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Investigation the Impact of Textile Industrial waste waters on the Soil and Plants

Tesfalem Belay Woldeamanuale
Ethiopian Environment and Forest Research Institute, Central Ethiopian Environment and Forest Research Center, Department of Environmental Pollution Management

Abstract: *This study was conducted to determine effect of textile waste waters on the soil properties and plants. Lycopersicon esculentum (Tomato) plants were treated with textile effluents with different ratio concentration, 0, 20 40, 60 and 80 % were analyzed for metal accumulation, growth and biochemical parameters at Pre, peak and post flowering stages. Findings of the study revealed that at 80% waste water treatment the chlorophyll, protein, nitrogen content, root and shoot length, root and shoot dry weight and total dry weight and soil properties were most severely affected by metal concentration. Total chlorophyll content showed a reduction of 62.5% while protein and nitrogen content showed reduction of 71.29 and 71.65% respectively. Root length, shoot length, root dry weight, shoot dry weight, total dry weight were reduced by 61.9, 70.8, 69.2, 70.5, 67.3% respectively and the soil contained Cu; 0.725, 1.312 and 1.89 gm kg^{-1}. Cr; 6.54, 7.02 and 8.40 gm kg^{-1}. At Pre, peak and Post flower stage respectively. These indicated that concentration of heavy metals increase with increasing of concentration of the treatment.*
Keywords: *Waste water, Plant, Soil, Water*

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I. Introduction

Textile industry consumes large quantities of water and produces large volumes of wastewater from different steps in dyeing and finishing processes. Business and industry play a crucial role in the socio-economic development of a country. However, industrial development is the main cause of depletion of natural resources and degradation of the environment [1]. Industries generate wastes, which can be damaging to water, air, land resources and quality of life [2]. Central pollution control board has listed the dye industry as one of the heavily polluting industries [3] The dye effluent is highly toxic in nature as it contains high suspended solid, COD, dye and chemicals along with high concentration of heavy metals like Cr, Cu, Cd, Zn, Ni and Pb.The dye effluent contaminates the surface and ground water, thereby, making it unfits for irrigation and drinking [4]. The dye effluent contains certain chemicals that could be toxic, carcinogenic or mutagenic to living organisms [5]. Crops and vegetables grown in the agricultural fields irrigated by textile effluent are adversely affected both qualitatively and quantitatively. Impact of textile waste water on plants has been studied earlier by several workers [6] reported heavy metal accumulation in different parts of tomato grown in soil treated with Industrial waste water. The accumulation and mobility of heavy metals such as Cr, Cd, Co, Cu, Fe, Ni, Pb and Zn from soil to leaves through roots and stems in vegetable crop has been reported by [7]. [8] Reported the effect of Cr, Cd, Cu, Ni and Zn on seed germination and seedling growth of tomato under controlled light and temperature conditions. The heavy metal mixture treatment showed toxic effects on seed germination and seedling growth of tomato. In view of the above, the present study aimed to investigate the effect of textile waste water on the growth parameter of tomato plants and soil properties.

II. Material and Method

2.1. Description of the Study Area

The study was conducted to Kombolcha which is located on the north central part of Ethiopia placed immediately south east of Dessie in Amhara region at 11^{o}06’ north latitude and 39^{o}45’ east longitude. River Borkena crosses the town emerging from the east and running to the west direction. In its way all through the town, it receives effluents indirectly through its tributaries rivers named Worka and Leyole. Most of the factories are found closely together in the middle of the town near by the tributary rivers of Borkena.

2.2. Sample collection and analysis

An experiment was conducted in textile industrial area. Textile waste water was collected from common waste water treatment plants and the impacts of textile waste water on vegetables were evaluated. For the experimental study tomato vegetables were selected as test plant. Tomato (Lycopersicon esculentum) belongs to family Solanaceae. It is a commonly used fruit vegetable. The plants were grown in the plastic pots and the populations of five plants per pot were maintained for experiment. The plants were treated with waste water with different ratio concentration, 20:80, 40:60, 60:40 80: 20, and 0:100 textile waste water and tap water. The plants treated with tap water served as control.

2.3. Growth parameters:

The plants were harvested at pre-flowering, peak-flowering and post-flowering stages for studying different growth parameters (root and shoot length, dry weight of root and shoot and total dry weight). For dry weight determination roots and shoots were separated and dried by oven at 80ºC for 72 hr.

2.3. Physico-chemical analysis:

Tomato plants samples were collected from both experimental and control pots harvesting at pre-, peak- and post-flowering stages of tomato, plant samples were collected oven-dried at 80ºC for 72 hr., ground and passed through 2mm sieve and stored in polythene bags for physico-chemical analysis. Heavy metals were estimated using Atomic Absorption Spectrophotometer (AAS).
Biochemical analysis: Chlorophyll a, b and total chlorophyll content in fresh leaves of treated and control plant were estimated following method suggested by [9]. Protein contents were determined by method of [10] while nitrogen content was estimated by micro kjeldhal method [12].

2.4. Soil sample collection and analysis

Soil samples were collected from both experimental and control pots after irrigation. These samples confirmed about homogeneity of the soil in all pots at the beginning of the research project. After harvesting at pre-, peak-and post-flowering stages of tomato, soil samples were collected oven-dried, crushed and passed through 2mm sieve and stored in polythene bags for heavy metals analysis. The heavy metals were determined using procedures of [13].

III. Results and Discussions

Tomato plant(L.esculentum) treated with 80% effluents showed maximum reduction in the root length (61.9%), Root dry weight(69.2 %), shoot dry weight (70.5%), total dry weight (67.3%) and total Chlorophyll (62.5%) contents were found at post-flowering stage and shoot length (70.8%)content was found at peak-flowering stage (Table 1 2, 3). Table4. Maximum reduction in nitrogen (74.71%) and protein (71.29%) contents were found at peak-flowering stage at 80% effluent treatment short period.

Table1. *Effect of textile waste water on root length and shoot length of tomato(mean ± SD).*

Treatment	Root length (cm)			Shoot length (cm)		
	Pre-flower	**Peak-flowering**	**Post-flowering**	**Pre-flowering**	**Peak-flowering**	**Post-flowering**
Control	26.56±6.005	32.40±.100	40.12±4005	55.12±.010	62.34±.010	69.01±.010
20	22.12±2.005	29.30±.100	36.20±6.100	52.10±.100	58.56±.010	66.24±.010
40	17.2±1.952	21.20±.100	31.20±4.100	38.01±.010	40.76±.010	47.11±.010
60	14.32±1.010	19.40±.100	25.40±3.951	24.12±.010	31.13±.010	35.15±0.99
80	10.23 ±2.005	5.30±.100	15.30±.100	17.43±.010	18.21±.010	26.17±.010
	61.4%	58.6%	61.9%	68.4%	70.8%	62.1%

The mean ± SD Values were significance variation among the treatment<0.05

Table 2.*Effect of textile waste water on root dry weight and shoot dry weight of tomato plant (mean ± SD).*

Treatment	Root dry weight (gm /kg)			Shoot dry weight (gm/kg)			Total dry weight. (gm/kg)		
	Pre-flower	**Peak flower**	**Post flower**	**Pre-flower**	**Peak flower**	**Post flower**	**Pre-flower**	**Peak flower**	**Post flower**
Control	1.02±.1	1.71±.010	2.21±.010	7.34±.010	11.34±.010	16.50±.100	8.11±.010	10.32±.010	14.23±.01
20	.75±.010	1.01±.010	2.01±.010	5.21±.010	10.20±.010	11.67±.010	6.32±.010	7.45±.010	12.23±.01
40	.65±.010	.87±.010	1.82±.010	4.78±.010	8.71±.010	9.30±.010	5.01±.010	5.65±.010	10.89±.01
60	.51±.010	.73±.010	.74±.010	3.10±.010	5.10±.100	7.01±.010	4.12±.010	4.32±.010	7.87±.010
80	.47±.010	.66±.010	.68±.010	2.87±.010	3.35±.010	4.33±.010	3.56±.010	3.65±.010	4.65±.010
	53.9%	61.4%	69.2%	60.9%	70.5%	73.8%	56.1%	64.6%	67.3%

The mean ± SD Values were significance variation among the treatment P<0.05

Table 3.*Effect of textile waste water on plant pigment of tomato (mean ± SD).*

Treatment	Chla gm/kg			Chl b gm/kg			Total Chl mg/kg		
	Pre-flower	**Peak-flower**	**Post-flower**	**Pre-flower**	**Peak-flower**	**Post-flower**	**Pre-flower**	**Peak-flower**	**Post-flower**
Control	1.1300±.01	1.2200 ±.01	1.4010±.001	.55 ±.001	.7210±.001	.7110±.001	1.6810±.001	2.1240±.001	1.0000 ±.01
20	.9300 ±.010	.8830 ±.001	1.3620±.001	.521±.001	.9010 ±.001	.3810 ±.001	1.9410±.001	1.1210±.001	1.2764±.0001
40	.7400 ±.010	.7210±.001	.8130 ±.001	.3810±.001	.5860 ±.001	.5510 ±.001	2.3020±.001	1.1280±.001	.7040 ±.001
60	.5600 ±.01	.6190±.001	.7254 ±.001	.3410±.001	.7620 ±.001	.2780 ±.001	1.4510±.001	1.5240±.001	.7910 ±.001
80	.4900 ±.01	.5130±.001	1.5460 ±.001	.2140±.001	.4070 ±.001	.3450 ±.001	1.4690±.001	.9010 ±.001	.8630 ±.001

The mean ± SD Values were significance variation among the treatment $P<0.05$

Table 4.*Effect of textile waste water on total Nitrogen and Protein (gm/Kg) Content in tomato (mean ± SD).*

Treatment	Pre-flowering	Peak-lowering	Post-flowering	Pre-flowering	Peak-flowering	Post-flowering
Control	0.648	0.879	0.799	4.053	5.495	4.995
20	0.566(12.54)	0.778(11.44)	0.674 (15.63)	3.542 (12.60)	4.865 (11.46)	4.213(15.65)
40	0.438 (32.39)	0.561 (36.06)	0.535(32.99)	2.738 (32.44)	3.512 (36.08)	3.346(33.01)
60	0.251 (61.25)	0.335 (61.84)	0.336(57.87)	1.569(61.28)	2.096 (61.85)	2.103 (57.89)
80	0.179 (72.27)	0.222 (74.71)	0.232(70.91)	1.123 (72.29)	1.389 (74.72)	1.452 (70.93)

The mean ± SD Values were significance variation among the treatment $P<0.05$

Table 5.*Concentration of heavy metals (gmkg^{-1}) in different plant parts of tomato.*

Heavy metals	Plant parts	Post-flowering stage				
		control	**20**	**40**	**60**	**80**
Cr	Leaves	0.0143	0.148	0.741	0.862	0.876
	Stem	0.083	0.263	0.221	0.271	0.281
	Root	0.142	0.496	0.464	0.574	0.734
	Fruit	0.022	0.392	0.724	0.821	1.12
Cu	Leaves	0.054	0.153	0.188	0.214	0.187
	Stem	0.026	0.196	0.104	0.176	0.23
	Root	0.078	0.172	0.197	0.202	0.193
	Fruit	0.123	0.678	0.173	0.187	1.023

Table 6.*Concentration of metals (gm kg^{-1}.) in pot soil of tomato (L. esculentum) plants after harvesting at pre, peak and post-flowering stages.*

Treatment	Pre-flowering		Peak-flowering		Post-flowering	
	Cr	**Cu**	**Cr**	**Cu**	**Cr**	**Cu**
Control	0.103	0.11	0.176	0.108	0.29	0.21
20	0.37	0.46	3.741	0.645	4.22	0.954
40	4.821	0.632	4.95	0.901	5.371	1.204
60	4.96	0.679	5.32	1.02	6.001	1.509
80	6.54	0.725	7.02	1.312	8.40	1.89

The results of heavy metals (Cr and Cu analyzed in different plant parts of tomato) at post-flowering stages were given in Table 5. The concentration of Cr and Cu in different parts of tomato plants of post-flowering stages at 80% treatment were given: 0.876, 0.281, 0.734,1.02gm Kg^{-1} and 0.187, 0.23, 0.193, 1.023gm kg^{-1} in leaf, steam, root and fruit respectively at Post flowering stage respectively. This indicated that the concentration of heavy metals increase with increasing the concentration of treatment. The result of soil samples were given in Table 6.At 80% effluent treatment, the soil contained Cu; 0.725, 1.312 and 1.89 gm kg^{-1}. Cr; 6.54, 7.02 and 8.40 gm kg^{-1}. At Pre, peak and Post flower stage respectively. These results indicated that concentration of heavy metals increase on soil with increasing of concentration of the treatment.

IV. Conclusion

Tomato plants were treated with effluents with different ratio concentration, 0, 20 40, 60 and 80 % were analyzed for metal accumulation, growth and biochemical parameters at Pre, peak and post flowering stages.

This study revealed that at 80% waste water treatment the chlorophyll, protein, nitrogen content, root and shoot length, root and shoot dry weight and total dry weight and soil properties were most severely affected by metal concentration. Total chlorophyll content showed a reduction of 62.5% while protein and nitrogen content showed reduction of 71.29 and 71.65% respectively. Root length, shoot length, root dry weight, shoot dry weight, total dry weight were reduced by 61.9, 70.8, 69.2, 70.5, 67.3% respectively and the soil contained Cu; 0.725, 1.312 and 1.89 gm kg^{-1}. Cr; 6.54, 7.02 and 8.40 gm kg^{-1}. At Pre, peak and Post flower stage respectively. These indicated that concentration of heavy metals increase with increasing of concentration of the treatment.

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