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# Utilization of Waste Water From Winery on Growth and Biochemical Content of *Acacia holosericea A. Cunn.ex. Don.*

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**Abstract** The present study was planned to determine the effects of winery wastewater on germination, various growth parameters (shoot length, root length, fresh weight, dry weight, leaf area, leaf area index and vigor index) and biochemical characteristics i.e. estimation of plant pigments, carbohydrates and protein content of *Acacia holosericea A. Cunn.ex. Don.* The carbohydrates and protein content was found to decline with increasing concentration of the winery wastewater. High amounts of EC, organic and inorganic contaminants were reported to be present in winery wastewaters and are the matter of concern of their toxicity. The organic and inorganic compounds are released into the environment regularly shows a significant threat to the environment and public health.

**Keywords** Winery wastewater, Growth, Biochemical content, *Acacia holosericea.*

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## Introduction

Increasing pace of industrialization in a country develops its economy. On other hand, the rapid industrialization plays a significant role in creating pollution by sending its waste into environment. Disposal of wastewaters has become a global concern as the industries are associated with the generation of high volumes of wastewater and needed high cost of treatment technologies. In India, wastewaters from almost all the industries are being discharged untreated either on land or into the watercourses. Even at the places where some treatment facilities exist, these are not being operated properly. Resultantly these waste waters pollute the water resources and ultimately the agriculture land (Arjun et al. 2013). Effluents from industries which are normally considered as the main industrial pollutants containing organic and inorganic compounds are discharged into the nearby water bodies. It makes the water bodies toxic as a result the high level of pollutants mainly organic matter in river water causes an increase in BOD, COD, TDS, TSS and it makes the water unsuitable for drinking, irrigation or for other uses. Growth, yield and soil health get reduced when the farmers

use the effluents for irrigation of the cultivated land. Heavy metals are being released from various sectors of industries like electroplating, fertilizer, leather, paint, pesticide, pharmaceuticals, pulp and paper, mining, oil refinery. Out of the metals classified as toxic, lead (Pb), chromium (Cr), mercury (Hg), uranium (U), selenium (Se), zinc (Zn), arsenic (As), cadmium (Cd), cobalt (Co), copper (Cu), nickel (Ni) are emitted into environment in quantities that pose risks to human health and plant's lives (Johnson et al. 2008). The disposal of wastewater is a major problem faced by municipalities, particularly in the case of large metropolitan areas, with limited space for land based treatment and disposal. On the other hand, wastewater is also a resource that can be applied for productive uses since wastewater contains nutrients that have the potential for use in agriculture. Hence it was programmed to utilize winery wastewater and analyze the growth response of *Acacia holosericea A. Cunn.ex. Don.*

The aim and objectives of the present study: To analyze the physico-chemical characters of winery wastewater, To study of the effect of various concentrations of winery wastewater on growth and biochemical characteristics of *Acacia holosericea.*

**Materials and Methods**

Collection of winery wastewater and analysis

The winery wastewater effluent was collected from winery industry in a 20L plastic container. After collection, the effluent water was immediately transported to the laboratory for analysis. During the period of analysis the water samples were preserved and analyzed (APHA 2012).

Collection of plant materials

The certified seeds of *Acacia holosericea A. Cunn. ex. Don.* was collected from Tamil Nadu Agricultural department Kovilpatti, Tamil Nadu, India.

Seed treatment

Healthy seeds of *Acacia holosericea A. Cunn. ex. Don.* was washed with running tap water and followed by distilled water. Various concentrations of winery wastewater were made such as 10,20,30, 40 and 50%. Both the control and experimental seeds were allowed to grow in pots containing a mixture of 3 types of soils namely red, black and sandy soil in the ratios of 1:1:1. These experimental sets were kept in diffused light at room temperature. The experiment plants were watered with the respective concentration of winery wastewater and the control sets were supplied with tap water. After 120 days of growth various growth and biochemical characteristics were analyzed.

Growth and biochemical parameters

Growth and biochemical activity determinations were determined after 120 days of treatment. The germination percentage, shoots length, root length, fresh weight and dry weight were estimated as per Arts and Marks (1971). The plant vigor index was calculated by multiplying germination percentage with total length of seedlings (Abdul-Baki and Anderson 1973). The total Chlorophyll and Carotenoids (Arnon 1949), Anthocyanin (Mancinelli et al. 1975), Carbohydrate (Jeyaraman 1981) and Protein (Lowry et al. 1951) were estimated according to established procedures.

**Results and Discussion**

The physico-chemical characteristics of winery wastewater are presented in Table 1. The pH of the winery wastewater was 4.59. The electrical conductivity of the winery wastewater was 6.24 $dSm^{-1}$ indicating the presence of high concentration of ionic substances present in the winery wastewater. The total dissolved solids in the winery wastewater was high 5028 $mgL^{-1}$.The contents of cations and anions in the winery wastewater were higher making EC value higher. The BOD and COD of the winery wastewater was higher (632 and 1252 $mgL^{-1}$).

The percentage of reduction was observed in various parameters in different treatments and in comparison with the control. This was taken as the index to understand the level of suppression. Of the various percentage concentrations of the winery wastewater, the most inhibitory was found to be that at 50%, even though the other concentrations brought about considerable inhibition of the parameters an-

**Table 1.** Physico-chemical characteristics of winery wastewater. *All the values are expressed in $mgL^{-1}$ except pH and electrical conductivity ($dSm^{-1}$).

| Sl. No. | Parameters | Values* |
|---|---|---|
| 1 | pH | 4.59 |
| 2 | Color | Slightly pink |
| 3 | Temperature | 30.0 |
| 4 | Electrical conductivity | 6.24 |
| 5 | Total solids | 5934 |
| 6 | Total dissolved solids | 5028 |
| 7 | Total suspended solids | 906 |
| 8 | Sodium | 425 |
| 9 | Potassium | 109 |
| 10 | Calcium | 99 |
| 11 | Magnesium | 32 |
| 12 | Sulfate | 424 |
| 13 | Chloride | 204 |
| 14 | Phosphate | 20 |
| 15 | Bicarbonate | 977 |
| 16 | Nitrogen | 12.8 |
| 17 | Sodium absorption ratio | 9.72 |
| 18 | Soluble sodium percentage | 71.86 |
| 19 | BOD | 632 |
| 20 | COD | 1252 |
| 21 | Cadmium | 0.0164 |
| 22 | Lead | 0.0813 |
| 23 | Copper | 0.8785 |
| 24 | Nickel | 0.0857 |
| 25 | Zinc | 0.6980 |

alyzed (Table 2).

Regarding percentage of germination efficiency, the 50% concentrations of winery wastewater cause a maximum percentage of reduction and suppression in shoot length and root length of *Acacia holosericea.*

The percentage of reduction of fresh weight and dry weight in the case of the *Acacia holosericea* was noted in treated plants. Leaf density, which is a reliable toll in understanding the capacity of plants to fix carbon by photosynthesis, was observed to have been affected in all concentrations compared to the control plant. In the case of vigor index, level of inhibition was linked to the effluent treated plant.

In the biochemical parameters also , the study plant showed declining trend with increase in the concentrations of the wastewater. The inhibition was found to be the greatest at 50% concentrations when compared with the control. The chlorophyll *a* and *b* and total chlorophyll of *Acacia holosericea* grown in different concentrations of winery wastewater are presented in Table 3. The total chlorophyll content was reduced with increase in the concentration of the winery wastewater. The similar reduction was observed in the carotenoid but anthocyanin was raised (Table 3).

The carbohydrates and protein contents were found to decline with increasing concentration of the winery wastewater (Table 3).

The winery wastewater contains high values of electrical conductivity, total dissolved solids, cations andanions. The cations, anions and heavy metals present in the effluent interferes with the inhibition of uptake of other elements by the plants. The major pollutants in the winery wastewater are high total dissolved solids (TDS), sodium, chlorides, sulfates and bicarbonates. Besides the effluent was colored and it was also toxic for the plants.

**Table 2.** Effect of various concentrations of winery wastewater on growth characteristics of *Acacia holosericea a*fter 120th day. Values are mean ± standard error of 5 observations.

| Sl. No. | Parameters | Control | Waste water concentrations | | | | |
|---|---|---|---|---|---|---|---|
| | | | 10% | 20% | 30% | 40% | 50% |
| 1 | Germination (%) | 100 | 96 | 85 | 76 | 64 | 55 |
| 2 | Shoot length (cm) | 20.2 ± 0.2 | 18.1 ± 0.02 | 15.1 ± 0.03 | 12.7 ± 0.03 | 11.0 ±0.04 | 6.0 ± 0.03 |
| 3 | Root length (cm) | 11.2 ± 0.12 | 9.1 ± 0.23 | 7.20 ± 0.03 | 6.0 ± 0.33 | 4.1 ± 0.98 | 3.2 ± 0.45 |
| 4 | Fresh weight (g) | 6.4 ± 0.324 | 5.1 ± 0.23 | 4.8 ± 0.98 | 4.2 ± 0.98 | 3.2 ± 0.56 | 2.5 ± 0.34 |
| 5 | Dry weight (g) | 1.0 ± 0.45 | 0.90 ± 0.56 | 0.82 ± 0.56 | 0.54 ± 0.56 | 0.45 ± 0.6 | 0.21 ± 0.67 |
| 6 | Leaf area (cm) | 123.0 ± 0.34 | 115.0 ± 0.45 | 110.2 ± 0.98 | 90.5 ± 0.45 | 82.3 ± 0.3 | 72.3 ± 0.43 |
| 7 | Leaf area index (cm) | 50.5 ± 0.45 | 48.3 ±0.45 | 43.2 ± 0.45 | 36.5 ± 0.98 | 25.3 ± 0.4 | 18.2 ± 0.45 |
| 8 | Vigor index | 3140 | 2611 | 1895 | 1421 | 966 | 506 |

**Table 3.** Effect of various concentration of winery wastewater on biochemical characteristics of *Acacia holosericea* after 120th day. Values are mean ± standard error of 5 observations.

| Sl. No. | Parameters | Control | Waste water concentrations | | | | |
|---|---|---|---|---|---|---|---|
| | | | 10% | 20% | 30% | 40% | 50% |
| 1 | Chlorophyll–*a* (mg/g FW) | 0.750 ± 0.006 | 0.720 ± 0.005 | 0.680 ± 0.006 | 0.520 ± 0.007 | 0.423 ± 0.008 | 0.250 ± 0.005 |
| 2 | Chlorophyll–*b* (mg/g FW) | 0.650 ± 0.006 | 0.623 ± 0.006 | 0.543 ± 0.006 | 0.456 ± 0.009 | 0.230 ± 0.007 | 0.100 ± 0.006 |
| 3 | Total Chlorophyll (mg/g FW) | 1.400 ± 0.006 | 1.343 ± 0.008 | 1.223 ± 0.006 | 0.976 ± 0.005 | 0.653 ± 0.001 | 0.350 ± 0.002 |
| 4 | Carotenoids (mg/g FW) | 0.73 ± 0.21 | 0.65 ± 0.45 | 0.54 ± 0.78 | 0.45 ± 0.78 | 0.34 ± 0.45 | 0.12 ± 0.12 |
| 5 | Anthocyanin (mg/g FW) | 0.07 ± 0.03 | 0.12 ± 0.78 | 0.17 ± 0.98 | 0.23 ± 0.97 | 0.54 ± 0.45 | 0.79 ± 0.67 |
| 6 | Carbohydrates (mg/g FW) | 45.65 ± 0.78 | 43.00 ± 0.78 | 34.45 ± 0.67 | 23.4 ±0.56 | 12.3 ± 0 .45 | 8.0 ± 0.65 |
| 7 | Protein (mg/g FW) | 63.3 ± 0.056 | 54.3 ± 0.065 | 43.5 ± 0.067 | 32.4 ±0.098 | 23.4 ± 0.067 | 7.43 ± 0.056 |

In order to find out the toxicity of the effluent, a study was undertaken to observe the effect of various concentrations of winery wastewater on the growth and biochemical characteristics of *Acacia holosericea.* From the results it was clear that seed germination was inhibited gradually with increase in the concentration of winery wastewater, Beyond 50% (v/v) concentration of effluent, there was no germination at all. Excessive amounts of EC, TDS, cations and anions present in the winery wastewater inhibit the germination of seeds. Sisodia and Bedi (2001) reported a reduction in germination and growth of wheat, jawar and paddy, when irrigated with industrial effluent containing high values of pH, EC and TDS. A similar reduction in the germination and growth of guar seedlings due to the effluent treatment was also reported (Ramesh Kumar et al. 2005). Excessive concentration of cations and anions in the effluents may adversely effects the germination and growth pattern of the plants in two ways, viz (i) The availability of water is reduced due to higher osmotic concentration of effluent (ii) Higher concentration of chemicals like sodium, calcium, carbonate, bicarbonate, chlorides which are toxic to plants (Muthusamy and Jeyabalan 2005). In the present investigation the winery wastewater showed high values of EC, TDS, sodium, chloride, sulfate, bicarbonate, BOD and COD which inhibited the uptake of water and other ions, thereby reducing the germination percentage and plant growth. So, reduction in shoot length, root length, total fresh weight and dry weight was decreased in the case of the *Acacia holosericea* with increasing concentration of winery wastewater. High amount of cations and anions are present in the effluent affects the vigor index of the plant.

Inhibition of biomass accumulation is directly related to the photosynthetic process, which, in turn relies upon the pigment level and it was observed in effluent treated tree species. The total chlorophyll content, which is an indicator of the photosynthetic activity of the plants,showed a marked reduction in all the treatments. The total chlorophyll content was found to be decreased with increasing in the concentration of winery wastewater when compared with the control. This may be due to increasing in concentration of TDS cations and anions, which destabilize the chloroplast pigment. Increasing concentration of wastewater are inhibitory to synthesis of chlorophyll molecules (Khan et al. 2011). Decrease in carotenoid content was observed in the present investigation of *Acacia holosericea*. It was inferred that it might have accelerated the damage the chlorophyll of it and might have left the chlorophyll unprotected. Decrease in carotenoid content at higher concentration of textile effluent was reported (Garg and Kaushik 2008). The anthocyanin content increases with increasing concentration of winery wastewater. Anthocyanins are involved in photo protection induced by various abiotic stress (Merzlyak et al. 2008).

The carbohydrate and protein contents were found to be decreased with increasing concentrations of the winery wastewater. A reduction of chlorophyll synthesis might have caused a reduction in photosynthesis. The change might have affected the photosynthetic activity of the plant and hence, reduction in carbohydrate contents, similar result was also reported (Durgadevi and Sumathi 2017). Protein is one of the major components for biochemical activities. Reduction in protein content was observed in winery wastewater treated plant. Under the stress condition energy forming molecules may be disturbed and subsequently protein metabolite membranes are altered (Kannan and Upreti 2008).

The present study showed that the winery wastewater had an adverse effect on growth and development of *Acacia holosericea* at higher concentration, beneficial impact on general welfare of the plant was gradually decreased with increasing the concentration of the winery wastewater. It can be recommended from the study that winery wastewater should be treated and appropriate dilution could be used for irrigation in agricultural field.

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