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Effect of water quality and weeding on yield and quality of three Alfalfa (*Medicago sativa* L.) cultivars

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Abstract

A field experiment was carried out during 2005/06 and 2006/07 seasons at the Experimental Farm of the Faculty of Agriculture, University of Khartoum, Shambat, Sudan, to study the effect of water quality and weeding on the yield and quality of three alfalfa (*Medicago sativa* L.) cultivars. The three cultivars were Hegazi, a local cultivar, and two exotic cultivars (Cuf101 and Siriver). They were subjected to three water treatments (bore hole water, river water with screen mesh at the entrance of plots and river water without screen mesh) and three levels of weeding (monthly weeding, every two months and every three months). The treatments were assigned in a split-split plot design (watering as the main plots, weeding as the subplots and cultivars as the sub-subplots), replicated four times. The parameters studied were fresh and dry yields, crude protein and crude fiber content and number of weeds per unit area. The two introduced cultivars, Siriver and Cuf 101, were significantly better than the local cultivar, Hegazi, in forage fresh and dry yields and crude protein content. The local cultivar Hegazi gave a higher crude fiber content. Irrigation water treatments were not significantly different in crude protein and fiber contents. However, the river water with screen mesh treatment was significantly superior in forage fresh and dry yields and number of weeds per unit area than other water treatments, indicating the importance of this technique in boosting productivity of alfalfa along the River Nile. In all parameters, the river water without screen mesh treatment recorded the lowest estimates of the parameters measured. Monthly weeding gave a significant decrease in number of weeds per unit area than the other weeding treatments.

Keywords: alfalfa cultivars; forage yield; forage quality; water quality; weed competition

Introduction

The estimated number of livestock in Sudan is 165 millions heads, which is equivalent to about 86 million animal units (AOAD, 2001). The feed balance for livestock is negative because of desertification and degradation of range vegetation. The current gap in livestock feed was estimated at 104.4 million tons, which represent almost 50% of the total requirement of livestock feed (Abusuwar and Darag, 2002). To cope with the increase in animal resources and the shortage in forage produced in natural rangelands, expansion and improvement of irrigated forages become a necessity. Alfalfa (*Medicago sative* L.) is the most important forage crop grown in the Sudan. The total area cultivated by the crop is about 52,500 ha, the annual production is estimated at 1,002,500 tons green forage and the crop contributes about 94% of the total irrigated forages in the country (Abusuwar, 2004). The crop is exclusively grown under irrigation, particularly along the Nile from Khartoum State northwards. It is left to grow for 2 – 4 years giving a cut every three weeks on average. At the end of the third to fourth year, the crop may be left to produce seeds during the hot dry period, from March to May (Nayel and Khidir, 1995). The most serious problem in alfalfa production in the Sudan is the sharp decrease in forage yield during the *Damira* season (the period when River Nile floods). This may continue for 3-4 months, and is accompanied by severe weed infestation. High weed infestation, especially during *Damira* time, is thought to be due to the fact that river water transports weed seeds to fields through irrigation. Use of selective herbicides to control weeds is beyond the financial capacity of farmers, as they are expensive they can not afford it. Consequently looking into an alternative to control weeds becomes a necessity. Moreover, the dependence on one local variety (Hegazi) without improvement or introducing exotic cultivars is part of the feed gap problem. The Hegazi cultivar has been grown in the Sudan for more than 90 years (Agabawi, 1968) without any serious efforts to improve it. During the eighties some of the exotic cultivars brought from the USA and Australia were tried with promising results (Abusuwar, 2004).

Despite the fact that the River Nile provides the major portion of water needed for irrigation, yet bore holes are an important source of irrigation water for the high terraces land away from the Nile. The problem with the bore hole water is that, in most of the times, it contains salts that create secondary salinization resulting from continuous pumping of this water. The main objective of this study was, therefore, to investigate the effect of cultivar, water quality and weeding on yield and quality of three alfalfa cultivars with the aim of boosting forage production and quality and bridging the feed gap in the area.

Materials and methods

A field experiment was carried out during 2005/06 and 2006/07 seasons at the Experimental Farm of the Faculty of Agriculture, University of Khartoum-Shambat, (latitude 15°40′N, longitude 32°32′E and 380 meters above sea level) to study the effect of water quality and weeding on yield and quality of three alfalfa (*Medicago sativa* L.) cultivars.

The soil is cracking clay, moderately alkaline (pH 7.8 – 8.5) and the climate is semi-arid with a mean annual rainfall of 67.8 mm (Sudan Meteorological Department, 2006). The experiment site was disc ploughed, disc harrowed to crush clods and leveled out to maintain a well leveled seedbed, then ridged up 70 cm apart. Individual plot size was 4 × 4 m with five ridges. The treatments consisted of three alfalfa cultivars: Hegazi (C_1), which is commercially grown in Sudan and two introduced cultivars, Cuf101 (C_2) and Siriver (C_3). Cuf 101 and Siriver were introduced from USA and Australia, respectively. The water treatments were bore hole water (I_1), river water with screen mesh (diameter 0.5mm) at the entrances of plots (I_2) and river water without screen mesh (I_3). The three levels of weeding were monthly weeding (W_1), weeding every two months (W_2) and every three months (W_3) as the control. The treatments were arranged in a split-split plot design with four replicates. The water treatments were assigned to the main plots, whereas the weeding levels and cultivars were allocated to the subplots and the sub-subplots, respectively. The crop was sown on the third week of November, after inoculating the seeds with *Rhizobium melilotti*, by drilling on the side of the ridge at a rate of 47.6 kg\ ha. The first irrigation was given immediately after sowing, then the crop was watered at a rate of 833 to 952 cubic meters/ha every 12 – 14 days depending on weather conditions. Two hand weeding were carried out for the entire experiment, one month from sowing and after the first cut, thereafter weeding treatments were imposed. The following parameters were measured:-

Fresh yield

For each treatment, the whole plot was cut when 10% of plants were flowering and the fresh weight of the plants per plot was determined, and the fresh yield per hectare was calculated. Eighteen harvests were obtained during the course of the study.

Dry yield

Plants within an area of 0.7 m^2 from the middle ridge of each plot were cut, oven dried at 85 °C until a constant weight was reached, and forage dry yield per hectare was calculated.

Proximate analysis

Crude protein and crude fiber were determined according to the method described by AOAC (1984). Two samples, each weighing 0.2 g, were taken from each plot to estimate crude protein and crude fiber. The Arc-sine transformation was performed to the data before statistical analysis.

Number of weeds per unit area

Number and types of weeds, in an area of one square meter, in each plot were determined each time at harvest, and the number of weeds per unit area was estimated.

Irrigation water analysis

Ten samples were randomly taken from river water and the bore hole water, in each season, to determine salinity, number of weed seeds and the dominant salts and weeds.

Salinity of irrigation water and the amounts of salts were measured by an electrical conductivity meter following the procedure adopted by Nachtergaele (1976). For weed seeds determination in the irrigation water, the same screen mesh used in the experiment (diameter 0.5mm) was used to screen and determine the number of weed seeds in the irrigation water.

Table 1. Effect of cultivar, water quality and weeding on fresh yield of alfalfa (t/ha)

Treatments	Cuts																		Mean
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	
C_1	8.2^{b}	9.1^{b}	8.7^{b}	7.6^{b}	8.2^{b}	6.3^{b}	6.0^{b}	4.2^{b}	3.8^{b}	2.9^{b}	3.2^{b}	6.8^{b}	7.9^{b}	8.6^{b}	7.2^{b}	6.7^{b}	5.9^{b}	5.0^{b}	6.46
C_2	12.9^{a}	15.1^{a}	15.6^{a}	11.7^{a}	12.2^{a}	9.8^{a}	7.6^{a}	7.2^{a}	6.9^{a}	4.9^{a}	6.7^{a}	12.5^{a}	14.7^{a}	13.9^{a}	11.8^{a}	10.6^{a}	8.3^{a}	7.2^{a}	10.53
C_3	14.2^{a}	16.2^{a}	15.6^{a}	12.8^{a}	13.7^{a}	10.8^{a}	8.5^{a}	7.8^{a}	6.0^{a}	5.8^{a}	8.9^{a}	14.0^{a}	16.2^{a}	15.7^{a}	13.6^{a}	11.5^{a}	9.8^{a}	8.7^{a}	11.66
Means of cuts	11.77	13.47	13.3	10.7	11.37	8.97	7.37	6.40	5.57	4.53	6.27	11.10	12.93	12.73	10.87	9.60	8.60	6.97	
LSD P=0.05	3.21	2.73	3.14	2.92	2.49	2.11	2.06	2.19	1.96	1.86	2.24	2.78	3.08	3.19	3.01	2.69	2.19	1.96	
I_1	11.9^{a}	12.3^{a}	10.^{a}	8.6^{a}	5.4^{b}	6.1^{ab}	5.8^{b}	4.3^{b}	5.9^{a}	4.8^{ab}	5.4^{a}	8.1^{a}	8.6^{a}	8.1^{a}	7.4^{a}	7.8^{a}	6.5^{a}	5.8^{a}	7.42
I_2	12.3^{a}	14.2^{a}	11.6^{a}	9.8^{a}	9.4^{a}	8.9^{a}	8.7^{a}	7.8^{a}	6.9^{a}	5.3^{a}	7.2^{a}	10.8^{a}	11.3^{a}	11.2^{a}	9.8^{a}	10.2^{a}	8.8^{a}	7.7^{a}	9.55
I_3	12.5^{a}	13.6^{a}	10.4^{a}	7.7^{a}	6.3^{b}	4.2^{b}	3.4^{c}	3.2^{b}	2.9^{b}	2.4^{b}	6.4^{a}	8.2^{a}	9.6^{a}	9.8^{a}	6.8^{a}	8.1^{a}	7.9^{a}	6.8^{a}	7.23
Means of cuts	12.23	13.37	20.93	8.70	7.03	6.40	5.97	5.10	5.23	4.17	6.33	9.03	9.83	9.70	8.00	8.70	7.73	6.77	
LSD P=0.05	3.21	2.96	2.64	2.99	2.16	2.82	2.12	2.52	2.64	2.64	2.67	3.16	2.96	3.28	3.36	3.54	2.95	2.69	
W_1	10.4^{a}	12.2^{a}	13.8^{a}	10.2^{a}	8.9^{a}	9.3^{a}	7.1a	5.3^{a}	4.6^{a}	4.7^{a}	7.2^{a}	10.4^{a}	11.6^{a}	10.6^{a}	8.7^{a}	7.9^{a}	8.4^{a}	6.4^{a}	8.77
W_2	12.2^{a}	14.3^{a}	15.1^{a}	7.3^{b}	6.9^{b}	5.2^{b}	4.2^{b}	2.9^{b}	2.2^{b}	2.3^{b}	3.1^{b}	4.5^{b}	6.1^{b}	5.8^{b}	4.1^{b}	3.9^{b}	4.2^{b}	3.6^{b}	5.99
W_3	10.1^{a}	15.6^{a}	14.8^{a}	6.8^{b}	4.2^{b}	4.1^{b}	3.6^{b}	2.6^{b}	2.0^{b}	2.1^{b}	2.5^{b}	4.2^{b}	4.8^{b}	4.2^{b}	3.8^{b}	4.0^{b}	3.8^{b}	3.2^{b}	5.36
Means of cuts	10.9	14.03	14.57	8.10	6.67	6.20	4.97	3.60	2.93	3.03	4.27	6.37	7.50	6.93	5.53	5.27	5.47	4.40	
LSD P=0.05	3.24	3.65	2.79	2.56	2.46	3.18	2.66	2.14	2.18	2.09	2.56	2.11	2.75	2.78	2.16	2.83	3.16	2.58	

C_1, C2 and C_3 = Hegazi, Cuf 101 and Sirver, respectively. I_1, I_2, I_3 = bore hole water, river water with screen mesh, and river water w/o screen mesh, respectively.

W_1, W_2, W_3= monthly weeding, weeding every two month, and weeding every three months, respectively.

* Means followed by the same letter(s) within a column or a row are not significantly different at 0.05 level of probability according to the Duncan's multiple range test

Data analysis

Data were subjected to analysis of variance as described by Gomez and Gomez (1984), and the Duncan's multiple range test was used for mean separation.

Results

Irrigation water analysis

Irrigation water analysis showed that bore hole water salinity was around 2000ppm with sodium chloride (NaCl) being the dominant salt, whereas the River Nile water was free of salts. On the other hand, the bore hole water was free of seed weeds, whereas the River Nile water contained on average 75 weed seeds per liter of water. Seeds of Lukh (Dicanthium annulatum) and Nal (Cymbopogon nervatus) were the dominant weeds in the River Nile water.

Forage production

Fresh yield

Fresh yield of alfalfa varied significantly among the studied cultivars at all harvests (Table 1). The introduced cultivars Siriver (C_3) and Cuf 101 (C_2) significantly out yielded the local Hegazi (C1) by 44% and 34.9%, respectively, in fresh yield throughout the different sampling dates. No significant differences were obtained between the introduced cultivars, though Siriver was relatively high yielder than Cuf 101. Water treatments had significant effects on fresh forage yield of alfalfa cultivars in 12 out of 18 sampling occasions. The river water with screen mesh (I_2) significantly out yielded bore hole water (I_1), but without screen mesh (I_3) it resulted in a highly significant decrease in fresh forage yield. The increase in fresh forage yield of the treatment (I_2) was 22.3 % and 24.3% compared to (I_1) and (I_3), respectively (Table 1).
Weeding caused a significant effect on fresh forage yield in 15 out of 18 occasions. The highest mean fresh forage yield resulted from monthly weeding (W_1), whereas weeding every two month (W_2) and every three month (W_3) showed a significant decrease in fresh forage yield (Table 1). The decrease in fresh forage yield of W_2 and W_3 was 31.7% and 38.9% compared to W_1, respectively.

Dry yield

There was a significant variation in dry yield of the studied alfalfa cultivars at all harvests (Table 2). The cultivars Siriver (C_3) and Cuf 101 (C_2) were similar and recorded significantly higher dry yields than the local cultivar (C_1). The increase in dry yield of (C_3) and (C_2) was 44.9 and 39.0% compared to (C_1), (Table 2). Irrigation treatments significantly affected dry yield in six out of 18 harvests (Table 2). The river water with screen mesh (I_2) recorded significantly high mean dry yield values, followed by bore hole water (I_1). However, river water without screen mesh (I_3) showed a considerable decrease in this parameter. The decrease in dry yield of I_3 was 35.1% and 6.7% compared to I_2 and I_1 , respectively (Table 2).
Weeding treatments significantly affected dry yield of alfalfa cultivars in 15 out of 18 sampling occasions (Table 2). The highest mean dry yield was given by the monthly weeding (W_1) followed by weeding every two month (W_2) and weeding every three month (W_3). Decrease in dry yield as a result of W_2 and W_3 application was 36% and 34.6% compared to W_1, (Table 2).

Nutritive value

Crude protein

Cultivars were significantly different in their crude protein content. Siriver and Cuf 101 were similar in crude protein contents but gave significantly higher value than Hegazi (Table 3).
Neither irrigation water, nor weeding treatments had an effect on crude protein content (Table 3).

Crude fiber

There were no significant differences among cultivars in their crude fiber content although a slight increase in crude fiber was obtained for the cultivar Hegazi (Table 3). Irrigation water and weeding treatments had no significant effect on crude fiber content (Table 3).

Number of weeds/unit area

The three cultivars were not significantly different in this parameter (Table 3). Water treatments showed a highly significant difference in number of weeds, where river water without screen mesh scored the highest number of weeds compared to the other treatments (Table 3). Weeding treatments resulted in a significant effect on number of weeds. Weeding every three month showed a significant increase in this character followed by weeding every two month, while monthly weeding recorded the lowest number of weeds (Table 3).

Discussion

The studied alfalfa cultivars were significantly different in their forage fresh and dry yields in all cuts. The introduced cultivars Siriver and Cuf 101, out yielded Hegazi in forage fresh and dry yields. This may be attributed to the increase they scored

Table 2. Effect of cultivar, water quality and weeding on dry yield of alfalfa (t/ha)

Treatment	Cuts																		Mean
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	
C_1	2.3^{b}	2.5^{b}	2.4^{b}	2.1^{b}	2.3^{b}	1.7^{b}	1.6^{b}	1.1^{b}	1.0^{b}	0.8^{b}	0.9^{b}	1.9^{b}	2.2^{b}	2.4^{b}	2.0^{b}	1.9^{b}	1.6^{b}	1.4^{b}	1.78
C_2	3.6^{a}	4.2^{a}	4.4^{a}	3.3^{a}	3.4^{a}	2.7^{a}	2.1^{a}	2.0a	2.0^{a}	1.4^{a}	1.9^{b}	2.9^{a}	4.1^{a}	3.8^{a}	3.4^{a}	2.9^{a}	2.4^{a}	2.1^{a}	2.92
C_3	3.9^{a}	4.5^{a}	4.5^{a}	3.1^{a}	3.7^{a}	3.0^{a}	2.5^{a}	2.2a	1.7^{a}	1.6^{a}	2.5^{a}	3.9^{a}	4.5^{a}	4.4^{a}	3.8^{a}	3.2^{a}	2.7^{a}	2.4^{a}	3.23
Means of cuts	3.27	3.73	3.77	2.83	3.13	2.47	2.07	1.77	1.57	1.27	1.77	1.90	3.60	3.53	3.07	2.67	2.23	1.97	
LSD P=0.05	1.24	0.82	1.26	0.86	0.83	0.69	0.48	0.51	0.46	0.48	0.45	0.61	0.69	0.86	o.65	0.49	0.58	0.66	
I_1	3.3^{a}	3.4^{a}	3.0^{a}	2.4^{a}	1.5^{b}	1.7^{b}	1.6^{b}	1.2^{b}	1.6^{a}	1.3^{a}	1.5^{b}	2.3^{b}	2.4^{b}	2.3^{a}	2.1^{b}	2.2^{a}	1.8^{a}	1.6^{a}	2.07
I_2	3.4^{a}	3.8^{a}	3.2^{a}	2.7^{a}	2.6^{a}	2.5^{a}	2.4^{a}	2.2^{a}	1.9^{a}	1.5^{a}	2.0^{a}	3.0^{a}	3.1^{a}	3.0^{a}	2.7^{a}	2.8^{a}	2.3^{a}	2.0^{a}	2.62
I_3	3.4^{a}	3.7^{a}	2.9^{a}	2.0^{b}	1.8^{b}	1.2^{b}	0.9^{c}	0.8^{b}	0.7^{b}	0.5^{b}	1.7^{b}	2.3^{b}	2.7^{b}	2.6^{a}	1.8^{b}	2.2^{a}	2.1^{a}	1.8^{a}	1.94
Means of cuts	3.37	3.63	3.03	2.37	1.97	1.80	1.63	1.40	1.40	1.10	1.73	2.53	2.73	2.63	2.20	2.40	2.07	1.80	
LSD P=0.05	0.62	0.46	0.64	0.62	0.54	0.64	0.55	0.58	0.61	0.58	0.49	0.60	0.61	0.68	0.54	0.72	0.64	0.72	
W_1	2.8^{a}	3.3^{a}	3.7^{a}	2.7^{a}	2.4^{a}	2.5^{a}	1.9^{a}	1.4^{a}	1.2^{a}	1.3^{a}	1.8^{a}	2.9^{a}	3.1^{a}	3.0^{a}	2.3^{a}	2.1^{a}	2.3^{a}	1.7^{a}	2.36
W_2	3.1^{a}	3.6^{a}	3.8^{a}	2.0^{ab}	1.8^{b}	1.4^{b}	1.1^{b}	2.7^{b}	0.5^{b}	0.5^{b}	0.8^{b}	1.2^{b}	1.5^{b}	1.4^{b}	1.0^{b}	0.8^{b}	1.1^{b}	0.8^{b}	1.51
W_3	2.7^{a}	3.7^{a}	3.7^{a}	1.8^{b}	1.0^{c}	0.8^{b}	0.9^{b}	0.6^{b}	0.4^{b}	0.7^{b}	1.0^{b}	1.1^{b}	1.2^{b}	0.9^{b}	0.8^{a}	0.9^{b}	1.0^{b}	0.8^{b}	1.33
Means of cuts	2.87	3.53	3.73	2.17	1.73	1.57	1.30	0.9	0.7	0.83	1.20	1.73	1.93	1.77	1.37	1.27	1.47	1.10	
LSD P=0.05	0.68	0.81	0.64	0.60	0.52	0.62	0.4	0.52	0.59	0.49	0.62	0.71	0.49	0.62	0.72	0.69	0.66	0.78	

C_1, C2 and C_3 = Hegazi, Cuf 101 and Sirver, respectively. I_1, I_2, I_3 = bore hole water, river water with screen mesh, and river water w/o screen mesh.

W_1, W_2, W_3= monthly weeding, weeding every two month, and weeding every three months.

* Means followed by the same letter(s) within a column or a row are not significantly different at 0.05 level of probability according to the Duncan's multiple range test

Table3. Effect of water quality and weeding on crude protein, crude fiber and number of weeds of alfalfa cultivars

Treatment	% Crude protein	% crude fiber	Number of weeds /ha
Bore hole water (I1)	25.20 a	21.53a	2469b
River water with mesh(I2)	24.71a	21.65a	2431b
River water w/o mesh (I3)	24.46a	21.48a	2512a
LSD P=0.05	4.12	2.84	4938
Hegazi (C1)	19.99b	22.90a	2459a
Cuf 101 (C2)	24.42a	20.72a	2480a
Siriver (C3)	26.96a	20.63a	2473a
LSD P=0.05	5.47	3.36	38.19
Monthly weeding (W1)	24.50a	21.84a	2308c
Weeding every two months (W2)	25.24a	21.55a	2511b
Weeding every three months (W3)	24.29a	21.49a	2594a
LSD P=0.05	4.18	3.15	58.27

* Means followed by the same letter(s) within a column are not significantly different at 0.05 level of probability according to the Duncan's multiple range test

in the growth parameters: plant density, plant height, leaf area index and leaf to stem ratio and nodulation-(data not included in this paper)-, which all contribute to the final yield. Khair (1992) reported that the yield of Hegazi and Pioneer cultivar was not significantly different. On the other hand, Ali *et al*. (1998); Mohamed (2000) and Fadul (2001) found Hegazi to be superior to the introduced Pioneer in fresh and dry yields. Moreover, Jung and Lamb (2006) and Humphries and Hughes (2006) reported differences in the morphology, development and yields of different alfalfa cultivars. It is reasonable to expect that the performance of the exotic cultivars be better than the local ones as they are improved through breeding and selection. Application of water treatments resulted in a significant effect on fresh and dry yields of alfalfa cultivars. The screened river water gave significantly higher yield than the bore hole water, whereas without screening it caused a significant decrease in yield. The screen mesh might have prevented weed seeds from getting into the plots; therefore, less competition by weeds was encountered. Many researchers (Abusuwar, 2004; Michael *et. al*, 2002; El Sheikh *et.al*, 2006) reported that weed competition is detrimental to alfalfa productivity and longevity.

Reduction in yield as a result of bore hole water application may be attributed to the fact that alfalfa yield is reduced in saline conditions (Abusuwar, 2004). Bore hole water, unlike river water, had a salinity of 2000 ppm, with NaCl being the dominant salt and continuous irrigation by bore hole water may create secondary salinization that will harm the plants. On the other hand, a significant decline in yield was noticed when river water without screening was applied. This reduction was more pronounced during autumn months and late summer where *Damira* (flood) water brought considerable amount of weed seeds, which severely infested the crop. Results of water analysis showed that *Damira* water contained 75 seeds of weeds per liter of *Damira* water compared to none in the bore hole water.

Weeding treatments significantly affected fresh and dry yields of alfalfa cultivars. Monthly weeding scored significantly higher yield than weeding every two and three months. Reduction in yield due to application of the latter two treatments may be attributed to the fact that alfalfa has a poor competitive ability with weeds Lukh (*Dicanthium annulatum*) and Nal (*Cymbopogon nervatus*) present in the field, which may have threaten crop persistence. Similar results were reported by many authors (Chapko *et al*., 1991; Hall *et al*., 1995; Beck *et al.,* 1999; Doll, 2000 and Abusuwar, 2004). The cultivars under study were significantly different in their crude protein and crude fiber contents. The introduced cultivars recorded higher crude protein and lower crude fiber contents than the local cultivar. Many authors stated that alfalfa cultivars differ in their quality (McQueen and Belanger, 1994; Marvin *et al.,* 2000 and Humphries and Hughes, 2006). Water treatments showed highly significant differences in number of weeds per unit area. The river water without screening scored the highest estimates in number of weeds during *Damira* months. This is probably caused by weeds resulting from weed seeds brought by the river water. The weeds grown during and after this period, and were not present before, included: *Ambrosia martima* and *Eclipta alba* (family: Asteraceae), some *Cyperus* species, *Dicanthium annulatum, Cymbopogon nervatus* and *Phragnites ustratus* (family: Poaceae), *Polygonum glabrum* (family: Polygonacea), *Tamarix nilotica* (family: Tamaricaceae) and *Amaranthus spinosus* (family: Amaranthaceae). Weeding every two and three months recorded higher number of weeds compared to monthly weeding and this was expected according to weeding intervals.

Conclusion

Use of screen mesh (0.5mm diameter) at plot entrances seemed to be an effective tool to exclude weed seeds carried by flood (*Damira*) irrigation water to alfalfa fields. However frequent cleaning of the mesh may be needed to prevent clogging of mesh and allow free entry of water. Moreover, introduction of high yielding cultivars, like Cuf 101 and Siriver, may enhance productivity and improved forage quality to bridge the feed gab in the Sudan and similar areas along the Nile.

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