INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 7, p. 224-228, 2014

RESEARCH PAPER OPEN ACCESS

Effect of irrigation with leaven factory wastewater on biological yield and some traits of corn

Ata Bahojb-Almasi*

[1]*Plant Ecology, university of Tabriz, Iran*

[3]*Iran-mayeh company, Tabriz, Iran*

Key words: Biological yield, corn, irrigation, wastewater.

http://dx.doi.org/10.12692/ijb/4.7.224-228 Article published on April 14, 2014

Abstract

In recent years, water deficit and environmental hazards of wastewater have promoted the development of wastewater reuse in irrigation of agricultural lands in many arid and semi-arid regions. An experiment was conducted out at the experimental farm of a leaven factory, where the effect of treated wastewater on yield and yield components of corn (*Zea mays*) was studied during the growing season of 2012. Three, irrigation levels (I_1: irrigation with wastewater once in whole experimental period, I_2: irrigation with wastewater twice in whole experimental period and I_3: irrigation with wastewater in whole experimental period) and six wastewater percentage levels (C_1: 15% wastewater, C_2: 30% wastewater, C_3: 45% wastewater, C_4: 60% wastewater, A: pure water and P: pure wastewater) were studied in a randomized complete block factorial design with three replications. Results illustrated that number of irrigation with wastewater and wastewater percentage did not have significant effect on plant height, steam weight, steam diameter and stigma weight. But number of irrigation with wastewater affected tassel weight and biological yield. The most increase of biological yield was observed in irrigation with wastewater whole over growth season and interaction of irrigation with wastewater whole over growth season and 15% wastewater. Results also illustrated that irrigation with wastewater once in whole growth season had the most significant effect on tassel weight.

* **Corresponding Author:** Ata Bahojb-Almasi ✉ Ataalmasi@yahoo.com

Introduction

The demand for water is continuously increasing in arid and semi-arid countries. Therefore, water of higher quality is preserved for domestic use while that of lower quality is recommended for irrigation. Municipal wastewater is less expensive and considered an attractive source for irrigation in these countries (Al-Rashed and Sherif, 2000). It is inevitable and necessary to pay attention to the abnormal consumption of water resources (Najafi, 2002). Wastewater and agriculture are two sectors where the economic and environmental benefits of joint water management have been demonstrated through case studies around the world. It has been shown that the nutrients embodied in wastewater can increase yields as much or more than a combination of tap water and chemical fertilizer (Lopez *et al.*, 2006; WHO, 2006; Kiziloglu *et al.*, 2007). The reliable access to wastewater irrigation can improve farm productivity in water-constrained systems (Bradford *et al.*, 2003; Huibers and Van Lier, 2005).
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).

Erfani *et al.* (2001) showed that 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. Tavassoli *et al.* (2010) to evaluate the effects of municipal wastewater with manure and chemical fertilizer on yield and quality characteristics of corn forage reported that irrigation with wastewater will increase forage yield.
Day *et al.* (1979) compared the effect of irrigation with wastewater than pump water on wheat. They concluded that wastewater irrigation produced taller plants, more heads per unit area, heavier seeds and higher grain yields than pump water.

Esmailiyan *et al.* (2008) reported that wastewater had positive significantly influence on grain yield and all yield components. Esmailiyan *et al.* (2011) showed that irrigation with wastewater significantly increase oil and protein percentage of the grains than well water. They also reported that wastewater irrigation due to higher chlorophyll content, proline and carbohydrate contents in green leaf tissues. The objective of this study was assessed the impacts of leaven factory wastewater irrigation on biological yield and some traits of corn.

Materials and methods

This study was conducted at the experimental farm of Iran Mayeh Co a leaven factory where is located at Tabriz (46° 21′ N, 38° 09′ E) during 2012 growing season. The experiment was carried out as a factorial based on complete block design with three replications. The treatments were three levels of number of irrigation (I_1: irrigation with wastewater once in whole experimental period, I_2: irrigation with wastewater twice in whole experimental period, I_3: irrigation with wastewater in whole experimental period) and six levels of wastewater percentage (C_1: 15% wastewater, C_2: 30% wastewater, C_3: 45% wastewater, C_4: 60% wastewater, A: pure water and P: pure wastewater). The soil characteristics are given in Table 1.

Experimental plots were sown with hybrid corn KoSc 504 cultivar at 10 plants per square meter with 50 cm row spacing and 20 cm between plants in rows. After crop establishment, thinning was done maintaining one plant per hill. Analytical data of the treated wastewater and well water are shown in table 2. Irrigation was applied during growing season according to treatments. Treated wastewater was obtained from leaven factory.

Crop sampling and calculation

Plants in four central rows at each plot were harvested to determine the grain yield in November 2012. Traits of corn included plant height, steam diameter, steam weight, tassel weight and stigma were obtained from five selected plants in each experimental plot.
Statistical analysis

Data analyzed was done by MSTAT-C software. The ANOVA test was used to determine significant ($p<0.05$) treatment effect and Duncan Multiple Range Test to determine significant difference between individual means.

Results and discussion

Results of this study showed number of irrigation with wastewater had significant effect on tassel weight and biological yield of corn (Table 3).

Table 1. Soil properties measured prior to the initiation of the experiment.

Depth (cm)	Soil texture	pH	EC (dS m^{-1})	OM
0-30	Sandy-Loam	7.31	0.98	2.64%

Table 2. Chemical characteristics of treated leaven factory wastewater and well water

Fe(mg/l)	Zn(mg/l)	K(meq/l)	P(mg/l)	pH	EC(dS/m)	Wastewater percentage	Well water percentage
0.375	0.146	0.146	0	7.62	0.63	0%	100%
0.706	0.158	3.02	8.46	8.65	1.6	15%	85%
1.043	0.148	6.9	20.5	8.14	2.76	30%	70%
1.669	0.121	9.61	36.9	8.22	3.98	45%	55%
2.248	0.107	13.33	54.9	8.49	5.15	60%	40%
2.578	0.097	21.3	144	6.26	7.94	100%	0%

The effect of wastewater percentage was not significant on plant height, steam diameter, steam weight, tassel weight, stigma weight and biological yield of corn (Table 3).

Data presented at table 3 indicated that the number of irrigation with wastewater × wastewater percentage only at the biological yield was significant.

Table 3. Analysis of variance of grain specifications as affected by number of irrigation with wastewater and wastewater percentage treatments

S.O.V	df	Plant height	Steam diameter	Steam weight	Tassel weight	Stigma weight	Biological yield
Replication	2	447.353^{**}	0.0002	830.282	0.412	0.156	22652969.283^{**}
Number of irrigation with wastewater (A)	2	28.910^{ns}	0.036^{ns}	164.054^{ns}	3.882^{*}	0.091^{ns}	10769171.635^{*}
Wastewater percentage (B)	5	66.174^{ns}	0.035^{ns}	139.333^{ns}	1.694^{ns}	0.123^{ns}	1870234.418^{ns}
Number of irrigation × wastewater percentage (A×B)	10	118.010^{ns}	0.065^{ns}	220.593^{ns}	0.992^{ns}	0.094^{ns}	6365666.211^{*}
Error	34	70.195	0.032	153.224	0.999	0.065	3070391.523
CV (%)		4.61	7.97	26.80	24.50	17.09	14.23

Ns: Non significant; **, *: significant at 1% and 5% probability.

Tassel weight

The highest tassel weight obtained from irrigation with wastewater once in whole experimental period and the lowest tassel weight obtained from irrigation with wastewater in whole experimental period (Fig. 1). Zheng *et al* (2000), found that adequate supply of organic wastes with chemical fertilizers improve the wheat crop properties. Esmailian *et al* (2011) concluded that ear length and ear diameter were appreciably higher in plants grown in treated

wastewater compared with well water. This might be due to availability and better utilization of nutrients from wastewater.

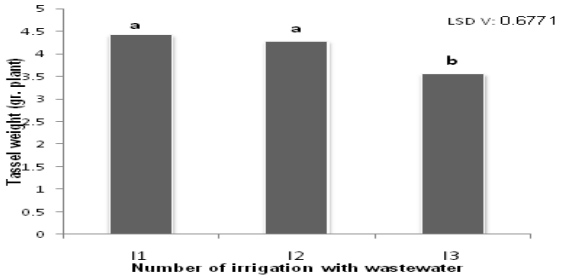

Fig. 1. Effect of number of irrigation with wastewater treatment on tassel weight. Different letters expose significant difference at 5% probability.

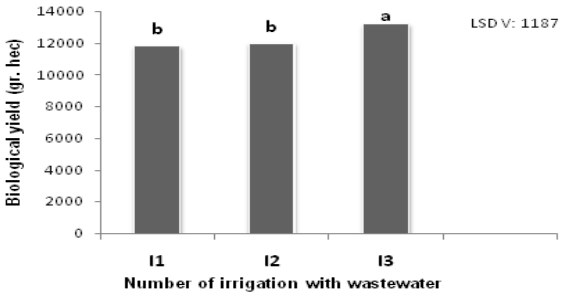

Fig. 2. Effect of number of irrigation with wastewater on biological yield. Different letters expose significant difference at 5% probability

Biological yield

According to means comparing recognized that the use of irrigation with wastewater in whole experimental period in comparison with irrigation with wastewater once and twice in whole experimental period, result in the increase of biological yield (Fig. 2). Grain yield was 54.6% higher in plants that irrigated with wastewater in comparison with well water (Erfani *et al.* 2001).

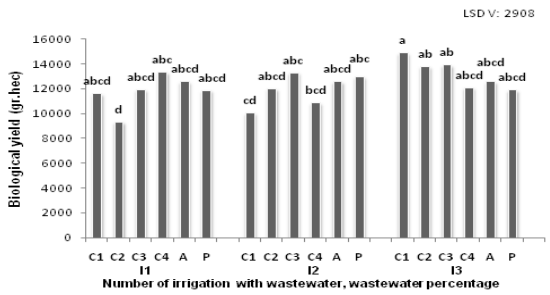

Fig. 3. The interaction effects of number of irrigation with wastewater and wastewater percentage on biological yield. Different letters expose significant difference at 5% probability

The highest biological weight obtained from irrigation with wastewater in whole experimental period × 15% wastewater treatment and it increased biological yield 18.44% than pure water and the lowest biological yield obtained from irrigation with wastewater once in whole experimental period × 30% wastewater. It decreased biological yield 25.94% than pure water (Fig. 3). The primary yield components of corn are biological yield, 1000-seed weight, number of seed per ear, row per ear, ear diameter and ear length. Even though, yield components are under genetic control, they do respond with various degree of flexibility to water deficit or irrigation regime (Nabipour *et al.* 2007). This increase of yield may be due to the phosphorus in the applied wastewater. Several researches reported accumulation of N, P and K in the soil with the wastewater causes increasing biological yield and grain yield in crops (Monnett *et al.* 1996).

References

Al-Rashed MF, Sherif MM. 2000. Water resources in the GCC countries: an overview. Water Research and Management **14**, 59-75. http://dx.doi.org/10.1023/A: 1008127027743

Bradford A, Brook R, Hunshal C. 2003. Wastewater irrigation in Hubli-Dharvar, India. Environment and Urbanization **15**, 157-172. http://dx.doi.org/10.1177/095624780301500206

Bouwer H, Chaney RL. 1974. Land treatment of wastewater. Advances in Agronomy **26**, 133-176. http://dx.doi.org/10.1016/S0065-2113(08)60870-6

Day AD, McFadyen JA, Tucker TC, Cluff CB. 1979. Commercial production of wheat grain irrigated with municipal wastewater and pump water. Journal of Environmental Quality **8,** 3-8.

Erfani A, Haghnia GH, Alizadeh A. 2001. Effect of irrigation by treated wastewater on the yield and quality of tomato. Journal of Agricultural Science and Technology **15,** 65-67.

Esmailian Y, Ghanbari A, Babaeian M, Tavassoli A. 2011. Influence of organic and inorganic fertilizers and wastewater irrigation on yield and quality traits of corn. Journal of Agricultural Science and Technology **10,** 658-666.

Esmailian Y, **Heidari M**, **Ghanbari A**. 2008. Effect of municipal wastewater with manure and chemical fertilizers on grain yield and yield components in corn. Journal of Agronomy **20,** 35-40.

Huibers F, Van Lier J. 2005. Use of wastewater in agriculture: the water chain approach. of irrigation and Drainage **54,** 3-9.
http://dx.doi.org/10.1002/ird.181

Lopez A, Pollice A, Lonigro A, Masi S, Palese AM, Cirelli GL, Toscano A, Passino R. 2006. Agricultural wastewater reuse in southern Italy. Integrated Concepts in Water Recycling **187**, 323-334.
http://dx.doi.org/10.1016/j.desal.2005.04.091

Monnett GT, Reneau RB, Hagedor C. 1998. Evaluation of spray irrigation for on-site wastewater treatment and disposal on marginal soils. Water Environment Research **68,** 11-18.
http://dx.doi.org/10.2175/106143096X127163

Nabipour M, Meskarbashee M, Yousefpour H. 2007. The effect of water stress on yield and yield components of safflower. Journal of Biological Sciences **10,** 421-426.

Najafi P. 2002. Assessment of optimum model of using treated wastewater in irrigation of some crops. Ph.D. Theses, Khorasgan Azad University, Isfahan, Iran, 36-48 p.

Tanji KK. 1997. Irrigation with marginal quality waters: issues. Journal of Irrigation and Drainage Engineering **123**, 165-169.
http://dx.doi.org/10.1061/(ASCE)07339437(1997)123:3(165)

Tavassoli A, Ghanbari A, Heydari M, Paygozar Y, Esmaeilian Y. 2010. Effect of treated wastewater with manure and chemical fertilizer different amounts on nutrients content and yield in corn. Journal of Wastewater Treatment and Analysis **75,** 1-8.

WHO. 2006. WHO guidelines for the safe use of wastewater, excreta and rainwater. Wastewater Use in Agriculture. World Health Organization **2,** 222.

Zhang M, Heaney D, Solberg E, Heriquez B. 2000. The effect of municipal solid waste compost on metal uptake and yield of wheat, barley and canola in less productive farming soils of Alberta. Compost Science and Utilization **8,** 224-35.
http://dx.doi.org/10.1080/1065657X.2000.10701995