Evaluating Yield and Quality of Three Alfalfa Cultivars Using Laboratory and Saline Affected Soil

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Abstract: Salinity is a main limiting factor to grow alfalfa (*Medicago sativa* L.) in Sahl El-Tina region (North Sinai) of Egypt. Objectives of this study were to evaluate the response of three alfalfa cultivars to salinity using field experiments and laboratory. The laboratory experiment include evaluation of seed germination under increasing levels of salt concentration (EC's = 8, 12 and 15 dSm^{-1})). Significant laboratory differences were found between cultivars. Seed content of proline % and potassium were increased with increasing levels of salinity. The forage production and quality were evaluated in the field experiment under saline soil conditions with significant differences between cultivar yields Canonical Correspondence. Siwa cultivar was more tolerant to salinity stress in North Sinai conditions.

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1- Introduction

Alfalfa (*Medicago sativa* L.) is one of the most important forage crops grown over a wide range of sod and climatic conditions. It is able to produce high yields without nitrogen fertilization. Alfalfa is worldwide forage that originated from Iran, Turkey, and Turkmenistan Caucasus (Falahati-Anbaran *et al.* 2007). It has the highest yield potential and one of the highest feeding values of all adapted perennial forage legumes with high level of digestible protein, which makes it an extremely valuable feed. Thus, it can be used successfully in many types of livestock feeding programs as pasture, hay, silage, green chop and as a cash crop. Alfalfa is the most important forage crop for the arid and semi-arid areas. Alfalfa germplasm is tolerant to salinity stress and more adapted to warm in desert regions (Rnmbaugh and Pendery, 1990). According to alfalfa biological, ecological characteristics and salt tolerances, these species were the first selected plants for resuming vegetation in derivative ecosystem. However, most alfalfa seeds could germinate well in middle or low saline soils. In high-level saline soil, alfalfa has difficulties to complete its whole growth life cycle because of serious stress condition. Low germination, non-uniform emergence, unsure seedling emergence and low seeding set usually occur during alfalfa sowing and maturation. These problems could restrict planting area of alfalfa to a certain extent. Improving the ability of salt tolerance will be beneficial to use abundant saline-alkaline soil resource and to develop alfalfa production energetically (Yang *et al.* 2001).

Germination is a critical stage affecting plant population density. Salinity has a profound effect on germination and can be a threat to economic crop production especially in arid and semi-arid regions of the world (Kayani *et al.* 1990). Salinity affects germination of seeds by creating an external osmotic potential that prevents water uptake or due to the toxic effects of sodium and chloride ions on the germinating seed (Khajeh-hossini and Powell, 2003) affecting the uniformity of plant density with negative effect on yield (Gamze *et al.* 2005). Crop yield markedly decreases with increasing salinity, but the threshold concentration and rate of yield decrease depend on species. Distinct inter specific differences within a species exist for salinity tolerance such that ecotypes that are tolerant to much higher salt concentrations than normal populations can be selected (Hester *et al.* 2001). Germination and seedling growth are reduced in saline soils with varying responses for species and cultivars (Hampson and Simpson, 1990). However, crop establishment depends on an interaction between seedbed environment and seed quality (Khajeh-hossini and Powell, 2003). Several investigations on seed germination under salinity stress indicated that seeds of most species achieve their maximum germination in distilled water and are very sensitive to elevate salinity at the germination and seedling phases of development (Ghoulam and Fares, 2001; Keiffer and Ungar, 1997 and Ungar, 1996). Proline accumulation is a common metabolic response of higher plants to salinity or water stress (Mattana *et al*. 2005). Proline is accumulated by leaves of many higher plant species grown in saline environment (Summart *et al.* 2010). Abd El-Naby *et al.* (2013) evaluated three local populations for forage yield in saline soils of

North Sinai under three starting levels of salinity and selected plants with superior performance when exposed to such stress. Seeds were blend to contain a new salt tolerant population.

Objectives of this study were to: 1) screen three alfalfa cultivars for salt tolerance during germination, 2) compare seed components of three parent cultivars under non-saline and saline field conditions. and 3) evaluate fresh, dry forage matter potentials and quality component of selected plants across different growing seasons.

2. Materials and Methods

Laboratory studies

The experiments were carried out during October 2012 at the seed technology laboratory – Giza. Seeds were germinated in sterilized cover plastic disposable Petri dishes containing Whitman No.2 filter paper moistened with either distilled water (control) or 8,12,15 dSm^{-1} of sodium chloride (Na Cl) solution. Three replications of 50 seeds each were used for each treatment. Seeds were incubated at 20°C and germination percentages were calculated according to the International Seed Testing Association **I.S.T.A. (1993)**. Normal seedlings were counted and expressed as the germination percentage at the final count after 14 days. Ten normal seedlings from each dish were taken to measure shoot and radical length (cm), fresh and dry weight. Germination index was calculated based on the formula:

$$\text{Germination index} = \frac{\text{No. of emerged seeds}}{\text{Days of first count}} + \frac{\text{No. of emerged seeds}}{\text{Days of final count}}$$

Electrical conductivity test

The electrical conductivity of seed leachate was determined as described by ISTA (1993) .Four sub-samples of 50 seeds of each cultivar were weighted and placed into plastic cups with 250 ml of distilled water and held at 25° c. After 24 hr, the electrical conductivity of the leachates was determined using EC meter. The mean values expressed in ($\mu scm^{-1}g^{-1}$) seed weight.

Field experiment

A field experiment was carried out in sandy clay loam soil of a private farm at Gelbana, East Suez Canal at North Sinai Governorate during two successive seasons from pre-spring 2011 to late-fall 2012. Experiment was sown in a split block design in randomized complete blocks arrangement with three replications. Salinity levels were considered the main plots, while the cultivars were distributed in the sub-plots. Three salinity levels were measured (8.73, 10.63 and 15.31 dSm^{-1}) and three Egyptian alfalfa cultivars, i.e., Ismaelia, New Valley and Siwa were obtained from Field Crops Research Institute, Agricultural Research Center, Giza, Egypt. The plot size was 50 m^2 (5 mX10 m). Seeds were sown at the rate of 20 Kg fed^{-1}. Super phosphate (15.5 % P_2O_5) was applied at a rate of 200 kg fed^{-1} during tillage then 100 kg super-phosphate was added every four months. Urea (46% N) was applied as N fertilizer at a rate of 30 kg N fed^{-1} on three equal doses after 21, 42 and 62 days from planting. Potassium sulphate (48% K_2O) was applied at a rate of 100 kg fed^{-1} at two equal doses, after 21and 42 days, and then 50 kg fed^{-1} were added every four months. The first irrigation was applied after eight days from sowing. The following irrigations were applied every eight days during summer and fifteen days during winter season. Irrigation water was applied from Salam Canal (Table 1).

Seeds were sown in March 2011, then fifteen cuts were taken after 65 days from sowing till July 2012, distributed across six seasons, the fresh and dry yield were recorded and chemical analysis of crude protein, crude fiber, carbohydrate and dry mater% (DM) were determined.

Table 1. Physical and chemical properties in soil before planting.

	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Texture		O.M* (%)		$CaCO_3$ (%)
Mean	2.16	65.83	10.60	21.41	Sandy clay loam		0.45		5.92
Starting salinity levels EC (dS/m)	**pH (1:2.5)**		**Cations (meq^{-1})**				**Anions (meq^{-1})**		
			Ca^{++}	**Mg^{++}**	**Na^{+}**	**K^{+}**	**HCO^{-}_3**	**Cl^{-}**	**SO^{-}_4**
8.73	8.05		10.36	8.97	62	0.97	4.82	44	40.09
10.63	8.07		12.68	14.67	78	0.95	5.63	52	48.67
15.31	8.12		10.49	22.69	119	0.92	10.20	98	44.90
	Available nutrients ($mgkg^{-1}$ soil)								
	N	**P**	**K**		**Fe**		**Mn**		**Zn**
8.73	40	3.77	193		1.95		6.36		0.91
10.63	37	3.69	188		1.92		6.31		0.88
15.31	34	3.36	180		1.84		6.26		0.85

* = organic matter %.

Table 2. Mean Chemical composition of El-Salam Canal water.

pH	EC (dSm^{-1})	Soluble cations (meq/l)				Soluble anions (meq/l)				SAR*
		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO^{-2}_{3}	HCO^{-}_{3}	CL^{-}	SO^{2-}_{4}	
8.20	1.93	3.57	5.30	10.10	0.16	0.00	2.83	8.40	8.10	5.22

cronutrients (mg/l)		Micronutrients (mg/l)					
NO_3-N	NH_4 N	P	Fe	Mn	Zn	Ca	B
4.03	12.57	5.10	0.51	0.31	0.40	0.55	0.05

*= Sodium adsorption ratio.

Laboratory analysis

Chemical analysis for nutritive value of seeds and plant tissues per cultivar over seasons salinity interaction, were fine powdered and wet digested according to Chapman and Pratt (1961). Crude protein percentage (CP %), carbohydrate and crude fiber percentage (CF %) were determined by wing microkjelhal methods .and Phosphorus and potassium percent were determined by using the procedure described by A. O. A. C. (1990). The atomic absorption spectrophotometer was used to determine Zn, Mn and Fe concentrations according to the methods recommended by A. O. A. C. (1990).

Proline content

Proline content was measured using nin-hyvdrin and phenol by the method of Zhu. (1993).

Statistical analysis

The results were analyzed using SAS statistical software 9.2 TS Level 2M3 (Der and Everitt, 2008).

3. Results and Discussion

1- Seed germination

Results in Table (3) showed that salinity concentrations greatly affected seedling characters, with significant effect on the interaction between salinity levels and cultivars. Torabi *et al.* (2011) reported similar results. Alfalfa seeds could germinate well only in middle or low saline-alkaline soils. High levels of soil salinity inhibited all growth processes and produced low germination, non-uniform emergence, unsure seedling emergence, little establishment and standing % (Hassan and Maryam, 2009). According to the analyzed data of germination percentage, germination index, shoot and radical length and fresh seedling weight (Table 3) were significantly affected by the high salinity level of 15dSm^{-1}. Significant reduction was found in germination percentage (26.50, 32.60 and 30.40%), germination index (1.20, 1.65 and 1.55), shoot length (0.50, 0.65 and 0.62cm), radical length (1.77, 1.95 and 2.80 cm) and fresh seedling weight (0.032, 0.050 and 0.043 g) for New Valley, Siwa and Ismaelia cultivars under salinity level 15 dSm^{-1}, respectively. Germination and seedling growth were reduced in saline levels with varying response for species establishment depends on interaction between soybean seedbed environment and seed quality (Khajeh- hossini and Powell, 2003).

Data recorded high variation in germination percentage between cultivars under salinity levels. New valley cultivar had the lowest germination percentage under 15 dSm^{-1} (26.50%) compared to Ismaelia and Siwa cultivars (30.40 and 32.60%, respectively). Data of shoot length showed significant reduction with the salinity concentration of 15 dSm^{-1} for the three cultivars and recorded 0.50 cm, 0.65 and 0.62cm, respectively) compared to the other treatments 8 and 12 dSm^{-1}). Esechie *et al.* (2002) showed that the salinity of 12 dSm^{-1} caused a significant reduction in shoot growth but the supply of mineral nitrogen to form ammonium or nitrate, in the field, reduced the negative effects of saline on shoot growth. Munns (2002) reported that the effects of osmotic oxidative and toxicity of sodium ions caused reduction in plant growth.

The radical root lengths were significantly decreased at the highest level of salinity (15 dSm^{-1}), lengths were 1.77, 1.95 and 2.80 cm, respectively, compared to the other treatments for New valley, Siwa and Ismaelia cultivars, respectively. For fresh seedling weight, the three cultivars were decreased from (0.153, 0.171 and 0.164 g) under 8 dSm^{-1} to (0.032, 0.050 and 0.043 g) under 15 dSm^{-1} salinity level for New valley, Siwa and Ismaelia cultivars. The high salinity concentration, 12 dSm^{-1}, increase the seedling dry weight (0.048, 0.070 and 0.051 g) for the three cultivars, respectively, compared to the other treatments. Munns, (2002) reported that the effects of osmotic oxidative and toxicity of sodium ions caused reduction in plant growth.

2- Proline content

Proline is sensitive physiological index of plants responding to some stresses. The result (Table 3) show that proline content increased with increasing in salinity levels. The values were (0.079, 0.097 and 0.083 molg$^{-1}\mu$) compared to control values (0.037, 0.045 and 0.045 molg$^{-1}\mu$) for New Valley, Siwa and Ismaelia cultivars, respectively. Proline accumulation is necessary under salt stress but the significance of proline accumulation in osmotic adjustment varies according to the cultivar, salinity level and their interactions (Table 3). Salinity stress induced significant increase of proline content in leaves and roots. These results are in harmony and agreed with El-Nakhlawy *et al*. (2012), Meloni *et al*. (2001) and Khedr *et al*. (2003).

Table 3. Seedling characters and proline content of three alfalfa cultivars under different salinity concentration.

Salinity concentration (Starting)	Cultivar	Germination		Length (cm)		Seedling weight (g)		Proline content molg^{-1}µ
		%	Index	Shoot	Radical	Fresh	Dry	
8 dSm^{-1}	NewValley	70.20	3.59	2.93	5.45	0.153	0.042	0.056
	Siwa	73.33	4.06	3.33	5.75	0.171	0.060	0.069
	Ismaelia	70.67	4.38	3.10	5.80	0.164	0.041	0.056
	Mean	**71.40**	**4.01**	**3.12**	**5.67**	**0.163**	**0.048**	**0.060**
12 dSm^{-1}	New Valley	50.10	2.58	2.47	4.20	0.091	0.048	0.077
	Siwa	54.60	2.42	2.65	4.22	0.102	0.070	0.078
	Ismaelia	50.30	2.69	2.52	4.21	0.114	0.051	0.077
	Mean	**51.67**	**2.56**	**2.55**	**4.21**	**0.102**	**0.056**	**0.077**
15 dSm^{-1}	New Valley	26.50	1.20	0.50	1.77	0.032	0.011	0.079
	Siwa	32.60	1.65	0.65	1.95	0.050	0.015	0.097
	Ismaelia	30.40	1.55	0.62	2.80	0.043	0.013	0.083
	Mean	**29.83**	**1.47**	**0.59**	**2.17**	**0.042**	**0.013**	**0.086**
Control	New Valley	75.00	6.52	3.50	6.25	0.244	0.030	0.037
	Siwa	80.50	8.02	3.80	6.60	0.282	0.050	0.045
	Ismaelia	78.20	7.02	3.60	6.42	0.253	0.032	0.045
	Mean	**77.90**	**7.19**	**3.63**	**6.420**	**0260**	**0037**	**0.042**
Grand mean		**57.700**	**3.807**	**2.473**	**4.62**	**0.142**	**0.039**	**0.066**
L.S.D 5%	Cultivar	2.28	0.11	1.50	0.63	0.044	0.001	0.01
	Salinity	1.20	0.21	2.31	1.20	0.030	0.003	0.03
	Interaction	7.41	0.19	0.66	2.42	0.081	0.005	0.02

Table 4. Protein, carbohydrate, phosphorus and potassium of seeds under different salinity levels.

Salinity concentration (Starting)	Cultivar	Protein %	Carbohydrate %	Phosphorus (ppm)	Potassium (ppm)	Electrical conductivity µscm^{-1}g^{-1}
8 dSm^{-1}	New valley	21.4	71.44	0.39	2.63	126.0
	Siwa	21.1	70.41	0.38	2.52	121.5
	Ismaelia	19.1	71.52	0.34	2.43	125.2
	Mean	**20.53**	**71.13**	**0.37**	**2.53**	**124.2**
12 dSm^{-1}	New valley	22.7	67.21	0.45	2.94	127.0
	Siwa	22.4	68.33	0.46	2.73	126.2
	Ismaelia	21.3	69.74	0.42	2.64	129.4
	Mean	**22.13**	**68.43**	**0.44**	**2.77**	**127.5**
15 dSm^{-1}	New valley	23.0	63.13	0.46	3.23	134.2
	Siwa	22.8	65.62	0.50	3.52	132.5
	Ismaelia	22.5	66.73	0.45	3.05	130.6
	Mean	**22.77**	**65.16**	**0.47**	**3.27**	**132.4**
Control	New valley	19.6	71.61	0.36	2.74	103.2
	Siwa	19.3	70.50	0.34	2.63	100.5
	Ismaelia	18.5	71.70	0.30	2.63	104.2
	Mean	**19.13**	**71.27**	**0.33**	**2.67**	**102.6**
Grand mean		**21.14**	**68.98**	**0.40**	**2.80**	**121.7**
L.S.D 5%	Cultivar	0.06	0.08	0.007.	0.44	2.65
	Salinity	0.69	1.81	0.005	0.36	2.67
	Interaction	0.12	0.14	0.012	0.76	4.60

Results in Table (4) showed that protein, carbohydrate, phosphorus and potassium were significantly affected by salinity levels. They were increased with salinity increase. Protein content in seeds ranged from 19.1% under 8 dSm^{-1} to 23.0% under 15 dSm^{-1}. El-Nakhlawy *et al*., (2012) found that protein and proline contents in plants were significantly affected as salinity increased. Carbohydrate %, in seeds, was decreased with increasing salinity level. Seed content of carbohydrate % ranged from 63.13% under Ec=15dSm^{-1} to 71.70 % under control, with mean of 68.98%. Phosphorus and potassium values ranged from 0.34 and 2.43 under Ec=8 dSm^{-1} to 0.50 and 3.52 under 15 dSm^{-1}. New valley cultivar seeds restricted high rate of K (ppm) under Ec's= 8 and 12 dSm^{-1}across all cultivars and salinity levels.

Siwa seeds had the highest contents of K (ppm) across all cultivars under 15 dSm^{-1} level of salinity (3.52 ppm). Abd El-Naby *et al.* (2013) showed increasing in potassium percentages, in plant tissues, with increased of salinity level. High potassium (ppm) increased the plant adaptability, persistence and tolerance to high saline soils. These results are in harmony and agreed with these ofChhipa and Lal, (1995) and Zhu., (2001). Also, carbohydrate (%) was decreased with increasing salinity concentrations. Their values ranged from 70.4% under 8 dSm^{-1} to 63.1% under 15 dSm^{-1} levels of salinity. For electrical conductivity ($\mu scm^{-1}g^{-1}$), the highest values were 130.0, 132.5 and 134.2 ($\mu scm^{-1}g^{-1}$) at the highest level of salinity compared to control (104.2, 100.5 and 103.2 $\mu scm^{-1}g^{-1}$) for Ismaelia, Siwa to control (104.2, 100.5 and 103.2 $\mu scm^{-1}g^{-1}$) for Ismaelia, Siwa and New Valley cultivars, respectively.

3- Microelements

Results (Table 5) showed that the microelements of seeds were decreased with increasing salinity concentration. The analyzed values of Cu, Mn, Zn and Fe (ppm) under 8, 12 and 15 dSm^{-1} for New Valley cultivar were 6.6, 80.4, 41.4, 413.6 ppm and 4.1, 71.5, 38.2 and 402 ppm, compared to control 7.62, 83.2, 43.5 and 419.2 ppm, respectively. Microelements content for Siwa cultivar were (6.25, 81.8, 41.2, 421.4 ppm) in salinity concentration 8 dSm^{-1} and (4.33, 71.5, 38.9 and 407.8 ppm) under 15 dSm^{-1} compared with the control of 7.93, 83.9, 44.5 and 426.4 (ppm), respectively. Cimrin *et al*. (2010) reported that the adverse effect of salinity stress on alfalfa resulted in lower root and shoot biomass production and mineral element content of plant.

Table 5. Some microelements in different salinity concentrations under laboratory conditions.

Salinity	Cultivar	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
8 dSm^{-1}	**New Valley**	413.61	41.10	80.40	6.62
	Siwa	421.40	41.23	81.80	6.25
	Ismaelia	418.20	41.11	85.60	6.12
	Mean	**417.7**	**41.14**	**82.60**	**6.33**
12 dSm^{-1}	**New Valley**	410.53	40.60	78.20	5.34
	Siwa	418.81	39.01	77.30	5.42
	Ismaelia	415.01	40.30	82.60	5.22
	Mean	**414.82**	**39.97**	**79.37**	**5.33**
15 dSm^{-1}	**New Valley**	402.00	38.20	73.22	4.53
	Siwa	407.81	38.90	71.53	4.33
	Ismaelia	406.51	39.20	78.31	4.13
	Mean	**405.40**	**38.77**	**74.32**	**4.33**
Control	**New Valley**	419.20	43.51	83.20	7.62
	Siwa	426.44	44.51	83.90	7.93
	Ismaelia	423.22	44.11	87.50	7.31
	Mean	**422.92**	**44.04**	**84.87**	**7.62**
Grand mean		415.22	40.97	80.29	5.87
L.S.D 5%	**Cultivars**	0.68	0.30	0.33	0.10
	Salinity	0.78	0.45	0.53	0.12
	Interaction	1.19	0.52	0.18	0.15

B- Field experiments

1- Fresh and dry yield

Previous studies have underscored with the same measured parameters a high diversity between cultivars (Julier *et al*. 1995, 2000 and 2010).

However, Flajoulot *et al.* (2008) reported that differentiation between populations is difficult because of the large variation within population and of the small mean differences among cultivars. In our results, the variance analysis showed significant differences (p<0,05) between Egyptian alfalfa cultivars for the total fresh and dry yield in different starting salinity levels of Sahl El-Tina saline soil.

Total forage yield of the three alfalfa cultivars was significantly influenced by the salinity. Siwa cultivar showed minimum reduction, when compared with total forage yield under starting level 8.73 dSm^{-1}, whereas maximum reduction was recorded in New valley cultivar. (Figure 1) Best total fresh and dry yield across fifteen cuts was observed for both of Siwa and Ismaelia cultivars (55.91, 13.57 and 52.07, 12.93 t fed^{-1}) under 8 dSm^{-1} salinity starting level, while, New valley obtained the lowest yield (46.92 and 12.20 t fed^{-1}) under the same starting level of salinity (Figs. 1 and 2).

Data manifested in Figure (1) showed decreasing of total fresh yield with increase of starting salinity level in soil (10.63 and 15.31 dSm^{-1}) compared with total fresh yield under 8.73 dSm^{-1}. The reduction percentages of total forage yield were (9.68 and 18.61%) of Ismaelia cultivar, (10.09 and 29.95%) of New valley cultivar and (4.90 and 10.41%) of Siwa cultivars, under 10.63 and 15.31 dSm^{-1}, respectively. Siwa and Ismaelia cultivars are the best performing ones and had higher forage yield under salinity stress. Our results agreed with Monirifar *et al.* (2004) and Johnson *et al.* (1992).

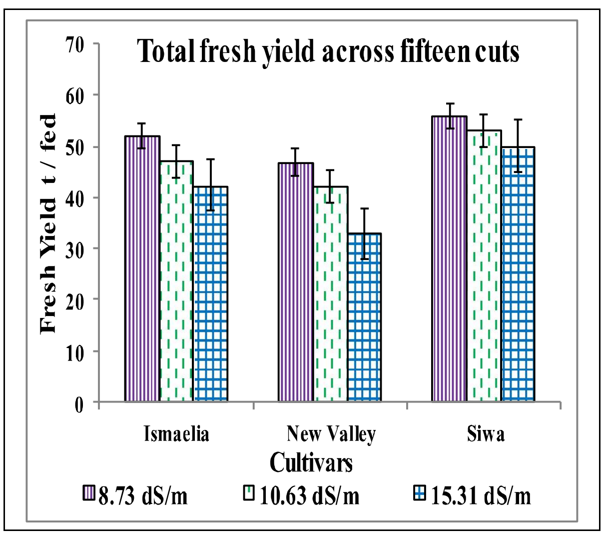

Figure 1. Total fresh yield of three alfalfa cultivars (means ± S.E.) across three starting levels of salinity.

Variations in dry yield of the three cultivars under study recorded significant differences (p≤ 0.05), starting salinity levels and their interactions. Siwa cultivar had the highest total dry yield (13.57, 12.45 and 11.77 t fed^{-1}) followed by Ismaelia cultivar (12.92, 11.23 and 9.38 t. fed^{-1}) and New valley cultivar had the lowest total dry yield across growing period (12.20, 10.09 and 9.38 t. fed^{-1}) under starting salinity levels (8.73, 10.63 and 15.31 dSm^{-1}) (Figure 2).

The reduction in total dry yield under high starting salinity levels compared with starting level of salinity 8.73dSm^{-1} recorded 17.3, 14.2 and 8.3% under 10.63 dSm^{-1} starting level and 43.9, 27.5 and 13.3% under 15.31 dSm^{-1} starting level of New valley, Ismaelia and Siwa. The poor performance of alfalfa cultivars during the first period, from 1^{st} to 4^{th} cuts, can be attributed to stand decline with senescence damages, also alfalfa cultivars produced the highest dry mater after plant establishment and plant growth age. These results agreed with Sheaffer *et al.* (1989).

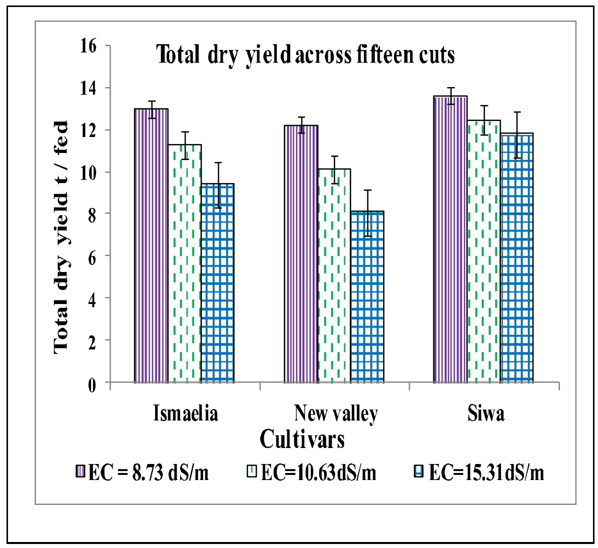

Figure 2. Total dry yield of three alfalfa cultivars (means ± S.E.) across three starting levels of salinity.

2. Quality characters

Cultivars, seasons and their interaction recorded significant differences of CP % (p≤0.05) (Table 6). CP ratios of alfalfa cultivars ranged from 18.71to 21.51% with mean value 19.75%. Ismaelia cultivar had the lowest percentage of CP% across all harvested seasons (Table 6). In Fall, 2011, season was considerably higher CP content (19.73%) among cultivars, but was relatively less than spring and summer seasons, 2012, with average of 20.15 and

20.73%, respectively. Similar results were reported by Rammah and Hamza (1980) and Nasr (1998).

No significant effect was found in carbohydrate %, fiber and dry matter% by interaction of cultivars and seasons. The highest content of Carbohydrate noted of Siwa cultivar (59.30%) in spring (2012) and the lowest range recorded for Ismaelia cultivar (54.89%) in summer (2012) and New valley cultivar (54.90%) in winter (2011/12). Crude fiber content ranged from 16.18 to 19.75% with mean of 18.5%. Spring (2012) showed the lowest content of Crude fiber% among cultivars with 16.62, 16.99 and 16.18% of New valley, Siwa and Ismaelia, respectively. Similar results were reported by Oshy *et al.* (1999).

Siwa cultivar indicated the best percentages of dry matter (DM) % (25.91, 29.73, 28.08, 27.84, 25.43 and 29.60% across all growing seasons. Results of DM% values varied according to plant establishment and plant growth age. These results agreed with Sheaffer *et al.* (1989).

Figure (3) shows the vigorous of alfalfa plants at different growing stages (Fig.$3_{\text{B and C}}$) under high starting salt stress (Fig.3_{A}).

Table 6. Quality components percentage of three alfalfa cultivars across growing seasons in Sahl el- Tina conditions.

Year	Seasons	Cultivars	%			
			Protein	Carbohydrate	Fiber	DM
2011	Spring	New Valley	19.39	56.20	18.91	16.27
		Siwa	19.39	55.40	18.51	25.91
		Ismaelia	18.71	56.13	19.21	14.90
		Mean	19.16	55.91	18.88	19.06
	Summer	New Valley	20.23	57.10	18.26	27.34
		Siwa	21.37	57.41	18.51	29.73
		Ismaelia	18.93	57.19	19.40	26.93
		Mean	19.84	57.23	18.73	28.00
	Fall	New Valley	19.62	56.92	18.31	23.12
		Siwa	20.72	55.81	18.36	28.08
		Ismaelia	18.84	56.19	18.00	22.43
		Mean	19.73	56.31	18.22	24.54
	Winter	New Valley	19.19	54.90	19.48	22.42
		Siwa	19.73	55.34	19.75	27.84
2012		Ismaelia	18.00	56.12	19.12	23.66
		Mean	18.98	55.46	19.45	24.31
	Spring	New Valley	20.00	57.80	16.62	22.31
		Siwa	21.41	59.30	16.99	25.43
		Ismaelia	19.05	58.91	16.18	24.98
		Mean	20.15	58.67	16.60	24.24
	Summer	New Valley	21.27	56.28	19.12	27.87
		Siwa	21.51	55.77	18.94	29.60
		Ismaelia	19.40	54.89	19.23	29.43
		Mean	20.73	55.65	19.10	28.97
Grand mean			19.75	56.54	18.50	24.90
L.S.D (0.05)		Cultivars	0.31	0.76	0.38	10.60
		Seasons	0.52	1.06	0.33	12.88
		Interaction	0.37	n.s.	n.s.	n.s.

n.s.: insignificant at 0.05 level of probability.


A) Sahl El-Tina salt soil before sowing


B) Growing plants under salt stress


C) Flowering under salt stress

Figure 3. Alfalfa field: A) before sowing, B) growing stage and C) flowering stage.

Conclusion

It was conducted that Siwa and Ismaelia cultivars showed better performance under salinity stress. So, selection was carried out according to the highest fresh and dry yield between and within cultivars across salinity levels.

Blend plants contain a new promised material (Sinai-1 population), which would be expected to retain tolerant to salinity stress in North Sinai salt soils. This material needs to be evaluating in the present breeding program.

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