1 garden soil, cow dung manure). Dilutions of the effluents at T1 (20%), T2(40%), T3(60%), T4(80%), Equal number a seeds were sown in each pot and irrigated with undiluted as well as diluted water for every alternate day to enough the soil moistened plants were allowed to grow till maturity. The total number of germinated seeds was counted at 24 hours interval starting from the third day of sowing up to 11 days and germination % was obtained. Observations on morphological parameters like germination percentage, seeding length, shoot length 10 days seedlings were considered.

### **Plant growth:-**

Five seeds were planted in each pot. Slightly pressed and allow germinating. The effluent (1 liter) was irrigated periodically at every 48 hours interval. The percentage of germination was assessed (rahman et al, 2002). The shoot length of the plant was recorded at every 72 hours for 15 days. The plants were uprooted and washed thoroughly with distilled water and length of the roots was measured.

### **Root and shoot length:-**

Five seedlings were taken from each treatment and their shoot and root lengths in cm were measured by using a measuring ruler and the values were recorded. The data was the average of three replicates and was represented in figures.

### **The chlorophyll:-**

The chlorophyll content was estimated by extracting fresh leaves with 80% acetone and after centrifugation at 8000 rpm for 20 min measuring the colour intensity of the extract at (645 and 663) nm wave lengths by spectrophotometer. Chlorophyll concentration was determined by the method of arnon (1999).

### **Determination of heavy metals:-**

Samples were digested for heavy metal analysis using the method of m.c. grath and cunliffe(1985). 5gm of the sample was weighed into a teflon beaker a volume of 10 ml of analytical grade concentrated hno<sub>3</sub> was added the solution was evaporated to dryness in order to remove the organic matter the residue was dissolved in 10 ml of 6n hno<sub>3</sub>, boiled gently for 5 minutes, cooled, filtered and made up to a volume of 25 ml with de-ionized water for heavy metal analysis by a perkin elmer model 372 atomic absorption spectrophotometer extracts were filtered, diluted to marks with de-ionized water and analyzed for Cr and Cd.

## Result and discussion:-

**Table . 1:-** physiochemical characteristics of tannery effluent collected from the outlet.

Parameters	Concentration (result)	Who permissible limits
Temp. (°c)	28.2	40
pH	9.5	6-9
Bod (mg/l)	156.78	30
COD (mg/l)	975.10	250
TDS (mg/l)	2400	2100
Lead pb (mg/l)	2.7	0.1
Chromium (mg/l)	6.805	2.0
Cadmium (mg/l)	4.10	2.0

The physicochemical properties of effluent were given in table -1, shows pH=9.5. The TDS were very high (2400) mg/l. The COD was 975.10mg/l, (agarwal and sachn (2003) reported higher (15000mg/l) value of COD in sugar industry effluent the BIS permits only 100mg/l of COD for disposal to the environment. The bod was 156.78mg/l the permissible limit of BOD is only 30mg/l for environmental disposal in the present study the bod is also beyond the permissible limit. Heavy metals are also found beyond the permissible limit (pb 2.7mg/l cr 6.805mg/l, cd 4.10mg/l).

**Table. 2:-** some growth parameters of tomato (*lycopersicon esculentum*) seeds as affected by different concentrations.

Concentration %	Germination %	Survival %	Plant height (cm)	Root length (cm)	Shoot length (cm)	No. Of flower	Average fruit	Fruit weight (gm)
T0	100	98%	62.1±0.0835	10.3±0.321	52.0±0.610	11.8±0.60	9.0±0.326	49.7±0.52
T1	85	75	55.2±0.609	8.96±0.175	48.8±0.410	8±0.32	6±0.312	44.9±0.389
T2	73	60	51.7±0.360	7.6±0.175	44.1±0.398	7±0.19	4±0.201	40.3±0.326
T3	65	51	49.5±0.287	1.0±0.118	42.5±0.429	6±0.19	4±0.172	37.9±0.175
T4	42	35	35.8±0.64	4.7±0.60	31.1±0.127	--	--	--

From the above analyzed data, shows the value of germination index was found to be higher in T1 treated at lowest (T1=85%) effluent concentration however germination index was lowest in T4 (42%) germination at highest effluent concentration (80%) higher quantity of tannery industry effluent concentration 80% (T4) inhibited the seed germination. According to (malla and mohanty (2005), there was significant decrease in percentage germination, root length, shoot length with increase in the effluent concentration. (pandey et al (2008) reported that supply of undiluted distilleries effluent produce significant inhibition in seed germination. The survival percentage of seedling decreased gradually in all concentration (table 2) in treated sample (T1, T2, T3, T4) it was 75%, 60%, 51%, 35% respectively.

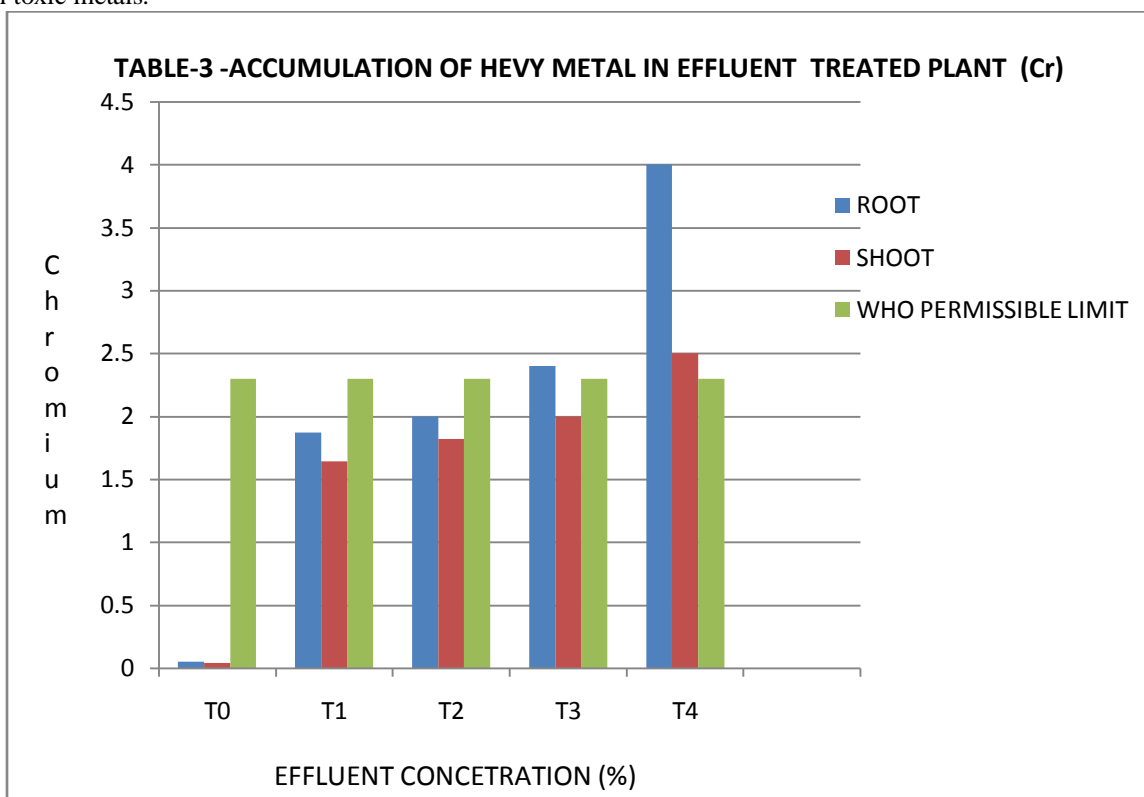
The average shoot length in all concentration was greater than the average root length (table-2) the average percentage of germination shoot length, root length, seedling length of the germinated seeds decrease with increasing effluent concentration compared to control (T0). According to (Rasula and Padmadevi (2000), the germination percentage and morphological character like shoot length and root length decrease gradually with increase in effluent concentration. table 2 no. of flower produced lower in T3.

**Table . 3:-** accumulation of heavy metal in effluent treated plant (cr)

Concentration	Root (mg/kg)	Shoot (mg/kg)
T0	0.05±0.03	0.04±0.02
T1	1.87±0.6	1.64±0.4
T2	2.0±0.4	1.82±0.3
T3	2.4±0.6	2.0±0.4
T4	4.0±0.9	2.5±0.6
Permissible limit WHO/FAO-2001	2.3	2.3

Accumulation of heavy metal from the above analyzed data shows that the mean concentration of chromium (cr) in roots (T4=4.0mg/kg) is higher than the maximum permissible limit and shoot values is also increased with

increasing effluent concentration (T4=2.5mg/kg). The orders of toxic heavy metal concentration in vegetable vary with toxic metals.

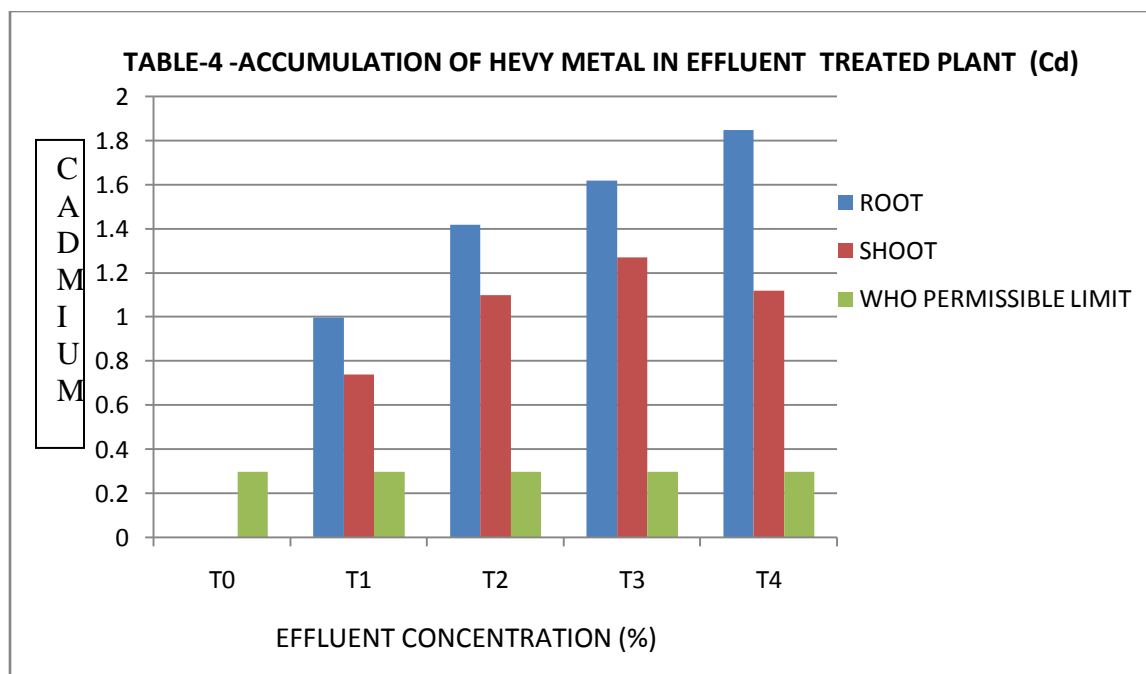


From the above analyzed data value of chromium shows more than the maximum permissible limit given by WHO (world health organization) in tomato plant, root and shoot that i.e. 2.3 mg/kg. The figure 1 shows distribution means concentration of chromium trend like roots > shoots > leaves > fruit.

**Table . 4:-** accumulation of heavy metal in effluent treated plant (cadmium mg/kg)

Concentration	Root (mg/kg)	Shoot (mg/kg)
T0	0.004±0.002	0.003±0.001
T1	1.0±0.08	0.74±0.04
T2	1.42±0.06	1.10±0.05
T3	1.62±0.04	1.27±0.3
T4	1.85±0.10	1.12±0.2
Permissible who/fao2001	0.2	0.2

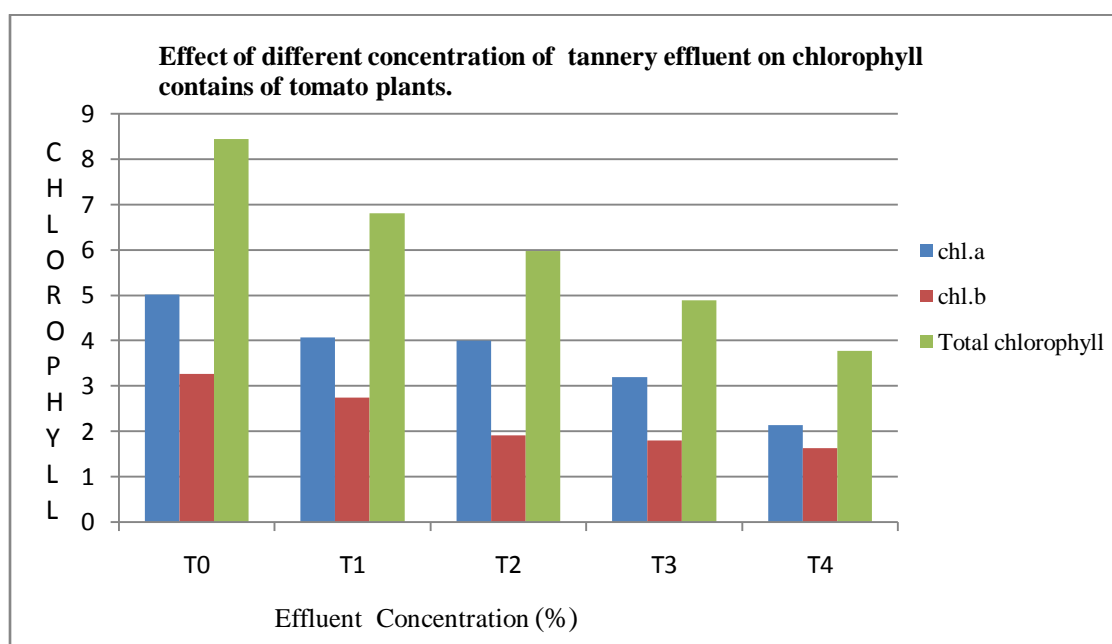
From the above analyzed data, the value of cadmium shows more than the maximum permissible limit given by WHO in tomato plant, root and shoot that i.e. 0.2 mg/kg. Figure no 2 shows distribution means concentration of cadmium trended like a decreasing order like roots > shoot > leaves > fruits.



Different vegetable species accumulate different metals depending on environmental condition, metals species and plant available forms of heavy metals (lokeshwari and chandrappa, 2006).

**Table . 5:-** effect of different concentrations of tannery effluent on chlorophyll (mg/gm) contents of tomato plant

Treatments	Chlorophyll 'a'	Chlorophyll 'b'	Total
T0	5.02±0.42	3.27±0.19	8.45±0.52
T1	4.07±0.21	2.75±0.15	6.82±0.37
T2	4.0±0.18	1.92±0.14	5.98±0.24
T3	3.2±0.15	1.80±0.10	4.89±0.19
T4	2.15±0.10	1.64±0.6	3.78±0.15



From the above analyzed data shows effect of various concentration of tannery industry effluent on bio-chemical characteristic of tomato plant are presented in table 5. The chlorophyll a,b and total chlorophyll content were higher

in T0 and lower in T4. According to (mishra et al (2008), in their study demonstrated that the levels of chlorophyll and protein decrease in eichornea crassipies when the metal level increase.

The pH of the effluent was kumaravelu et al, 2000 reported higher value of pH (8.81) in tannery effluent. Mondal, 2005, reported that chemicals such as sodium as sodium carbonate sodium bicarbonate, sodium chloride and calcium chloride based in tanning causes the alkalization of soil resulting in the increase of pH of the soil. Consumption of the affected vegetables will certainly result to health consequents which include kidney and liver damage, skin rashes, stomach upset and ulcer, respiratory problems and lung cancer and alteration of genetic materials. In the present study chlorophyll a,b total chlorophyll were higher in treatment T1, T2. Garg and kaushik 2008 reported lower value on the effect of textile effluent along with organic amendments on sorghum. Some essential micronutrients are needed in small quantities for plant growth. However the excessive level could prove toxic to plant growth.

Indra and ravi (2009) clearly reported the toxicity of tannery effluent on the growth, physiological and biochemical contents of black gram. The mean concentration of cr was found more than the maximum allowable limit. Cd accumulation was also found more than the maximum limit. The presence of heavy metals in the environment is of major concern because of their toxicity bio accumulating tendency, threat to human life and the environment (singh et.al 2010).

The salt content outside the seed is known to act as liming factor and causes less absorption of water by osmosis and inhibit the germination of seeds (malla and mohanty 2005). According in our study plant growth was highly affected due to the pH, presence higher dissolve solids and heavy metals in effluent

### Conclusion:-

The physicochemical analysis of effluents revealed in open eco-system produces health hazard to public health as well as environment. Result demonstrate that, even at the lowest contains of effluent affect the growth of tomato plant such as germination, root, shoot length, yield and bio-chemical contents such as chlorophyll a,b and total chlorophyll found decreased in increasing concentration of effluent. The mean concentration of chromium and cadmium (heavy metal) on tomato plant, observed to be more than world health organization (WHO) permissible limits. Periodical monitoring is necessary to avoid crop contamination.

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