International Journal of Agriculture Innovations and Research
Volume 4, Issue 2, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 22/09/2015 | Accepted on : 28/09/2015 | Published : 10/10/2015

Impact of Different Dilutions of Sewage Water on Seed Germination Characteristics and Carbohydrate Content of Seedlings of *Vigna unguiculata*

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Abstract – **The present study was carried out with the aim that irrigation with sewage shows positive or negative impact on plant growth. Nowadays large amount of untreated sewage is being discharged into surface bodies for disposal. As there is water shortage farmers are using this waste water to irrigate their vegetable fields in city conurbations The present study was carried out to evaluate the impact of different dilutions of sewage water on seed germination characteristics and carbohydrate content of seedlings of *Vigna unguiculata*. The significant decrease in seed germination% , was observed at all other dilutions as compared to untreated seedlings except 75%.There was significant reduction in root length, vigour index, Significant (p<0.05)increase was observed in shoot length, fresh weight as compared to untreated seedlings. Highly significant (p<0.01)decrease was observed in carbohydrate content at all dilutions except 25% dilution which was found to be insignificant (p>0.05) as compared to untreated seedlings.**

Keywords – **Carbohydrate Content, Germination %, Sewage Water, *Vigna unguiculata,* Vigour Index.**

I. Introduction

Advanced industrialization processes have provided comforts to human beings on one hand but it has also resulted in indiscriminate release of gases and liquids, which pollute the environment of biological system. Nowadays large amount of untreated sewage is being discharged into surface bodies for disposal. As there is water shortage farmers are using this waste water to irrigate their vegetable fields in city conurbations But sewage also contain non-essential heavy metals which when present in large amount could be transferred to animal and human beings through food chain (Ghafoor *et al.,* 2004). Cowpea is one of the most important food and forage legumes in the semi-arid tropics that include parts of Asia, Africa, Southern Europe, Southern United States, and Central and South America (Singh 2005; Timko *et al* 2007a). It is truly a multifunctional crop, providing food for man and livestock and serving as a valuable and dependable revenue-generating commodity for farmers and grain traders (Singh 2002; Langyintuo *et al* 2003). The present investigation is to be conducted to evaluate the impact of different dilutions of sewage water on seed germination characteristics and carbohydrate content of seedlings of *Vigna unguiculata.*

II. Material and Method

Sewage water used in the present study was collected from Krishnapura nallah Indore. The effect of this water was observed on cow pea. Various dilutions of sewage water were prepared. The dilutions of sewage used were as follows: (i) 20ml tap water i.e 100% dilution (Control)(ii)15ml tap water +5ml sewage water i.e. 75% dilution (iii) 10ml tap water +10ml sewage water i.e. 50% dilution (iv)5ml tap water +15ml sewage water i.e. 25% dilution (v) 0 .00 ml tap water +20ml sewage water i.e. 0% dilution.

Analysis of sewage water: Analysis of sewage water was done at Pollution Control Board, Indore

Sterilization of seeds: Seeds of uniform size were selected and surface sterilized with 0.1% solution of mercuric chloride for 5min to avoid any fungal growth, followed by washing for 4-5 times with distilled water . The seeds were then placed in10 cm diameter Petri dishes lined with Whatman No. 1 filter paper moistened with distilled water for 24 hours in dark for germination.

Germination Percentage estimation: It was estimated using method given by S.Rehman *et al.,* (1998). The germination percentage was calculated as

G% = (number of seed germinated / number of sampled seeds) × 100.

Viability percentage estimation: It was determined using method given by G. Lakon (1942)This test is based on the fact that colorless TTZ turns red when it is reduced by respiring cells.This test is able to detect live tissue and allow one to determine if the seed is viable or not.

Length of Root and Shoot: Root and shoot length of seedlings were recorded by using the standard centimeter scale.

Fresh weight and dry weight: For determining fresh weight, four seedlings were selected at random. Dry weight was determined after drying the seedlings in a hot air oven at 80^0C for 24 hours (M.Kabir, 2008). Fresh weight and dry weight of the seedlings were recorded using electrical balance.

Vigour index: Vigour index was calculated by using the formula as suggested by Abdul-Baki and Anderson (1973) and expressed in whole number.

Vigour Index = Germination (%) x (Root length + Shoot length in cm)

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Carbohydrate estimation: It was determined by the method as given J.E.Hedge *et al.,* (1962).Carbohydrates are dehydrated by conc. H_2SO_4 to form furfural. Furfural condenses with anthrone to form a blue-green colored complex which is measured calorimetrically at 630nm.

Statistical Analysis: Laboratory characteristics of studied parameters were expressed as mean ± standard deviation (SD). ANOVA is used to compare these data between treated seedlings and control seedlings. P values less than 0.05 was considered to be significant. Correlation analysis was performed for the assessment of change due to sewage treatment.

III. Result

Table 1: Sewage water Analysis

Parameters	**Methods**	**Results**
Colour	-	Light black
Odour	-	Unpleasant
PH	Electrometric	7.84
alkalinity	Titrimetric	250mg/l
Turbidity	Turbidimetric	78.4NTU
Total dissolve solid	Gravimetric	804mg/l
Total solid	Gravimetric	916mg/l
Electrical conductivity	Potentiometric	1342µmho
COD	Open Reflux	148mg/l
BOD	3 days 27˚c	54mg/l
Fe		0.139mg/l
sulphate	Turbidimetric	39.5mg/l
Chloride	Argentometric	155mg/l
Total Nitrogen	Kjeldahl	42.021mg/l

Photo 1: Site View of Krishnapura Nallah from where sewage was collected

Table 2: Effect of different dilutions of sewage on Germination %

S.No	% Dilution	% Germination	%Reduction
1	Control	97.33±2.30	-
2	75	96±4.12^{NS}	1.36
3	50	88±4.23*	9.5
4	25	85.33±6.11*	12.32
5	0	80.66±3.05*	17.12

Note * Indicates- significant, ^{NS} Indicates- insignificant

Table 3: Effect of different dilutions of sewage on Viability

S.No	% Dilution	Viability	% Reduction
1	Control	100±0	
2	75	96.66±5.77^{NS}	3.34
3	50	93.33±11.54^{NS}	6.67
4	25	83.33±15.27^{NS}	16.67
5	0	86.66±15.27^{NS}	13.34

Note * Indicates- significant, ^{NS} Indicates- insignificant

Table 4: Effect of different dilutions of sewage on Root length (cm)

S.No	% Dilution	Root length	% Reductions
1	Control	11.28 ±2.29	-
2	75	9.43±5.23^{NS}	16.40
3	50	4.46±2.9*	60.46
4	25	4.49±2.5*	60.19
5	0	2.46±1.19*	78.19

Note * Indicates- significant, ^{NS} Indicates- insignificant

Table 5: Effect of different dilutions of sewage on Shoot length (cm)

S.No	% Dilution	Shoot length	% Increase
1	Control	7.12±3.82	-
2	75	9.82±1.68*	37.92
3	50	9.42±3.98*	32.2
4	25	10.06±1.79*	41.29
5	0	9.24±0.84*	29.77

Note * Indicates- significant, ^{NS} Indicates- insignificant

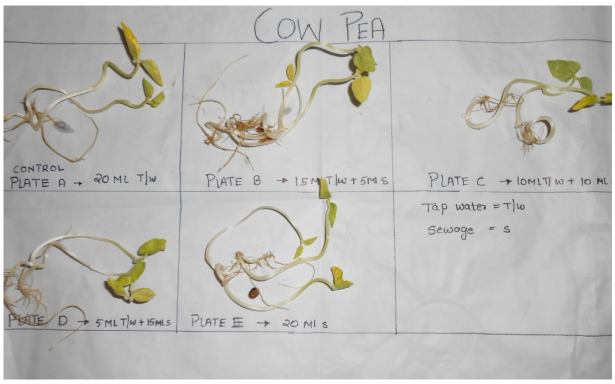

Photo 2: Effect of different dilutions of sewage water on visible parameters

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Volume 4, Issue 2, ISSN (Online) 2319-1473

Table 6: Effect of different dilutions of sewage on Vigour Index(%)

S.No	% Dilution	Vigour Index	% Reductions
1	Control	2021.4±143.08	
2	75	1700.5±829.05^{NS}	15.8
3	50	1834.77±638.74^{NS}	9.25
4	25	1644.16±326.30^{NS}	18.65
5	0	1500.46±245.32^{NS}	25.77

Note * Indicates- significant, ^{NS} Indicates- insignificant

Table 7: Effect of different dilutions of sewage on Fresh weight (gm)

S.No	% Dilution	Fresh weight	% Increase
1	Control	1±0.52	-
2	75	1.71±0.42*	71
3	50	1.82±0.140*	82
4	25	2.05±0.06*	105
5	0	2.03±0.37*	103

Note * Indicates- significant, ^{NS} Indicates- insignificant

Table 8: Effect of different dilutions of sewage on Dry weight (gm)

S.No	% Dilution	Dry weight	% Decrease
1	Control	0.13±0.01	-
2	75	0.11±0.03^{NS}	15.38
3	50	0.11±0.03^{NS}	15.38
4	25	0.07±0.059*	46.15
5	0	0.11±0.03^{NS}	15.38

Note * Indicates- significant, ^{NS} Indicates- insignificant

Table 9: Effect of different dilutions of sewage on Carbohydrate content (% mg)

S.No	% Dilution	Carbohydrate	% Reduction
1	Control	5.73±1.16	-
2	75	1.73±0.057*	69.80
3	50	2.66±0.83*	53.57
4	25	4.53±0.20^{NS}	20.94
5	0	1.83±0.33*	68.06

Note * Indicates- significant, ^{NS} Indicates- insignificant

IV. Discussion

Sewage is regarded as a fertilizer source, so its usage in irrigation is very important as a rich source for supplying the nutritional needs of the plants (Rattan *et al*., 2005).Alizadeh *et al*., (2001) reported that urban sewage treatment produced the highest grain yield and biological yield at all growth levels of corn plants. Da Fonseca *et al.* (2007) reported that urban sewage could substitute suitable conventional water for irrigating Bermuda grass; it had many economical advantages and irrigating with sewage increased dry matter production and protein

Simmons and Pongsakul (2002) showed that the accumulation of heavy metals in crop products did not only depend on the concentration of metals in water but also on the species.

Effect on Germination %, Root length and shoot length

Germination % in *Vigna unguiculata* was decreased in germinating seedlings treated with sewage as compared to 100% dilution. These results were in accordance with the work of Khan *et al* (2011) who reported that seed germination was decreased when treated with waste water which is contaminated by textile industrial effluents.

Dash (2012) showed discourageable effect of domestic wastewater on germination of rice and wheat with higher concentrations of sewage

Root length of *Vigna unguiculata* was decreased where as shoot length increased with decrease in dilutions of sewage. These results were in the support of findings of Singh and Agarwal (2009) who showed that when high nutrients were applied to the *A.esculentus* then shoot length increased and root length decreased. Singh and Agarwal (2010) observed that root length decreased in plants at waste water irrigated sites as compared to the ground water irrigated ones. The reductions in the root length may be due to increase in the nutrient concentrations under waste water irrigation as compared to the ground water irrigated ones.

Effect on Vigour index

The results of present study showed a significant increase in Vigour index of *Vigna unguiculata* at all dilutions as compared to the 100% dilution. The result were in accordance with the work of Dash (2012) who observed that the vigour index was increased with the treatment of sewage upto 50% both in rice and wheat and thereafter it declined gradually towards high concentrations both in rice and wheat. Girisha *et al* (2008) recorded that when sewage water is diluted to 25% for irrigation of *Arachis hypogea* it enhances the vigour index.

Effect on Fresh weight and Dry weight

Fresh weight of *Vigna unguiculata* increases with the decrease in dilutions. The present results are in accordance to the assessment done by Tamrabet *et al* (2009) that showed that increase in the weight may also be the result of improvement in soil fertility due to sewage sludge application. However the work of Singh and Agarwal (2010) were supporting the present findings, their results showed that higher bioavailability of heavy metals in wastewater irrigated sites may have reduced the nutrient availability to plants that may be the cause for insignificant increments in biomass of these plants as compared to the plants grown at ground water irrigated sites.

Dry weight affected significantly at all dilutions of sewage as compared to 100% dilution. The present findings showed decrease in dry weight of *Vigna unguiculata* with decrease in dilutions of sewage. The findings of study are contradictory to Bouzerzour *et al* (2002) who reported that the application of sewage sludge increased dry matter of barley (*Hordeum vulgare* l.) and oat (*Avena sativa* l.) genotypes, evaluated in pots experiment. Khan *et al.* (2007) reported that with the increased application of sewage sludge increased total dry matter yield. Onal *et al.* (2003) reported that plant dry matter in fruits of tomato plant was increased by the increasing applications of sewage sludge rates. El-Dewiny *et al* (2006) showed that dry weight of radish and spinach plants increased with application of sewage sludge. However the research done by Bray and Reid (2002) showed that low values of the dry weight recorded in the most saline treatments and can be explained by the fact that salt reduced fresh and dry weights of leaves , which is in support of present study in accordance to dry weight.

Effect on carbohydrate content

Total carbohydrate content of the seedlings of *Vigna unguiculata* was decreased significantly at all the level of dilutions as compared to the control. The results of present study were not in agreement of Bamniya *et al* (2010) who showed that Total carbohydrate content is higher in wastewater irrigated crops than control. Rong Guo *et al* (2007) observed that stress causes increase in soluble sugar content. Zeid *et al* (2007) also showed that carbohydrate content increases when *Phaseolus vulgaris* seedlings were irrigated with sewage waste water. Devaraj *et al* (2003) also demonstrated that when *Phaseolus vulgaris* were germinated in sewage water then total sugar content tends to increase. Results of Bedouh *et al* (2012) revealed that when *Allium cepa* is irrigated with waste water, the levels of sugar increases.

V. Conclusion

From the present study it was concluded that most of the seed germination characteristics and carbohydrate content were adversely affected as on decreasing dilution of sewage water.

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