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Full Length Research Paper

Effect of irrigation with wastewater and foliar fertilizer application on some forage characteristics of foxtail millet (*Setaria italica*)

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In order to study effects of treated wastewater, with complete fertilizer sprayed on some forage quantitative and qualitative characteristics of foxtail millet (*Setaria italica*), A split plot experiment based on randomized complete block design (R.C.B design) with three replicates was carried out at the Agriculture Institute of Zabol University in south east Iran during 2009 growing season. Treatments included three levels of irrigation namely, irrigation with tap water at all stages of grows (control), irrigation with wastewater and tap water alternately, irrigation with wastewater for all growing stages, as the main plot and sprayed with three levels of complete fertilizer (NATBA-LIB): non-spraying (control), Sprayed with 600 g of complete fertilizer in each hectare, sprayed with 1200 g of complete fertilizer in each hectare, as were the subplots. According to the results, the irrigation with wastewater and complete fertilizer sprayed had a significant effect on yield and forage quality characteristics. Among the irrigation treatments, irrigation with wastewater for all growing stages cause increase of grain yield and forage quality characteristics such as soluble carbohydrate, crude protein, ash, dry matter digestibility and significant decrease in cell wall, cell wall without hemi cellulose and lignin percentage. Also the highest grain yield and dry matter digestibility were obtained from 1200 g of fertilizer sprayed in comparison with sprayed with 600 g of complete fertilizer and control treatments. Therefore, in order to achieve the desired quantitative and qualitative characteristics of forage millet, using the treated wastewater and complete fertilizer has recommended.

Key words: Irrigation, nitrogen, micronutrients, yields.

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; Mohammad and Mazahreh, 2003), and any sources of water which might be used economically and effectively should be considered to promote further development. Iran is among the Middle East countries, which will experience 20 to 25% drop in annual rainfall in the year of 2050 as compared to its 1961 to 1990 average annual rainfall (Abedi and Najafi, 2001). In addition, Iran is among the countries in which the per capita water consumption is beyond the international standards (Najafi, 2002). So, where the country is suffering severely from the shortage of consumptive water and critical problems of water resources exist, the problem is serious.

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

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

pH	EC(ds/m)	P(mg/kg)	K(mg/kg)	Ca(mg/kg)	Fe^{+2}(mg/kg)	Cu^{+2}(mg/kg)	Zn^{+2}(mg/kg)	Mn^{+2}(mg/kg)
7.1	2.68	0.09	86.86	0.19	0.003	0.11	0.04	0.07

Table 2. Chemical analysis of complete fertilizer.

N(w/w)%	P_2O_5(w/w)%	K(w/w)%	Fe (ppm)	Cu (ppm)	Mn (ppm)	Zn (ppm)	Mo (ppm)	B_2O_5 (ppm)
20	20	20	156	60	80	55	16	96

much or more than a combination of tap water and chemical fertilizer (Mohammad and Ayadi, 2005; 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; Raschid-Sally et al., 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 (Bouwer and Idelovitch, 1987; Al-Jaloud et al., 1995; Tanji, 1997), and (c) the use of wastewater as nutrient source (Bouwer and Chaney, 1974; Vazquez-Montiel et al., 1996) associated with mineral fertilizer savings and high crop yields (Smith and Peterson, 1982;

Erfani et al. (2001) showed that utilization of treated municipal wastewater has caused an increase in forage yield and whole plant dry matter as compared to irrigation with the well water. Rezvani and Baraki (2001) reported irrigation with wastewater caused significantly decrease in plant fiber percentage and increasing of crude protein percentage of millet. 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. Galavi et al. (2009) in research on sorghum showed irrigation with sewage caused increase of forage yield and reduced of cell wall and cell wall without hemi cellulose. However, wastewater has essential nutrient elements for plant function, but these concentration of nutrient aren't enough to plant production in this condition. Then plants need application another fertilizer such as chemical fertilizer as foliar application. In order to achieve crops yield potential supply their food needs is necessary through using of chemical fertilizer. Therefore, chemical fertilizers sprayed on to be investigated to achieve soil stability and prevention of environmental pollution.

Micronutrient uptake and transport to the edible parts of plants can be increased by fertilizer application to leaf. Foliar fertilization is one of the most effective and safest approaches to enrich essential micronutrients in crop grain. Leaf-applied substances can enter the leaf either by penetration of the cuticle or via the stomata pathway. Foliar application is increasingly used to alleviate micronutrient deficiencies, and presently most of the studies have been focused on uptake and distribution of single micronutrient in fruit tree, corn, and wheat (16 to 20) (Kaya and Higgs, 2002; Elmer et al., 2007; Haslett et al., 2001; Godsey et al., 2003). In other research Sharafi et al. (2002) concluded that consumption of micro elements; especially zinc was increased crude protein in corn grain and forage. Whitty and Chambliss (2005) reported that the consumption of micronutrients elements such as zinc, iron and manganese with the increase of stem height cause increased dry matter yield and forage in corn pay attention to lack of micro and macro elements in region soils and top level of millet cultivation.

The aim of this research is access to proper method for using of the combined wastewater and fertilizer sprayed on forage with high yield and good quality.

MATERIALS AND METHODS

This experiment was carried out during the 2009 growing season in the Agriculture Research Center of Zabol University in south east Iran. The site lies at longitude 61°29′ and latitude 31°2′ and the altitude of the area is 483 m above sea level. It has a warm dry climate with the mean minimum; mean maximum and average air temperatures of 18, 41 and 29°C, respectively. The soil profile, to a depth of 30 cm, consists of about 70% sand, 26% silt and 12% clay. The soil classified as a sandy loam texture and other physical and chemical characteristics of soil tests are in Table 1. Earth in the year before implementation has been under furrow. The experimental layout was that of a split plot design based on randomized complete block design with three replicates.

The treatment were comprised of three levels of irrigation water (tap water at all stages of grows (control), wastewater and tap water alternately, wastewater for all growing stages) in the main plot and sprayed with three levels of complete fertilizer (NATBA-LIB): non-spraying (control), Sprayed with 600 g of complete fertilizer in each hectare, sprayed with 1200 g of complete fertilizer in each hectare, as were the sub plots. The average values of physical and chemical characteristics of the complete fertilizer (NATBA-LIB) and, water and treated wastewater are reported in Tables 2 and 3, respectively. Each plot consisted of 6 rows of millet with a length of 7 m. The distance between rows was 30 cm with 10 cm spacing between the plants in a row and 333000 plants ha^{-1}.

Table 3. Chemical analysis of tap water and treated wastewater of experiment.

Parameter	Unit	Water	Wastewater
pH	-	7.1	7.8
EC	Ds/m	2.3	2.9
N	Meq/lit	-	22.92
P	Meq/lit	-	11.3
K	Meq/lit	6.5	24.98
Ca	Meq/lit	11.23	6.4
Mn	Meq/lit	0.03	0.06
Zn	Meq/lit	0.013	0.014
Fe	Meq/lit	0.014	0.012
BOD	Meq/lit	-	30
COD	Meq/lit	-	85

In this study, the total chemical fertilizers (N, P and K) were applied to the sowing seeds. After planting, irrigation was applied as required during the growing season. The first irrigation was immediately after planting and using of ordinary water in April 23. The first Irrigation with treated wastewater was applied after the millet establishment in May 11. The foliar application with complete fertilizer (NABTA-LIB) was performance in two stages: (a) in stage of stem elongation and stage of panicle emerge. The millet was harvested in two stages: (a) in stage of milk-dough seed for forage in July 27 and (b) in stage of ripening seeds for grain in August 11.

Data collected (obtained by combining the four center rows at each experiment unit) includes: dry forage yield, grain yield and grain to forage ratio (were measured after drying samples at 70°C for 48 h in an air oven) (Schurman and Goedewaagen, 1971; Veli et al., 1991). The forage quality characteristics such as NDF, ADF and ADL (were measured by Van-soest and Wine method in 1967), crude protein (was measured by Kjeldal method) and ash percentage (was determined by burning the plant tissues in temperature of 500 and 550°C in electrical kiln), (Wilson, 1983). WSC content was measured by spectrophotometer method (Deriaz, 1961).

The data were analyzed using MSTATC software; mean comparison was done using Duncan Multiple Comparison at 5% probability level.

RESULTS AND DISCUSSION

Dry forage yield

The effect of irrigation treatments and foliar application was significant on fresh and dry forage yield of millet ($p<0.01$), (Table 4). Mean comparison showed that the use of wastewater for all growing stages in comparison with tap water irrigation, result in the increase of dry forage yield. The highest amount of dry forage (12462 kg/ha) and the lowest amount (6962.5 kg/ha) was obtained from wastewater for all growing stages and control, respectively (Table 5). The increase of dry forage yield of millet could be related to the amount of enough nutritious elements (such as N, P and K) in wastewater.

Munir et al. (2007) in research on forage crops reported that irrigation with wastewater for two years was caused increasing of barley biomass. Alizadeh et al. (2001) reported that irrigation treatment with wastewater in all the growth stages cause the most biological yield of corn to be achieved. The foliar application with 600 gr of complete fertilizer in comparison to control foliar application induced 45.43% increase in the dry forage yield of millet (Table 5). The increase in the studied characters due to micronutrients may be attributed to its influences in enhancing the photosynthesis process and translocation of photosynthetic products to the seed as a result of increase enzymatic activity and other biological activities. Brennan (2001) reported that foliar application with micronutrient caused increasing of yield and dry forage yield in corn. Khalili Mahaleh and Roshdi (2008) to evaluate micronutrient sprayed on corn reported that foliar application with micronutrient elements (such as Fe, Zn and Mn) lead to significantly increase of dry forage yield.

The interaction effect of irrigation treatments and foliar application was significant on dry forage yield of millet. The mean comparison of interaction effects showed that the highest amount of dry forage yield obtained from wastewater for all growing stages and foliar application with 1200 g of complete fertilizer treatment, which was equal to 14150 kg/ha and the lowest amount of it, achieved from tap water and non foliar application treatment, which was equal to 5277 kg/ha (Table 6). Aziz (2010) reported that irrigation with wastewater and foliar application with Mn and Zn caused increasing the biological yield in millet.

Grain yield

Results of this study showed wastewater and foliar application had significantly effects on grain yield ($p<0.01$), (Table 4). According to means comparing recognized that the use of wastewater for all growing stages and wastewater and tap water as alternately in

Table 4. Analysis of variance for yield and some qualitative characteristics of millet forage.

S.O.V	df	Dry forage yield (kg/ha)	Grain yield (kg/ha)	Grain/forage	NDF(%)	ADF(%)	ADL(%)
				Mean square			
Replication	2	22478.6	3726.2	0.00003	1.30	2.51	0.1743
Irrigation	2	62116238.3**	103814.3**	0.00281**	41.62**	33.37*	37.65**
Error a	4	9444.7	1080.3	0.00003	0.4217	4.59	0.0947
Foliar application	2	27389120.5**	33339.9**	0.00191**	24.05**	16.56*	18.22**
Interaction	4	53986.7*	798.9ns	0.00007ns	0.8214ns	3.92ns	1.62ns
Error b	12	11316	363.8	0.00002	1.82	2.88	0.7329
CV	-	1.11	1.79	4.58	2.59	6.23	5.21

*, ** Significantly different at the 5 and 1% levels of probability, respectively; n.s non significant . df = Degree of freedom.

Table 5. Mean comparison for yield and some qualitative characteristics of millet forage.

Treatment	Dry forage yield (kg/ha)	Grain yield (kg/ha)	Grain/forage	NDF (%)	ADF (%)	ADL (%)
Irrigation						
Tap water	6962.50c	941.13c	0.1332a	54.31a	28.97a	18.69a
Wastewater + Tap water	9032.78b	1063.00b	0.1198b	51.60b	26.18b	15.88b
Wastewater	12462.44a	1176.89a	0.0995c	50.06c	25.28b	14.71c
Foliar application						
Non foliar application	7656.78c	995.66c	0.1314a	53.75a	28.37a	17.92a
600 g of complete fertilizer	9962.30b	1086.87b	0.1123b	51.70b	26.15b	16.26b
1200 g of complete fertilizer	11135.67a	1114.66a	0.1026c	50.52b	25.91b	15.09c

Mean followed by similar letters in each column, are not significantly different at the 5% level of probability level using Duncan's multiple range test.

comparison with tap water irrigation, result in the increase of grain yield (25.05 and 10.71%, respectively), (Table 5). Similar result reported by Tavassoli et al. (2010) that showed irrigation with wastewater caused increasing the grain yield in corn. The effects of foliar application treatments were significant on grain yield. Among the foliar application treatments, foliar application with 1200 g of complete fertilizer showed the highest amount of grain yield (1176.89 kg/ha) and the lowest amount (941.13 kg/ha) obtained from control treatment (Table 5). Paygozar et al. (2009) reported that foliar application with micronutrient lead to significant increase in grain yield of millet.

The interaction effect of irrigation and foliar application treatments was significant on grain yield of millet. The mean comparison of interaction effects showed that the highest amount of grain yield (1236 kg/ha) obtained from wastewater for all growing stages and foliar application with 1200 g of complete fertilizer treatment and the lowest of its amount (846.7 kg/ha) was achieved from tap water and non foliar application treatment (Table 6).

Grain to forage ratio

The wastewater and foliar application treatments had a significant increase of grain to forage ratio in millet. Compared to control irrigation, wastewater for all growing season and, wastewater and tap water as alternately showed a significant decrease in grain to forge ratio. The highest grain to forage ratio (0.133) was achieved from control irrigation treatment and the lowest grain to forage ratio (0.095) obtained from wastewater treatment for all growing season (Table 5). Also, the foliar application caused decreasing in grain to forage ratio. So that compared to the control treatment, the foliar application with 1200 g of complete fertilizer induced 21.92% decrease in the grain to forage ratio of millet and the foliar application with 600 g of complete fertilizer reduced its equal to 14.54% (Table 5).

The interaction effect of wastewater irrigation and foliar application treatments was reducing on grain to forage ratio of millet. The mean comparison of interaction effects showed that the highest amount of grain to forage ratio

Table 6. Interaction between wastewater irrigation and foliar application on yield and some qualitative characteristics of millet forage.

Treatment		Dry forage yield (kg/ha)	Grain yield (kg/ha)	Grain/ forage	NDF (%)	ADF (%)	ADL (%)
Tap water	Non foliar application	5277h	864.71f	0.1629a	56.14a	31.37a	20.68a
	Foliar application with 600 g of complete fertilizer	7234g	955.32e	0.1321b	54.35ab	26.84bc	18.36b
	Foliar application with 1200 g of complete fertilizer	8459f	983.73e	0.1163c	52.44bcd	28.72ab	17.05bc
Wastewater + Tap water	Non foliar application	7151g	979.32e	0.1370b	53.45bc	27.45bc	17.84b
	Foliar application with 600 g of complete fertilizer	9154e	1085d	0.1186c	51.49cde	26.45bc	15.64cd
	Foliar application with 1200 g of complete fertilizer	10790c	1124c	0.1924b	49.87de	24.65c	14.17d
Wastewater	Non foliar application	10540d	1111cd	0.1054d	51.66cde	26.30bc	15.27d
	Foliar application with 600 g of complete fertilizer	12580b	1184b	0.0941e	49.28e	25.19c	14.81d
	Foliar application with 1200 g of complete fertilizer	14150a	1236a	0.0873e	49.25e	24.36c	14.07d

Mean followed by similar letters in each column, are not significantly different at the 5% level of probability level using Duncan's multiple range test.

(0.1629) obtained from tap water and non foliar application treatment, and the lowest of it's amount (0.0873) achieved from wastewater treatment for all growing stage and foliar application with 1200 gr of complete fertilizer (Table 6).

Neutral detergent fiber (NDF)

The result showed that irrigation with wastewater and foliar application treatment had a significant effect on NDF percentage of millet forage ($p<0.01$), (Table 4). According to the means comparison, the highest NDF percentage (54.31%) was achieved from control irrigation treatment and the lowest of its percentage (50.06%) obtained from wastewater treatment for all growing stage. Also the wastewater and tap water as alternately treatment induced 3.71% decrease of the NDF percentage (Table 5). They attributed this decrease to the nitrogen, phosphorus and potassium and other nutrient elements related to wastewater that they causes increasing of stem length and vegetative growth, and subsequently this points lead to decrease in crud fiber percentage of millet.

In this field, the similar results have reported by some researchers (Rezvani and Baraki, 2001; Smith et al., 2002). The effect of foliar application treatments was significant on NDF percentage of forage millet. The foliar application with 600 and 1200 g of complete fertilizer caused 2.05 and 3.23% decrease of the NDF percentage of forage millet. The micro and macro nutrient related to complete fertilizer with increasing of leaf area expansion and leaf to stem ratio causes decrease of NDF percentage of millet forage (Table 5). Parhamfar (2006) reported that macro and micro nutrient applied in soil lead to increase of stem length and subsequently decrease of NDF percentage.

The interaction effect of wastewater and foliar application treatments was significant on NDF parentage. So that the highest of NDF percentage (56.14%) obtained

Table 7. Analysis of variance for some qualitative characteristics of millet forage.

S.O.V	df	Ash	WSC	CP	DMD
			Mean square		
Replication	2	0.0961	0.6818	0.7483	0.3491491
Irrigation	2	27.6185**	42.51**	10.90**	66.01**
Error a	4	0.0759	0.1596	0.5897	1.33
Foliar application	2	8.0971**	7.816**	15.38**	31.44**
	4	0.1390 ^{ns}	0.4984 ^{ns}	0.4509 ^{ns}	0.4071 ^{ns}
Error b	12	0.1600	0.8404	0.7551	0.6558
CV	-	3.83	4.37	7.69	1.32

*, ** Significantly different at the 5 and 1% levels of probability, respectively; n.s non significant . df = Degree of freedom.

from tap water and non foliar application, and the lowest of its percentage (49.25%) achieved from wastewater for all growing stage and foliar application with 1200 g of complete fertilizer (Table 6).

Acid detergent fiber (ADF)

The irrigation and foliar application treatments had significant effects on ADF percentage of forage millet ($p<0.05$), (Table 4). Compared to control treatment, irrigation with wastewater for all growing stage and, wastewater and tap water alternately treatments induced 14.59 and 10.65% decrease of ADF percentage of forage millet (Table 4). The similar results in this field havereported by many researchers (Taha et al., 2002; Galavi et al., 2009)

Also the foliar application treatments had significant effect on ADF percentage. So that, the highest ADF percentage (28.37%) achieved from non foliar application and the lowest of its percentage (25.91%) obtained from foliar application with 1200 g of complete fertilizer (Table 4).

The interaction of irrigation and foliar application treatments had significant effect on ADF percentage of forage millet. The highest of ADF percentage (31.37%) obtained from tap water and non foliar application, and the lowest of its percentage (24.36%) achieved from wastewater for all rowing stage and foliar application with 1200 g of complete fertilizer (Table 5).

Acid detergent lignin (ADL)

The effect of wastewater irrigation and foliar application treatments on the ADL was significant ($p<0.01$), (Table 4). The highest of ADL percentage (11.69%) obtained from control irrigation treatment and the lowest of its percentage (14.71%) achieved from wastewater for all growing season treatment. The wastewater and tap water as alternately treatment with 15.88% ADL had a significant difference with wastewater for all growing season and control treatments (Table 5). Rezvani Moghdam (2001) reported that irrigation with wastewater caused decreasing of ADL percentage in millet. Also the foliar application had significant effect on ADL percentage of forage millet. Compared to the control treatment, foliar application with 600 and 1200 g of complete fertilizer induced 10.20% and 18.75 decrease of ADL percentage, respectively (Table 5). Tas (2005) reported that consumption of nitrogen fertilizer caused decrease of ADL percentage in ryegrass.

The interaction effects of irrigation and foliar application treatments were significant on the ADL percentage. The highest ADL percentage (20.68%) achieved from tap water and non foliar application treatment and the lowest of its percentage (14.07%) obtained from wastewater for all growing season and foliar application with 1200 g of complete fertilizer (Table 6). The decrease of crude fiber percentage (such as NDF, ADF and ADL) of millet forage could be related to suitable amount of nitrogen element in wastewater and complete fertilizer that caused decrease C/N ratio.

ASH, crud protein (CP) and water soluble carbohydrate (WSC)

The result of statistical analysis showed that irrigation and foliar application had significant effect on ASH, CP and WSC percentage of millet forage ($p<0.01$), (Table 7). According to means comparing recognized that the highest ASH (12.04%), CP (12.54%) and WSC (23.13%) percentage were achieved from wastewater treatment for all growing stage and their lowest percentage obtained from tap water irrigation (Table 8). The increase of ASH, CP and WSC percentage of millet forage could be related to suitable amount of elements (such as nitrogen, phosphor, potassium and etc), in wastewater and complete fertilizer. Ghanbari et al. (2006) reported that irrigation with wastewater in comparison to well water caused increasing of CP percentage in wheat.

Table 8. Mean comparison for some qualitative characteristics of millet forage.

Treatment		ASH (%)	WSC (%)	CP (%)	DMD (%)
Tap water	Non foliar application	7.37d	17.33j	8.90d	56.09f
	Foliar application with 600 g of complete fertilizer	9.14b	19.65ef	10.85bc	59.29e
	Foliar application with 1200 g of complete fertilizer	9.17c	19.37f	11.65b	60.31e
Wastewater + Tap water	Non foliar application	9.39c	19.88def	9.84d	59.23e
	Foliar application with 600 g of complete fertilizer	11.25b	21.28cde	10.75c	61.27d
	Foliar application with 1200 g of complete fertilizer	11.31b	21.56bcd	11.97b	62.83b
Wastewater	Non foliar application	11.22b	22.53abc	11.23b	62.15bc
	Foliar application with 600 g of complete fertilizer	12.30a	23.26ab	12.19b	64.51a
	Foliar application with 1200 g of complete fertilizer	12.62a	23.61a	14.20a	65.28a

Mean followed by similar letters in each column, are not significantly different at the 5% level of probability level using Duncan's multiple range test.

Galavi et al., (2009) evaluated the effects of treated wastewater on sorghum and it showed that irrigation with wastewater caused increase of WSC percentage. Adjei and Jack (2002) reported that increasing of CP percentage with using of wastewater could be related to available or total nitrogen in wastewater. Alizadeh et al. (2001) showed that, the irrigation with wastewater in all of growth stages leads to increase of nitrogen and other macro elements content in corn. Also, the effect of foliar application treatments was significant on ASH, CP and WSC percentage. Compared to the control treatment (non foliar application), foliar application with 1200 g of complete fertilizer induced 19.63, 26.12 and 8.03% on ASH, CP and WSC percentage, respectively (Table 8).

Khalili Mahaleh and Roshdi (2008) reported that foliar application with micronutrient caused increase of ASH and CP percentage in corn. The interaction effect of wastewater and foliar application treatment was significant on ASH, CP and WSC percentage of millet forage. The highest ASH (12.62%), CP (14.20%) and WSC (23.61%) percentage were obtained from wastewater for all growing season and foliar application with 1200 g of complete fertilizer and their lowest percentage achieved from tap water and non foliar application (Table 9).

Dry matter digestibility (DMD)

The wastewater irrigation and foliar application treatment had significant effect on DMD of millet forage ($p<0.01$), (Table 7). The wastewater irrigation treatments caused increasing of DMD in millet. The highest amount of DMD (63.97%) achieved in wastewater treatment for all growing season and the lowest of its (58.56%) obtained from control treatment. The wastewater and tap water as alternately treatment with 61.11% was between wastewater treatment for all growing stage and control (Table 8). The foliar application treatment was caused increase of DMD amount. Compared to control treatment, the foliar application with 600 and 1200 g of complete fertilizer induced 5.07 and 4.29% on DMD amount, respectively.

Wilman and Rezvani (1998) after evaluating nine plant species reported that the cell wall is very important in DMD determination (Table 8). Furthermore stem percentage, leaf number; tiller number and cell wall percentage has effect on DMD amount (Buxton, 1996; Wilson, 1994). So the wastewater and foliar application treatments with decreasing of cell wall percentage caused increasing of DMD amount. The interaction effect of wastewater irrigation and foliar application treatments were significant on DMD amount. The highest amount of DMD was achieved from wastewater for all growing stage and foliar application with 1200 g of complete fertilizer and the lowest of its amount obtained from tap water and non foliar application (Table 9).

Conclusion

The results in this experiment showed that irrigation with wastewater treatments significantly increase the dry forage and grain yield, ash percentage, CP content, WSC and DMD amounts in millet forage. This increase could be related to the amount of enough nutritious elements in

Table 9. Interaction between wastewater irrigation and foliar application on some qualitative characteristics of millet forage.

Treatment	ASH (%)	WSC (%)	CP (%)	DMD (%)
Irrigation				
Tap water	8.56c	18.78c	10.47b	58.56c
Wastewater + Tap water	10.65b	20.90b	10.83b	61.11b
wastewater	12.04a	23.13a	12.54a	63.97a
Foliar application				
Non foliar application	9.22c	19.91b	9.99c	59.15c
600 g of complete fertilizer	10.89b	21.39b	11.26b	61.69b
1200 g of complete fertilizer	11.03a	21.51a	12.60a	59.15a

Mean followed by similar letters in each column, are not significantly different at the 5% level of probability level using Duncan's multiple range test.

wastewater (such as N, P and K). But wastewater treatments lead to decrease of grain to forage ratio, NDF, ADF and ADL percentage in millet forage. The decrease of crude fiber percentage (such as NDF, ADF and ADL) of millet forage could be related to suitable amount of nitrogen element in wastewater and complete fertilizer.

The foliar application treatments had significant effect on all of factors. Among the foliar application treatments the highest dry forage yield, grain yield and the most ash percentage, CP content, WSC and DMD amount and the lowest of NDF, ADF and ADL percentage obtained from foliar application with 1200 g of complete fertilizer. In general, it can be concluded that integrated application of wastewater and complete fertilizer as foliar application lead to increasing of quantitative and qualitative characteristics in millet forage.

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