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Characterization of waste water for cultivation of mulberry

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Abstract
To study the effect of different waste water irrigation on mulberry cultivation, different waste water samples were collected from Vadavalli, Thekkampatti and Ukkadam in Coimbatore district. The waste water samples were analyzed for the physico-chemical properties. The colour and odour of the tap water, paper mill waste water and sewage waste water were colourless and odourless but reeling waste water is grey colour with foul smell. The waste water samples consisting the major nutrients like nitrogen (N), phosphorus (P) and potassium (K) in tap water 12,84 mg/l (N), 0.89 mg/l (P), 20.04 mg/l (K), reeling waste water 13.57 mg/l (N), 1.15 mg/l (P), 22.68 mg/l (K), paper mill waste water 23.6 mg/l (N), 1.18 mg/l (P), 24.88 mg/l (K) and sewage waste water 18.46 mg/l (N), 1.68 mg/l (P), 20.33 mg/l (K). Minor nutrients like calcium (Ca), magnesium (Mg) and chloride (Cl) in tap water is 98.4 mg/l, 24 mg/l and 5.68 mg/l respectively, reeling waste water contains 109.6 mg/l, 37.44 mg/l and 28.4mg/l respectively, paper mill waste water is having 116.8 mg/l, 91.2 mg/l and 41.18 mg/l respectively and sewage waste water contains 548 mg/l, 221.6 mg/l, 46.86 mg/l respectively. So, utilization of waste water for the cultivation of mulberry is effective and ecofriendly.

Keywords: Physico-chemical properties, reeling waste water, paper mill waste water, sewage waste water.

Introduction
Mulberry (*Morus indica* L.) belongs to the family moraceae, a fast growing, deciduous and perennial plant. It is the sole food plant of the silkworm (*Bombyx mori* .L) for silk production. Mulberry cultivation and silk production together comprises sericulture due to an eco-friendly, agro-based, labour intensive, rural cottage industry providing subsidiary employment and supplementing the income of rural farmers especially the economically weaker section of the society. Tamil Nadu state possesses 3.96% (1.3 crore ha) arable land, 6.08% (7.4 crores) population of the nation with per capita land of 0.208 ha. As against national level 0.32 ha. And 46.89 lakh ha. (36.0%) net sown area and 2.9% land unutilized (Anonymous, 2011) [1]. In Tamil Nadu, at present (up to 31.03.2018) about 24,427 farmers are practicing the Sericulture in Tamil Nadu cultivating 46,570.25 acres of mulberry. This gives employment opportunities to the 2, 32,000 persons (Anonymous, 2018) [2].

Waste water refers to all effluent from household, commercial establishments and institutions, hospitals, industries and so on. It also includes storm water and urban runoff, agricultural, horticultural and aquaculture effluent. fluent refers to the sewage or liquid waste that is discharged into water bodies either from direct sources or from treatment plants. Influent refers to water, wastewater or other liquid flowing into a reservoir, basin or treatment plant. http://www.eschooltoday.com/wastewater/what-is-wastewater.html/). Bongale and Krishna, (2000) [4] investigated the effect of sewage and bore well water irrigation on leaf quality of mulberry (*Morus indica.* L). composite samples of mulberry leaf and soil were collected from each of 7 mulberry gardens. Leaf samples were analyzed for total nitrogen and chlorophyll, soluble protein, sugar, calcium and magnesium. It was concluded that sewage water irrigated gardens were associated with significantly higher values of leaf chlorophyll, protein, nitrogen, phosphorus and potassium contents compared to bore well irrigated mulberry gardens.

Rabin Chandra Paramanik., (2015) [12] stated that domestic sewage water irrigation can be done to the mulberry garden only when water scarcity arise or better to use alternatively to the bore well irrigation. Jimilee M Garcia *et al.*, (2015) [8] reported that reeling water can also be used as an alternative source for organic fertilizer sampling in the nursery and test the different parameters in mulberry varieties with reeling waste water and tap water. The length of shoots, root-shoot ratio (length) and sprouting % have significant interaction effect. Nowadays, water scarcity is making agriculture increasingly dependent on the reuse of water which leads to search alternative sources of irrigation which could sustaintiate yield potential of crops and also serve as an alternative source for fresh water. Due to population explosion, it Leads to water crisis for irrigation by 2050. Waste water irrigation is alternative practice for agriculture. It helps for the conservation of water, recycling of nutrients in waste water, reducing the direct application of organic fertilizers and minimizing the contamination of water bodies (Vasudevan *et al.*, 2010). Irrigation water scarcity in the summer season at tropical region, which coincides with peak crop water requirement period, results in farmer interest to use recycling waste water as alternative water resource. Hence, to overcome the water crisis and efficient recycling of waste water will increase the mulberry production.

Methodology

Collection of samples: In this study the different waste water were collected from Vadavalli, Thekkampatti and Ukkadam in Coimbatore district. The samples were brought to the laboratory and analyzed for various physico-chemical parameters. Physiochemical analysis: Standard methods are used for analysis of various physico-chemical parameters of the different waste water. The physico-chemical parameters analyzed were Colour, Odour, pH, Electric Conductivity, and Total solids, Total Dissolved Solids, Total Soluble Solids, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Nitrogen, Phosphorus, Potassium, Carbonates, Bicarbonates, Calcium, Magnesium and Chloride.

Table 1: Methodology for analyzing various parameters in different waste water

S. No	Parameter	Method	Reference
1	Colour	--	--
2	Odour	--	--
3	Ph	pH meter	Jackson (1973)
4	Electrical conductivity	Electrical conductivity meter	Jackson (1973)
5	Total Solids	Filtration method	Gupta (2002)
6	Total dissolved solids	Filtration method	Gupta (2002)
7	Total soluble solids	Filtration method	Gupta (2002)
8	Dissolved Oxygen	Modified Winkler method	APHA (1985)
9	Biological Oxygen Demand	5 days incubation @ 20°C and titration of initial and final dissolved oxygen	Gupta (2002)
10	Chemical Oxygen Demand	Reflux method	Gupta (2002)
11	Carbonates	Titration method	Gupta (2002)
12	Bicarbonates	Titration method	Gupta (2002)
13	Total nitrogen	Kjendahl method	Humpheries (1956)
14	Total phosphorus	photometric measurement	APHA (1980)
15	Total Potassium	Photoelectric colorimeter	Jackson (1973)
16	Calcium	Titration method	Jackson (1973)
17	Magnesium	Titration method	Jackson (1973)
18	Chloride	Mohr's method	Jackson (1976)

Results and Discussion

The physico-chemical parameters were shown in (Table.2) such as Colour, Odour, pH, Electric Conductivity (EC), Total solids, Total dissolved solids (TDS), Total soluble Solids (TSS), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrogen (N), Phosphorus (P), Potassium (K), Carbonates, Bicarbonates, Calcium (Ca), Magnesium (Mg), Chloride (Cl).

Table 2: Physico-chemical properties of different waste water used for mulberry cultivation.

S. No	Parameters	Units	Tap water	Reeling waste water	Paper mill waste water	Sewage waste water
1	Colour	-----	Colourless	Grey	Colourless	Colourless
2	Odour	-----	Odourless	Foul smell	Odourless	Odourless
3	pH	-----	7.04	6.82	7.57	7.19
4	Electric Conductivity	dsm^{-1}	1.325	15.98	13.94	9.06
5	Total Solids	mg/l	3000	8500	8000	5500
6	Total Dissolved Solids	mg/l	2000	7000	6800	3500
7	Total Suspended Solids	mg/l	1000	1500	1200	2000
8	Dissolved Oxygen	mg/l	9.6	0.16	3.2	3.52
9	Biological Oxygen Demand	mg/l	32	275	387	352
10	Chemical Oxygen Demand	mg/l	80	736	1272	525
11	Nitrogen	mg/l	19.63	13.57	23.6	18.46
12	Phosphorous	mg/l	1.54	1.15	1.18	1.68
13	Potassium	mg/l	84.6	22.68	19.88	20.33
14	Carbonates	mg/l	Nil	Nil	Nil	Nil
15	Bicarbonates	mg/l	1200	4379	1900	1195
16	Calcium	mg/l	98.4	109.6	116.8	548
17	Magnesium	mg/l	24	37.44	91.2	221.6
18	Chloride	mg/l	56.8	28.4	41.18	46.86

Physico-chemical characteristics of different waste water

The colour is usually the first contaminated to be recognized in waste waters that affects the aesthetics, transparency and gas solubility of the water bodies. In sewage waste water, paper mill waste water, reeling waste water and tap water are visualized with naked eyes and in that reeling waste water are grey colour due to sericin and fibroin dissolved during reeling process compare to sewage waste water, paper mill waste water and control. Colouration reduced the some other parameters such as temperature, dissolved oxygen, and biochemical oxygen demand etc., and it also reduced to the decomposition of substances by microbes (Buvaneswari *et al.*, 2013) [5].

In present study, sewage waste water, paper mill waste water and tap water are odourless but reeling waste water is shown foul smell. Vijayaragavan *et al.*, (2011) [16] conformity with the earlier findings such as decomposition of organic compounds are responsible for odour of effluent.

The different waste water pH fluctuated between 7.04, 6.82, 7.57 and 7.19 in tap water, reeling waste water, paper mill waste water and sewage waste water respectively. Among this waste water, reeling waste water is shown acidic condition. Low value of pH is due to the metabolism of fungus and also metabolic production of acids by indigenous micro flora (Ademoroti, 1996) [3].

The electrical conductivity values of the different waters are varies 1.325 dsm^{-1} in tap water, 15.98 dsm^{-1} in reeling waste water, 13.94 dsm^{-1} in paper mill waste water and 9.06 dsm^{-1} in sewage waste water. Reeling waste water has highest electrical conductivity compare to other waste water. The electric conductivity of the different waste water was found to be higher than the BIS prescribed limit (Kuzhali *et al.*, 2012) [10]. In this investigation, reeling waste water having 8500 mg/l of total solids are present followed by paper mill waste water 8000 mg/l, sewage waste water 4500 mg/l and control (tap water) of about 3000 mg/l. Total dissolved solids are more in reeling waste water (7000 mg/l) then the paper mill waste water, sewage waste water and tap water. In sewage waste water having more total suspended solids compare to reeling waste water, paper mill waste water and tap water is 2000 mg/l, 1500 mg/l, 1200 mg/l and 1000 mg/l individually. Waste water, total dissolved solids are composed mainly of bicarbonates, chlorides, carbonates, phosphates and nitrates of calcium, magnesium, sodium, potassium, manganese, salt and other particles (Mahananda, *et al.*,2010) [11].

Dissolved Oxygen of the tap water having 9.6 mg/l followed by Sewage waste water, Paper mill waste water and Reeling waste water having 3.52 mg/l, 3.2 mg/l and 0.16 mg/l respectively. The consequences of high BOD are the same as those for low DO: aquatic organisms become stressed, suffocate and die (Lokhande *et al.*, 2011) [13].Paper mill waste water having 387 mg/l of biochemical Oxygen Demand then sewage waste water, reeling waste water and tap water. The high BOD and low oxygen content of waste water will affect survival of gill breathing animals of receiving water body (Sawyer *et al.*, 1978) [14]. In Paper mill waste water having 1272 mg/l of chemical oxygen demand followed by Reeling waste water (736mg/l), Sewage waste water (525mg/l) and Tap water (50mg/l). A high COD level indicates the toxic state of the waste water along with the presence of biologically resistance organic substances (Dutta *et al.*, 2004). The waste water samples consisting the major nutrients like nitrogen(N), phosphorus(P) and potassium(K) in tap water 12,84 mg/l(N), 0.89 mg/l(P), 20.04 mg/l(K), reeling waste water 13.57 mg/l(N), 1.15 mg(P), 22.68mg/l (K), paper mill waste water 23.6 mg/l(N), 1.18 mg/l(P), 24.88 mg/l(K) and sewage waste water 18.46 mg/l(N), 1.68 mg/l(P), 20.33 mg/l(K).

In this investigation, tap water, reeling waste water, paper mill waste water, sewage waste water does not contain carbonates and reeling waste water, paper mill waste water, tap water, sewage waste water of about 4379mg/l, 1903mg/l, 1200 mg/l and 1195mg/l of bicarbonates are present respectively.

Minor nutrients like calcium (Ca), magnesium (Mg) and chloride (Cl) in tap water is 98.4 mg/l, 24 mg/l and 5.68 mg/l respectively, reeling waste water contains 109.6 mg/l, 37.44 mg/l and 28.4mg/l respectively, paper mill waste water is having 116.8 mg/l, 91.2 mg/l and 41.18 mg/l respectively and sewage waste water ranges from 548 mg/l, 221.6 mg/l, 46.86 mg/l respectively. Sewage water proved to be good source of micronutrients (Huma and Khan, 2003) [7].

Conclusion

Waste water is alternative source for cultivation of agricultural crops. In Sericulture, using the different waste waters like reeling waste water, paper mill waste water, and sewage waste water due to scarcity of water in summer season in tropical region. Waste water is consisting essential nutrients for growth and development of agricultural crops. Especially, reeling waste water having rich in nutrient improve the soil fertility, plant growth and leaf quality traits in the mulberry compare to paper mill waste water, sewage waste water and tap water.

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