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Effect of Different Levels of Secondary Treated Waste Water on Growth of Mustard Crop (*Brascia Juncea* Var. Bio 902) Plant

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Abstract
Sustained availability of biomass is a pre-requisite for biomass based energy generation. Seasonal crops of oil bearing plants yield oil seeds (with 30-50% vegetable oil) as well as biomass residues, both being potential fuels. Indeed the Brassica vegetables are a dietary staple in every part of the world with the possible exception of the tropics. The use of treated urban wastewater for irrigation in modern agriculture is steadily increasing world-wide and due to shortage of fresh water is common today in many regions throughout the world. Utilization of this water source for irrigation in the production fields is an environmentally sustainable approach, which incorporates the advantage of minimizing the disposal to the environment. Furthermore, irrigation with treated wastewater incorporate benefits to agricultural sectors by reducing demands for fertilizer inputs as a result of the higher concentration of macronutrients in this water. Secondary Treated wastewater was collected from Delawas Sewage Treatment plant, Pratap Nagar, Jaipur. Plants were irrigated with five different mixtures of distilled water and treated wastewater (100:00, 80:20, 60:40, 40:60, 20:80 and 00:100) in addition to distilled water as control. In this study, different levels of secondary treated waste water were used in pots of *Brassica juncea* and it was found that at each succeeding level, the biomass and carbohydrate content get increased up to the last (completely treated) level due to the nutrients presence in secondary treated waste water. At pre, peak and post stage the plant biomass including, root length, shoot length, root dry weight and shoot dry weight, increases up to 100% treated level.

Keywords: Biomass, Sustainable, Concentration, Advantage, Irrigation, Environment

1. Introduction

The Brassica oil seed crops that annually occupy over 26 million hectares of the world's agricultural land. Because of their ability to survive and grow at relatively low temperature, they are one of the few edible oil sources that can be successfully produced in cool temperate regions. In temperate regions, oilseed rape (Brassica napus) and turnip rape (Brassica rapa) predominate, while in the subtropics of Asia, Indian mustard or rai (Brassica juncea) is the major oil source. The earth and its ecosystem have been changed dramatically after the entrance of the human species into the cycle. One of the major problem, which has been accelerated especially after the industrial revolution is environmental pollution, among them water pollution (Amir, H. H., 2014). The present era is the time of industrialization, urbanization and technological advancement. The progress in the human civilization has exploited the environment which resulted in the pollution (Amit Sen *et al.,* 2013) [3]. Rapid growth of urban population results in generation of huge quantities of wastewater perennially. In India only 30% of the wastewater is treated before it's discharged. Thus, untreated water finds its way into water systems such as rivers, lakes, groundwater and coastal waters, causing serious water pollution (GOI, 2002; AlkaThapliyal 2011) [1].

Water supply and sanitation will be one of the main future challenges in a world of growing population and industrialization. The growing awareness of water resource scarcity, the competition for water resources and the negative impact of contaminated water on human health and the environment demand the development of adequate strategies in water management. Next to the development of new management strategies to supply fresh water, the issue of treating and recycling wastewater will play an important role in tackling the existing and occurring problems. Here the shortage of water is usually the main driving force for conservation of water (Amin Mojiri *et al*., 2013) [2]. Human impacts on freshwater systems are substantial in most populated parts of the world. Over extraction of freshwater, mainly for agriculture, has led to significant degradation of rivers, lakes and aquifers. Liberation of water for the environment through substitution with treated wastewater has been promoted as a means of reducing anthropogenic impacts (Hamilton *et al*., 2005). However, treated wastewaters can still be used for irrigation under controlled conditions which minimize hazard from pathogenic and toxic contaminants to agricultural products, soil, surface, and groundwater (Kiziloglu *et al.,* 2007) [9]. Treated wastewater appears to be the only water resource that is increasing as other sources are dwindling. Taking into account the scarcity of conventional water resources, due to water demand increases both for human consumption and for agricultural use, the reuse of saline, brackish, and treated wastewater (TWW) could be a realistic way for reducing water shortage, as it has been demonstrated in many countries in the Mediterranean basin. The TWW can constitute a reliable water and nutrient source for crops and its use for irrigation reduces the amount of nutrient-rich water returned to rivers or sea; but its use can have controversial impacts, especially because of the potential heavy metal risk for plant growth, agricultural products, and physicochemical properties of the soil. The reuse of TWW in India can either satisfy the increasing water requirements of agriculture or constitute a tool to preserve freshwater resources for human consumption. Currently, the effluent used for irrigation is mainly obtained after biological treatments (secondary treatment). However, this effluent differs from freshwater for salinity, pH, and concentrations of microelements and nutrients; all parameters are generally higher in TWW than in freshwater (Saida Bedbabis *et al*., 2014) [10]. Irrigation with treated wastewater has been used for three purposes: (a) complementary treatment method for wastewater (Bouwer and Chaney, 1974), (b) the use of marginal water as an available water source for agriculture (Tanji, 1997), and (c) the use of wastewater as nutrient source (Bouwer and Chaney, 1974). Utilization of treated municipal wastewater has caused an increase in forage yield and whole plant dry matters as compared to irrigation with the well water (Ata, B. A., 2014) [5]. Sustained availability of biomass is a pre-requisite for biomass based energy generation. Seasonal crops of oil bearing plants yield oil seeds (with 30-50% vegetable oil) as well as biomass residues, both being potential fuels. India is the fourth largest oilseed economy in the world. Among the seven edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6% in the total oilseeds production and ranks second after groundnut sharing 27.8% in the India's oilseed economy. Rapeseed-mustard (*Brasciajuncea*) is a major group of oilseed crop in the world with India being the second largest cultivator after China. Although there has been a significant increase in oilseed production since 1960s, the demand for oilseeds production in the future is likely to go up due to population increase and their income. (Boomiraj, K. *et al.,* 2010) [8]

2. Material and Methods

The seeds of *Brascia juncea* var. Bio 902 were obtained from Agriculture Research centre, Rajasthan Agriculture University of Bikaner located in Durgapura, Jaipur, Rajasthan. Earthen pots (with a diameter of 12 inch) were used for growing test plant species *Brascia juncea* var. Bio 902. The seeds were surface sterilized with dilute solution hypo chloride. The sand was thoroughly washed with water and then treated with 2% sodium hypo chloride and dried. The seeds were sown in earthen pots containing equal quantities of soil and each pot were treated with different treatment levels of textile effluent. The plants were investigated at 3 stages of their maturation at pre flowering stage, peak flowering stage and post flowering stage.

Table 1: Development of *Brassica juncea* at different concentration levels of treated effluent at pre Flowering Stage

Levels Distilled water: Treated waste Water (DW : TWW)	Root Length (in cm)	Shoot Length (in cm)	Root Dry weight (in mg)	Shoot Dry weight (in mg)
100 : 00	12.84±0.501	25.46±0.790	0.87±0.064	2.10±0.302
80 : 20	13.53±0.348 (5.37%)	27.70±0.363 (8.79%)	0.94±0.049 (8.04%)	2.35±0.200 (11.90%)
60 : 40	14.81±0.357 (15.34%)	30.46±0.405 (19.63%)	1.02±0.108 (17.24%)	2.64±0.410 (25.71%)
40 : 60	16.46±0.151 (28.19%)	32.50±0.701 (27.65%)	1.14±0.144 (31.03%)	2.77±0.787 (31.90%)
20 : 80	17.29±0.169 (34.65%)	35.24±0.641 (38.41%)	1.21±0.154 (39.08%)	2.94±0.573 (40.00%)
00 : 100	19.14±0.098 (49.06%)	38.17±0.947 (49.92%)	1.32±0.191 (51.72%)	3.12±0.598 (48.57%)

Mean Value,±S.D., (% Increase)

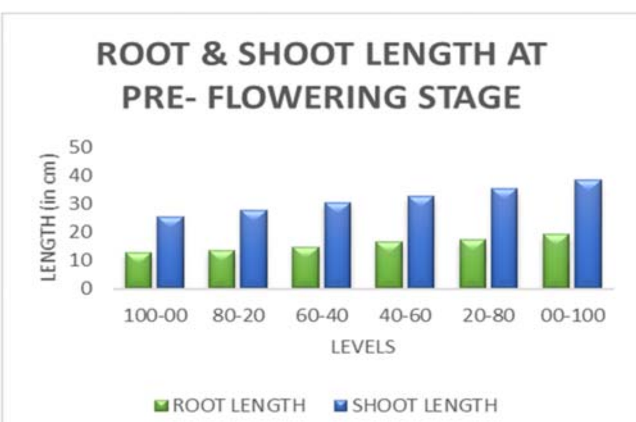
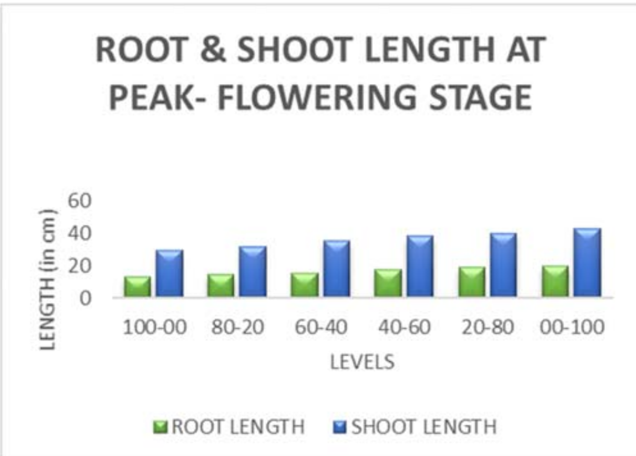


Table 2: Development of *Brassica juncea* at different concentration levels of treated effluent at Peak-Flowering Stage.

Levels Distilled Water: Treated Waste water (DW : TWW)	Root Length (in cm)	Shoot Length (in cm)	Root Dry weight (in mg)	Shoot Dry weight (in mg)
100 : 00	13.16±1.133	29.30±2.63	0.95±0.087	2.56±0.364
80 : 20	14.29±1.141 (8.58%)	31.86±2.247 (8.73%)	1.02±0.165 (7.36%)	2.75±0.220 (7.42%)
60 : 40	15.64±0.946 (18.84%)	35.26±1.986 (20.34%)	1.13±0.175 (18.94%)	2.98±0.081 (16.40%)
40 : 60	17.59±1.335 (33.66%)	38.36±1.787 (30.92%)	1.23±0.452 (29.47%)	3.22±0.254 (25.78%)
20 : 80	18.78±1.689 (42.70%)	40.15±1.375 (37.03%)	1.31±0.621 (37.89%)	3.42±0.369 (33.59%)
00 : 100	19.85±1.460 (50.83%)	43.22±1.164 (47.50%)	1.42±0.612 (49.47%)	3.64±0.224 (42.18%)

Mean Value,±S.D., (% Increase)



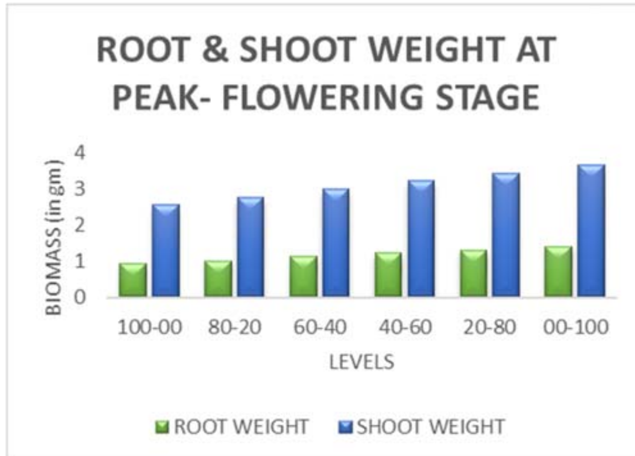


Table 3: Developmentof *Brassica juncea* at different concentration levels of treated effluent at post flowering Stage.

Levels Distilled Water: TreatedWaste Water (DW: TWW)	Root Length (in cm)	Shoot Length (in cm)	Pod Length (in cm)
100 : 00	13.40±2.364	35.72±2.643	3.6±1.834
80 : 20	14.69±2.523 (9.62%)	38.54±2.637 (7.89%)	3.7±1.927 (2.77%)
60 : 40	15.74±3.135 (17.46%)	42.30±3.548 (18.42%)	4.0±1.815 (11.11%)
40 : 60	17.45±2.799 (30.22%)	46.58±3.488 (30.40%)	4.2±1.742 (16.66%)
20 : 80	18.72±2.846 (39.70%)	50.32±3.301 (40.87%)	4.3±1.689 (19.44%)
00 :100	20.10±2.616 (50.00%)	54.68±2.243 (53.07%)	4.6±1.755 (27.77%)

#Mean Value,±S.D., (% Increase)

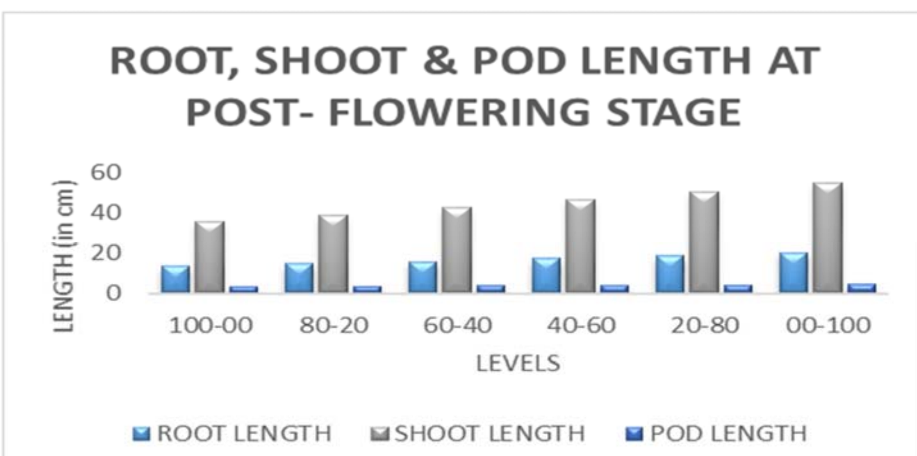
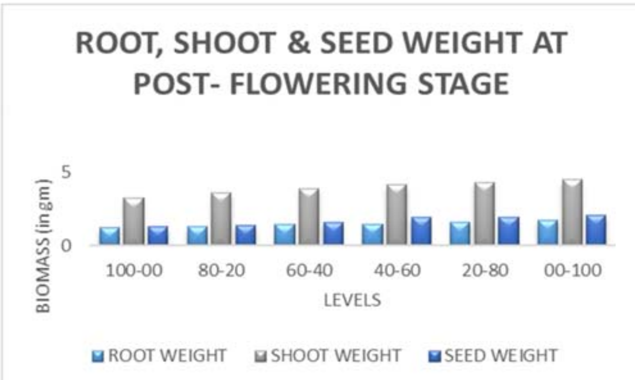


Table 4: Development of *Brassica juncea* at different concentration levels of treated effluent at post flowering Stage

Levels Distilled Water: Treated Waste Water (DW: TWW)	Root dry weight (in mg)	Shoot Dry weight (in mg)	Seed Weight (in mg)
100 : 00	1.24±0.145	3.26±0.156	1.31±0.105
80 : 20	1.33±0.105 (7.25%)	3.58±0.256 (9.81%)	1.44±0.119 (9.92%)
60 : 40	1.45±0.343 (16.93%)	3.89±0.386 (19.32%)	1.59±0.126 (21.37%)
40 : 60	1.51±0.223 (21.77%)	4.15±0.358 (27.30%)	1.95±0.213 (48.85%)
20 : 80	1.65±0.140 (33.06%)	4.34±0.268 (33.12%)	1.97±0.213 (50.38%)
00 :100	1.78±0.231 (43.54%)	4.52±0.309 (38.65%)	2.08±0.227 (58.77%)

Mean Value, ±S.D., (% Increase)



3. Results

In the present study secondary treated effluent which is used for irrigation of *Brassica juncea* at different concentration level showed its effect on plant growth. The results of plant biomass including; root length, shoot length, root dry weight and shoot dry weight, at pre flowering stage of development are given in the Table -1 which show that growth parameters increase from 12.84 to 19.14cm, 25.46 to 38.17cm 0.87 to 1.32gm, and 2.10 to 3.12 gm, respectively at each succeeding level. Table -2 shows that at peak flowering stage, it increases from 13.16 to 19.85 cm, 29.30 to 43.22cm 0.95 to 1.42gm and 2.56 to 3.64 gm, respectively. Table -3 shows that at post flowering stage, root length, shoot length and pod length increase from 13.40 to 20.10 cm 35.72 to 54.68 cm and 3.6 cm to 4.6 cm respectively. Table -4 shows that at post flowering stage root weight, shoot weight and seed weight increases from 1.24 to 1.78 gm, 3.26 to 4.52 gm and 1.31gm to 2.08 gm respectively. In all growth parameters at all developmental stages maximum % increase was found at 40% concentration level of treated effluent (diluted with 60 % distilled water).

4. Discussion

Results reveal that at each successive level of effluent, plant biomass and carbohydrate content increases due the presence of nutrients. Growth parameters show positive response up to the 100% level of treated effluent due to the micronutrient effect which is present in secondary treated waste water. It was also observed that maximum percent increase gain at 40% level. Esmailian *et al.,* (2011) [7], Erfani *et al.,* (2001) [1] also observed the same results. From pre flowering stage to post flowering stage, plant biomass and length increases. So, the use of secondary treated effluent for irrigation may serve as an additional source of water with fertilizing properties after appropriate dilution with distilled water.

5. Conclusion

Though sewage waste water is used frequently now a day for irrigation purposes due to its fertilizer value but it should be cautious of using sewage regarding pollutant perspective. Still the use of treated waste water for irrigation purposes is found to be beneficiary for crop plants, as it is the safe disposal of sewage effluents. Otherwise it possesses adverse effects on the environment as well as on human health. Besides through the irrigation the sewage water can be recycled. In the present study, treated sewage waste water is used for cultivation of *Brassica juncea* to know the physical growth and dry matter concentration and it shows the positive effects. TWW irrigated crop presented a higher concentration of nutrients and this could be important for the successive vegetative season. In conclusion, results can give useful indications for a more rational nutrition schedule of *Brassica juncea* saving both mineral and water inputs towards a more sustainable management.

6. Recommendations

It is recommended that 100% sewage waste water should not be discharged directly in the agricultural fields. Sewage waste water should be treated by installing waste water treatment plant to protect the crop so that crop can consume treated waste water as a source of nutrient and this type of treated waste water also reduces the dependency on the artificially fertilizers. The use of treated waste water for irrigation can either allow reusing water to save nutrient inputs in the crop (fewer fertilizers). So appropriate wastewater treatment and water management practices will have to be followed to allow the reuse of untreated wastewater for irrigation is must necessary. Saida Bedbabis *et al.,* also recommended the same.

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