Research Article

DOMESTIC WASTE WATER INFLUENCE ON V-1 (*MORUS SPP*) MULBERRY LEAF YIELD AND ELEMENTAL COMPOSITION

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ABSTRACT

Domestic waste water or grey water is commonly available source among waste water in every household. The influence of this water on mulberry leaf quality was experimented at College of Sericulture, Chintamani by using hostel waste water with primary sedimentation and the supernatant water collected was pumped into another storage tank and utilised for irrigation of mulberry garden. The experiment was set up in RCBD with 7 different treatments varying (recommended dose of Fertilizer) RDF under three replications and compared with borewell water irrigation and 100% RDF. The experiment showed clear significant differences among the treatments on the elemental composition of leaf. It has shown that good amount of nutrients accumulated in the leaf that was grown under Domestic Waste Water (DWW) along with 75% RDF applied to the soil compared to other treatments and also the control. All the three primary nutrients (N, P, K), secondary nutrients (Ca, Mg, S) and four micronutrients (Zn, Cu, Fe and Mn) showed similar trend. The study has thrown light that in low fertile soil (Zone 5-eastern dry) the above recommendation holds well. This reduces the excess accumulation of nutrients in the soil and thus toxicity can be avoided. The bioassay study was also done using the same mulberry leaf to confirm its utility for rearing. Here Effective rate of rearing and Defective cocoon percent showed the difference among the treatments. Complete 100% RDF along with DWW has shown some negative effect on these parameters. Hence looking into the leaf quality and rearing parameters 75% RDF with DWW proved to be recommendable and 50% RDF with domestic waste water for medium fertile soil.

INTRODUCTION

Mulberry (*Morus spp*.) is cultivated mainly for its leaf which the sole food of commercially exploited silkworm, *Bombyx mori* L. On an average mulberry requires 1.5 to 2-acre inch water per irrigation demanding 6-9 irrigation its growth period of 70 days (Dandin and Giridhar, 2014). However due to inadequate and erratic rainfall pattern coupled with the absence of perennial surface water system has made even the rainfed agriculture system to gradually shift to ground water-based system. Over dependency of ground water has led to drying phreatic and fractured aquifers giving rise to severe water scarcity and chronic drought condition in Kolar and Chickballapur district of Karnataka. This has led to the exploration of alternative sources of irrigation such as municipal sewage water, domestic or grey water dairy farms used water and commercial complex waste water for agriculture crop production (Degens *et al.*, 2000). Domestic waste water contains phosphorus, potassium, nitrogen compounds are normally viewed as pollutants to lakes, rivers and ground water but are excellent sources for vegetation when it is made available for irrigation (Jimnez-cisneros, 1995 and Angin *et al.*, 2005). With this background, initial field study conducted on chawki garden without the application of fertilizers didn’t show any deleterious effect on the cocoon crop at farmers level (Bharathi *et al.*, 2016). Thus, further it is experimented for V-1 mulberry garden for its utility in late age silkworm rearing along with varied recommended dose of fertilizers.

MATERIALS AND METHODS

The experimental plot is situated in the eastern dry zone of Karnataka (zone-5) lies between latitude of 78° 12’36’’N, a longitude of 13° 16’ 38’’ E and 77° 51’39’’N, 13° 42’ 00’’ E. with an altitude of 865 m above the mean sea level and recording an average rain fall of 400 to 650 mm annually. The experiment is laid out in a area of 1022 sq.m (10.22 guntas).

Before the treatment imposition the soil is analysed for its physical and chemical composition. Then collected sample was air dried, powdered with the pestle and mortar and then it was passed through the 2 mm sieve and stored in the plastic bottles for the further analysis of the soil nutrients.

Methods followed for the analysis of soil and plant samples are represented in Table 1. Hostel waste water was allowed for primary sedimentation in big tank and later the supernatant water collected was pumped into another storage tank and utilised for irrigation of mulberry garden.

Table 1: Methods followed for the analysis of soil and plant samples

Parameters	Methods	References
Soil Analysis		
pH (1:2.5)	Potentiometric method	Jackson, 1973
EC (dS m^{-1})	Conductometric method	Jackson, 1973
Organic carbon (%)	Wet oxidation method	Walkey and Black, 1934
Avail. N (kg ha^{-1})	Alkaline potassium permanganate method	Subbiah and Asija, 1956
Avail. P_2O_5 (kg ha^{-1})	Bray's and Olsen's extractant method, Colorimetry	Jackson, 1973
Avail. K_2O (kg ha^{-1})	N NH_4OAC extractant method, Flame photometry	Jackson, 1973
Exch. Ca [c mol (p^+) kg^{-1}]	N NH_4OAC extractant method, Versenate titration method	Jackson, 1973
Exch. Mg [c mol (p^+) kg^{-1}]	Versenate titration method	Jackson, 1973
Avail. S (kg ha^{-1})	$CaCl_2$ extractant method, Turbidimetry	Black, 1965
DTPA extractable Fe, Mn, Zn and Cu (mg kg^{-1})	Atomic absorption spectrophotometry	Lindsay and Norvell, 1978
Hot water extractable Boron (mg kg^{-1})	Azomethane H spectrophotometry	How and Wagener, 1996
Plant analysis		
Nitrogen (%)	Kjeldahl digestion distillation method	Piper, 1966
Phosphorus (%)	Diacid digestion and vamadomolybdate method	Piper, 1966
Potassium (%)	Diacid digestion and Flame Photometer method	Piper, 1966
Calcium (%)	Diacid digestion and Versenate titration	Jackson, 1973
Magnesium (%)	Diacid digestion and Versenate titration	Jackson, 1973
Sulphur (%)	Diacid digestion and Turbidometry	
Fe, Mn, Zn and Cu (mg kg^{-1})	Diacid digestion and atomic absorption spectrophotometer method	Piper, 1966

The experiment was laid out in a randomized complete block design (RCBD) with 8 treatments and 3 replications (Fig 1, Fig 2). The soil nutrient status is presented in table 2.

Treatment Details are as follows

T_1 - only domestic waste water + 0% RDF and FYM

T_2 - domestic waste water + 25% RDF and FYM

T_3 - domestic waste water + 50% RDF and FYM

T_4 - domestic waste water + 75% RDF and FYM

T_5 - domestic waste water + 100% RDF and FYM

T_6 - Alternate irrigation of domestic waste water and borewell water + 25% RDF and FYM

T_7 - Alternate irrigation of domestic waste water and borewell water + 50% RDF and FYM

T_8 - Control (Borewell water under RDF and FYM).

Each replicated treatment is fit in a plot size of 42.58 m^2 and the spacing is 90 cm X 90 cm and the the plot was irrigated once in 6-8 days looking into the moisture condition of the soil according to the treatments. The domestic waste water sample was collected for every irrigation after 15 minutes of turning on the pump. The sample was analysed for pH, hardness, coliform, residual chlorine, iron, fluoride, chloride, residual chlorine, nitrate, ammonia and alkalinity using water testing kit. The test results are presented in table 2.

Figure 1: Experiment layout

Figure 2: Fertilizer treatment imposition

Table 2: Physicochemical properties of soil and Domestic waste water analysis

Soil		Domestic waste Water	
Physical properties		P^H	8
Sand (%)	72.97	Turbidity	50 NTU
Silt (%)	4.93	Nitrate	45mg/L
Clay (%)	22.10	Ammonia	3
Textural Class	Sandy clay loam	Alkalinity	800mg/L
Taxonomical classification	Kandic Paleustalfs	Hardness	640mg/L
Chemical properties		Residual chlorine	0.8
pH (1:2.5)	7.48	Chloride	567.20mg/L
EC dS m^{-1}	0.28	Fluoride	1.5mg/L
Organic Carbon (%)	0.62	Phosphorus	1.0
Available N (kg ha^{-1})	388.86	Iron	0.3
Available P (kg ha^{-1})	9.34	Coliform	Present
Available K (kg ha^{-1})	552.64		
Available Sulpur (mg kg^{-1})	5.96		
Exch. Calcium (cmol kg^{-1})	3.00		
Exch. Magnesium (cmol kg^{-1})	2.25		
DTPA extractable Zinc (mg kg^{-1})	0.26		
DTPA extractable Iron (mg kg^{-1})	0.91		
DTPA extractable Copper (mg kg^{-1})	0.18		
DTPA extractable Manganese (mg kg^{-1})	0.96		
Hot water extractable Boron (mg kg^{-1})	0.29		

Leaf samples were randomly collected from labelled plants in each treatment, air dried and then oven dried the sample at 60℃ for 18 hours. Moisture % of the leaf samples were calculated,

$$\text{Moisture (\%)} = \frac{\text{Fresh weight of leaves - Oven dry weight of leaves}}{\text{Fresh weight of leaves}} \times 100$$

The samples were then powdered and stored in the butter paper covers. These samples have to be analyzed for nitrogen, phosphorus, potash, calcium, magnesium, sulphur and micronutrients like zinc, iron, manganese and copper.

Statistical Analysis and Interpretation of Data

The data analyzed statistically for one-way RCBD using Fishers's method of analysis of variance. The level of significance of F test was at 5% level.

RESULTS AND DISCUSSION

The experimental results obtained (Table 3) are discussed in the following lines.

Leaf Yield/ Plant (kg)

There was significant difference between the treatments with respect to leaf yield of mulberry. Significantly higher leaf yield was recorded in the plants grown under T5 (DWW + 100% RDF) (1.107kg) followed by T3 (DWW + 50% RDF) (1.093kg).

Table 3: Mulberry leaf yield under varied dose of fertilizer and domestic waste water irrigation

Treatments	Leaf yield/plant (Kg)	Leaf yield /ha (kg/crop)	Moisture content (%)
T1 - DWW (domestic waste water) + 0% RDF	0.727	10,349.33	71.71
T2 - DWW + 25% RDF	0.920	10,620.69	72.54
T3 - DWW + 50% RDF and FYM	1.093	11,365.33	75.08
T4 - DWW + 75% RDF and FYM	0.847	13,460.00	74.10
T5 - DWW + 100% RDF and FYM	1.107	13,629.00	70.84
T6 - Borewell water (BW)+DWW + 25% RDF	0.923	11,378.00	71.75
T7 - Borewell water (BW)+DWW + 50% RDF	0.933	11,480.67	69.95
T8 - Control (Borewell water under RDF)	0840	8,950	71.63
F- Test	**	**	**
S.Em ±	**0.021**	**250.83**	**0.37**
CD (5% or 1%)	**0.086**	**1055.96**	**1.57**

Leaf Yield/ ha (Kg)

Leaf yield per hectare was significantly higher in T5 (DWW + 100% RDF) 13,629kg) followed by T3 (DWW + 50% RDF) (13,460kg). Borewell water with 100% RDF showed a least leaf yield of 8,950kg.

Moisture Content (%)

Moisture content of leaf was significantly higher in T3 (DWW + 50% RDF) (75.08%) followed by T4 (DWW + 75% RDF) (74.10%) compared to other treatments.

Leaf Quality Parameters

The leaf quality parameters are presented in Table 4.

Macro Nutrients (%)

The macro nutrients viz., nitrogen, phosphorus, calcium, magnesium and sulphur content were significantly higher when mulberry leaves grown under domestic waste water irrigation with 100% RDF followed by 75% RDF. Whereas Potassium content was significantly higher in T6 i.e., with Domestic waste water and 100% RDF (4.75%) compared to all other treatments indicating more of potassium absorption.

Micronutrients (ppm)

Micronutrients contents such as Zinc, Copper and Manganese showed significantly higher in DWW with 100% RDF followed by DWW with 75% RDF whereas the iron content in leaf was significantly maximum in leaf grown under 100% RDF with DWW supply compared to all other treatments.

The present findings are in conformity with the earlier studies taken in the field by Subbarayappa *et al*. (1996) who studied the influence of sewage water irrigation on nutrient status of mulberry garden and reported a distinct advantage with respect to the nutrient supplementation with high phosphorus, sulphur and manganese content in leaf. Das *et al.* (2003) in their study on comparison of sewage and borewell water irrigation to mulberry found that the direct usage of sewage water is harmful to the growth of heterotrophic soil micro flora. The leaf quality assessment of mulberry leaves from raw sewage water irrigated garden hewed significantly higher concentration of heavy metals such as Cu, Cd, Pb, Ni, over borewell irrigation. A noticeable increase in reducing sugars, phenolic compounds, Mn and Cu has been reported by Ambika *et al. (*2011). Initial study conducted at College of Sericulture, UAS(B), Chintamani on the use of domestic waste water for irrigation of chawki garden (S-36) did not show any harmful effect in chawki stage and also the cocoon crop in farmers field (Bharathi *et al.*, 2016). Sewage water also forms an important source of nutrient to soil (Jimenez-cisneros, 1995 & Angin *et al.*, 2005). Significantly higher moisture %, total proteins, total sugars and chlorophyll pigments are recorded in mulberry and other agricultural crops irrigated with sewage water (Rija *et al.*, 2005 and Surendranath *et al.*, 2007).

Table 4: The macro and micro nutrient status of mulberry leaf under varied dose of fertilizer

Nutrients/ Treatments	N %	P %	K %	Ca %	Mg %	S %	Zn ppm	Cu ppm	Fe ppm	Mn ppm
DWW + No RDF	3.10	0.14	2.55	1.29	0.25	0.07	10.55	26.55	797.40	92.68
DWW + 25% RDF	3.12	0.16	3.25	1.34	0.32	0.06	13.95	26.25	923.62	95.99
DWW + 50% RDF	3.70	0.16	3.36	1.37	0.21	0.06	14.19	32.00	1124.56	96.74
DWW + 75% RDF	3.99	0.18	3.68	1.85	0.37	0.07	15.33	38.23	1162.00	104.97
DWW + 100% RDF	3.83	0.19	4.75	1.86	0.38	0.08	19.01	47.62	1400.47	109.70
BW + DWW + 25% RDF	3.05	0.15	3.22	1.47	0.31	0.05	11.35	25.27	910.50	102.02
BW + DWW + 50% RDF	3.61	0.19	3.21	1.41	0.32	0.06	12.44	33.54	1069.70	106.89
BW + 100 % RDF (Control)	3.41	0.17	3.23	1.36	0.34	0.07	15.26	32.54	677.15	93.99
F test	*	*	*	*	*	*	*	*	*	*
S.Em ±	0.07	0.003	0.10	0.04	0.01	0.01	0.19	0.70	26. 50	1.98
CD at 5%	0.20	0.01	0.29	0.12	0.02	0.02	0.58	2.13	80.37	6.00

Mulberry leaf yield was significantly higher when domestic waste water was used with varying fertilizer dose compared to only borewell water irrigation. This could be attributed to extra nutrients available in the domestic waste water along with altered dose of fertilizer. But when taking into the nutrient status of leaf and leaf yield Domestic waste water with 50% RDF is suitable for the soil condition prevailed in the experimental plot which had medium nutrient availability in the soil, however in low fertility soil 75% RDF can be recommended when domestic waste water is used. And the regular check on soil physico -chemical and biological properties are necessary every two years for monitoring the heavy metal accumulation in the soil and leaf.

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