The effect of Yazd wastewater on forage quantity and quality of *Atriplex lentiformis*

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Abstract: Municipal wastewater is a major source of water in arid regions. The study on the production of forage crops using wastewater is very important. This study examines the effects of municipal wastewater on forage quantity and quality of *Atriplex lentiformis*. This experiment includes a completely randomized design with 3 irrigation treatments (100% drinking water, 50% drinking water + 50% wastewater, 100% wastewater) in 10 replicates for 4 months. The results showed that 100% wastewater treatment increased leaf fresh and dry weight to stem ratio of *Atriplex lentiformis* (p<0.05), but had no significant effect on height of this plant. In the wastewater treatment, quality characteristics such as percent crude protein increased and decreased total ash. The percentage of NDF and ADF, dry matter digestibility, metabolic energy, crude fiber, digestible energy and total digestible nutrients were not affected by irrigation treatment. According to this survey results, 100% wastewater treatment, is the best treatment for irrigate this species. In total it seems that due to water scarcity in arid region, the use of wastewater not only to compensate for the shortage of water resources to forage production but is also effective in improving forage quality.

Key words: *Atriplex lentiformis*, Municipal wastewater, Forage Quantity, Forage Quality

1. INTRODUCTION

The effect of sewage irrigation on yield and quality of forage plants has been studied by several researchers (Paliwal et al., 1998; Ali Nejad Jahromy et al., 2012; Yadav et al., 2002). The impact of wastewater on the nutritive value and digestibility of Rye grass showed that the amount of soluble carbohydrates of feed in the first period of cutting to the third period, was 3 to 6 times higher (Ben-Gadelia et al., 2001). The nutritional value of Bahyagras (*Paspalum notatum* Flugge) were examined under irrigation with sewage and the result showed that wastewater increased the protein content of forage, while no significant difference was observed in digestibility (Adjei and Rechcigl, 2002). In another study increased forage crude protein of sorghum, irrigated by sewage water, but other quality parameters such as dry matter digestibility, digestible energy and cell wall percent had no significant change (Jalali et al., 2010). Increased soil nutrients under irrigation with wastewater, and easier access to macro and micronutrients of sewage water will be increase plant growth (Moradmand, 2008). Generally, in the production of forage plants not only performance of dry mater but the quality of forage is also important. The main criteria in determining the quality of forage is crude protein, digestibility and percent of cell wall (Wilson, 1994). In this case, digestibility has special importance because it is directly related to the amount of energy and nutrients received by the animals (Tilley and Terry, 1963).

The aim of this study was to evaluate quantitative and qualitative characteristics of *Atriplex lentiformis* forage under sewage irrigation.

2. MATERIAL AND METHODS

The process of this research was conducted in the greenhouse of College of Natural Resources, University of Yazd. This study was done as a completely random design with three irrigation
treatments included (drinkable water 100%, drinkable water 50% + sewage water 50% and sewage water 100%) in 10 replicates during 4 months. Watering performed by Manual sprinklers regularly every 2 days until germination and after that water at field capacity and the same amount was given to plants. After 4 months some quantitative characteristics such as leaf fresh and dry weight to stem ratio, total weight (leaves + stem) and height and qualitative characteristics such as percent of crude protein (CP), soluble carbohydrates (SC), total ash decreased, Neutral detergent fiber (NDF), acid detergent fiber (ADF), dry matter digestibility (DMD), metabolic energy (ME), crude fiber (CF), digestible energy (DE) and total digestible nutrients (TDN) were determined. For data analyses SPSS software and one-way Anova were used. Data normality was tested using the Kolmogorov-Smirnov. Average were compared with Duncan test at the 5% level.

3. RESULTS

3.1 Soil properties before applying irrigation

Soil properties used for planting before applying irrigation are shown in Table 1.

<table>
<thead>
<tr>
<th>Soil texture</th>
<th>N (mg/kg)</th>
<th>Cd (mg/kg)</th>
<th>Pb (mg/kg)</th>
<th>P (mg/kg)</th>
<th>Mg (meq/lit)</th>
<th>Ca (meq/lit)</th>
<th>Na (meq/lit)</th>
<th>K (meq/lit)</th>
<th>EC (dS/m)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy loam</td>
<td>0.12</td>
<td>3.36</td>
<td>2.46</td>
<td>62</td>
<td>2.3</td>
<td>25.77</td>
<td>11.21</td>
<td>0.6</td>
<td>2.61</td>
<td>7.46</td>
</tr>
</tbody>
</table>

3.2 Quantitative characteristics of Atriplex lentiformis

3.2.1 Fresh and dry leaf to stem ratio

The effect of irrigation treatment (sewage 100%, drinkable water 100%, and sewage 50% and drinkable water 50%) on dry leaf to stem ratio was significant at the 1% level. But the total weight (leaves + stem) and height of Atriplex lentiformis was not significant (Table 2).

Wastewater treatment 100%, compared to other treatments, had maximum amount of leaf to stem ratio in both wet and dry (Figure 1).

3.3 Qualitative characteristics of Atriplex lentiformis

The effect of irrigation on the percentage of crude protein and total ash were significant differences. Soluble carbohydrates (SC) neutral detergent fiber (NDF), acid detergent fiber (ADF), dry matter digestibility (DMD), metabolism energy (ME), crude fiber (CF), digestible energy (DE)
and total digestible nutrients (TDN) were not affected by different irrigation treatments (Table 3).

![Figure 1. Comparison of the effect of irrigation on fresh and dry leaf to stem ratio of *Atriplex lentiformis* according to Duncan test at 5% level](image1.png)

**Table 3. Analysis of variance effect of different treatments on *Atriplex lentiformis* forage quality.**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Mean Square</th>
<th>CP</th>
<th>CF</th>
<th>DE</th>
<th>ME</th>
<th>Ash</th>
<th>WSE</th>
<th>DMD</th>
<th>TDN</th>
<th>ADF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>2</td>
<td>10.91</td>
<td>0.69</td>
<td>1.49</td>
<td>0.14</td>
<td>0.61</td>
<td>0.41</td>
<td>4.87</td>
<td>4.43</td>
<td>3.35</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>6</td>
<td>3.95</td>
<td>2.09</td>
<td>4.02</td>
<td>0.19</td>
<td>0.04</td>
<td>0.86</td>
<td>6.67</td>
<td>11.05</td>
<td>8.35</td>
<td></td>
</tr>
</tbody>
</table>

ns: no significant difference at 5% level, *: significant at 5% and **: significant at 1%

### 3.4 Crude protein

Mean comparison showed that crude protein in the sewage water 100% compare to drinkable water 100% had the highest value.

![Figure 2. Comparison of the effect of irrigation on the percentage of crude protein of *Atriplex lentiformis* according to Duncan test at 5% level.](image2.png)

### 3.5 Total ash

The highest amount of total ash in drinkable water 100% and the lowest wastewater 100% was observed (Figure 2).
Figure 3. Comparison of the effect of irrigation on the percentage of total ash of Atriplex lentiformis according to Duncan test at 5% level.

4. DISCUSSION AND CONCLUSION

Sewage increased leaf to stem ratio in state of the wet. Although leaf to stem ratio is a quantity parameter, it has an impact on quality. Increased leaf to stem ratio, is due to the increasing number and leaf area to stem ratio. Using wastewater for irrigation cause to facilitate Foliation and increased the number of leaves and consequently increasing plant photosynthesis (Myers et al., 1996).

Sewage increased the percentage of crude protein and reduced total ash of Atriplex lentiformis. This may be because of large quantities of organic matter to inorganic materials in plant. High crude protein concentration can be attributed to the presence of adequate amounts of nitrogen in wastewater. Adjei and Rechcigl (2002) reported that wastewater increased the protein content of forage. There was no significant change in cell wall in different treatments. Plant cell walls increased as a result of exposure to biotic and abiotic stresses. So it seems that in this study, plants haven’t faced with stress in different ratios of sewage and drinkable water. Therefore, it seems in situations where there is limited water resources in arid regions, if properly treated, the use of wastewater may not only compensate the shortage of water resources for feed product but is also effective in improving forage quality.

REFERENCES