International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 4, No. 5, p. 75-79, 2014

INNSPUB

RESEARCH PAPER OPEN ACCESS

Influence of irrigation with wastewater of a leaven factory on yield and quality of corn

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Article published on May 15, 2014

Key words: Corn, quality, wastewater, yield.

Abstract

In recent decades, 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 (Iran Mayeh Co.), where the effect of treated wastewater on grain yield and quality of corn (*Zea mays*) was evaluated 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, 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 factorial experiment on the bases of randomized complete block design with three replications. Results illustrated that number of irrigation with wastewater did not have significant effect on protein content, oil content of grains and leaf chlorophyll whereas it had significant effect on 1000-seeds weight, grain yield and harvest index. Also results showed that wastewater percentage did not have significant effect on mentioned traits. The maximum increase of grain yield was observed in irrigation with wastewater whole over growth season. Highest level of oil content was obtained from irrigation with wastewater once in whole experimental period × 60% wastewater treatment. Therefore, it seems that after assessing the effects on soil and environment, the wastewater of this leaven factory can be used in corn irrigation.

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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.

The objective of this study was assessed the impacts of leaven factory wastewater irrigation on grain yield and quality 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.

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%

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.

Oil and protein percentage were measured by "Zeltex Zx-5". Leaf chlorophyll was measured by "SPAD 502" chlorophyll-meter system in the end of flowering stage. Plants in four central rows at each plot were harvested to determine the grain yield in November 2012. All data were analyzed by MSTAT-C software.

Results

In this study it was revealed that the effect of wastewater percentage and interaction of number of irrigation with

wastewater and wastewater percentage was not significant on seed protein, seed oil, leaf chlorophyll content, grain yield and harvest index of corn (Table 3).

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%

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

S.O.V	df	Seed protein	Seed oil	chlorophyll	1000-seeds weight	Grain yield	Harvest index
Replication	2	0.891	8.912^{**}	89.526	2790.145^{*}	11618795.945^{**}	208.386^{**}
Number of irrigation with wastewater (A)	2	3.546^{ns}	0.272^{ns}	112.937^{ns}	4538.828^{**}	8019688.320^{**}	137.681^{**}
Wastewater percentage (B)	5	1.079^{ns}	3.318^{ns}	32.142^{ns}	648.035^{ns}	1106264.621^{ns}	37.110^{ns}
Number of irrigation × wastewater percentage (A×B)	10	1.175^{ns}	1.580^{ns}	57.528^{ns}	488.038^{ns}	1850007.558^{ns}	31.365^{ns}
Error	34	1.676	1.375	54.327	722.094	1286647.299	25.534
CV (%)		15.41	17.75	14.94	12.82	19.18	10.59

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

Results of this study depicted that the number of irrigation with wastewater had a significant effect on 1000-seeds weight, grain yield and harvest index of corn (Table 3). Among the number of irrigation with wastewater treatments, irrigation with wastewater in whole experimental period showed the highest 1000-seed weight and the lowest 1000-seed weight obtained from irrigation with wastewater once in whole experimental period (Fig. 3).

The grain yield of those treatments which used irrigation with wastewater in whole experimental period was higher than treatments which used irrigation with wastewater once in whole experimental period and irrigation with wastewater twice in whole experimental period (Fig. 4).

Among all numbers of irrigation with wastewater treatments, irrigation with wastewater in whole experimental period had the highest and irrigation with wastewater twice in whole experimental period had the lowest effect on harvest index of corn (Fig. 4).

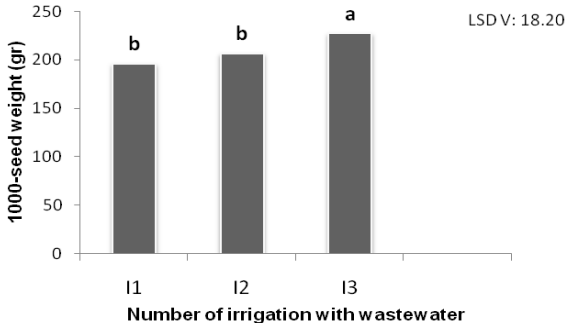

Fig. 1. Effect of number of irrigation with wastewater treatment on 1000-seed weight. Different letters expose significant difference at 5% probability

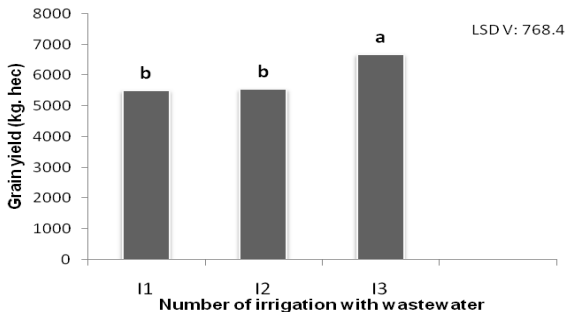

Fig. 2. Effect of number of irrigation with wastewater treatment on grain yield. Different letters expose significant difference at 5% probability

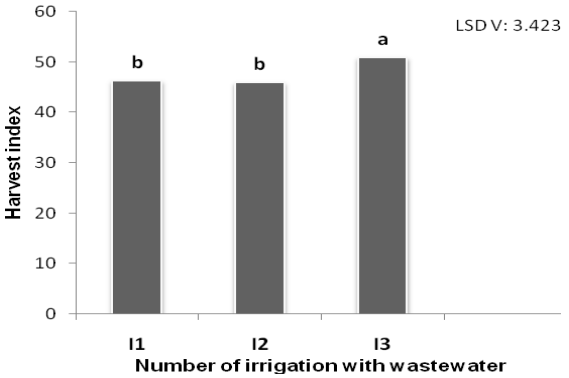

Fig. 3. Effect of number of irrigation with wastewater on harvest index. Different letters expose significant difference at 5% probability

Discussion

Drawing upon the findings of the current study, Esmailian *et al* (2011) reported that wastewater irrigation show a significant effect on grain yield of corn. Effects of treated sewage effluent irrigation on increase the protein content in ryegrasses, wheat and forage corn were observed (Day *et al*., 1974; Quin and Woods, 1978; Mohamad and Ayadi, 2004).

Mohamad and Ayadi (2004) reported that grain weight of corn was increased significantly by wastewater irrigation compared to pure water irrigation. Esmailian *et al.* (2011) demonstrated that wastewater irrigation and fertilizer treatments were very effective on the yield components. Among yield components, wastewater had the most influence on the 1000-grain weight and increased it 19.1% than well water.

Similar results were reported by Erfani *et al* (2001). Similar results were reported by Day *et al.* (1979) who observed that wheat irrigated with wastewater produced taller plants, more heads per unit area, heavier seeds, higher grain yield than did wheat grown with pump water alone. They attributed this increase to the nitrogen, phosphorous, potassium and another nutrient elements which added by wastewater to the soil. Esmailian *et al.* (2011) reported that the yield of those treatments which used treated wastewater was higher than treatments which used well water. Tavassoli *et al.* (2010) reported that irrigation with wastewater caused increasing the grain yield in corn.

Conclusion

The results in this experiment showed that irrigation with wastewater in whole experimental period significantly increased grain yield, 1000-seed weight and harvest index but it did not have significant effect on oil, protein and leaf chlorophyll content. Therefore, it seems that after assessing the effects on soil and environment, the wastewater of this leaven factory can be used in corn irrigation.

Refrences

Al-Rashed MF, **Sherif MM**. 2000. Water resources in the GCC countries: an overview. Water Research and Management **14**, 59-75.

Bradford A, **Brook R**, **Hunshal C**. 2003. Wastewater irrigation in Hubli-Dharvar, India. Environment and Urbanization **15**, 157-172.

Bouwer H, **Chaney RL**. 1974. Land treatment of wastewater. Advances in Agronomy **26**, 133-176.

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.

Huibers F, **Van Lier J**. 2005. Use of wastewater in agriculture: the water chain approach. Journal of irrigation and Drainage **54**, 3-9.

Kiziloglu FM, **Turanb M**, **Sahina U**, **Kuslua Y**, **Dursunc A**. 2008. Effects of untreated and treated wastewater irrigation on some chemical properties of cauliflower and red cabbage grown on calcareous soil in Turkey. Agriculture and Water Management **95**, 716-724.

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.

Mohamad MJ, **Ayadi M**. 2004. Forage yield and nutrient uptake as influenced by secondary treated wastewater. Journal of Plant Nutrition **27**, 351-365.

Najafi P. 2002. Assessment of optimum model of using treated wastewater in irrigation of some crops. Ph.D. Theses, Khorasgan Azad University, Isfahan, Iran, p. 304.

Quin BF, **Woods PH**. 1978. Surface irrigation of pasture with treated sewage effluent. I. Nutrient status of soil and pastures. New Zealand Journal of Agricultural Research **21**, 419-426.

Tanji KK. 1997. Irrigation with marginal quality waters: issues. Journal of Irrigation and Drainage Engineering **123**, 165-169.

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.