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Establishment of Local and Introduced Alfalfa *"Medicago sativa* L." Populations under Gradual Soil Salinity Conditions

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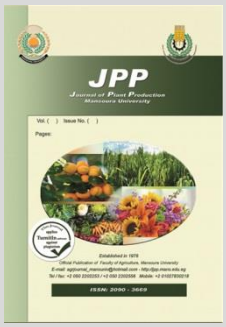

ABSTRACT

Salinity is an important abiotic stress limiting alfalfa "Medicago sativa, L." production. Thus, finding out genotypes have high salt tolerance with high germination, early season growth and productivity became an urgent need. Commonly, counting of germination after seven days from sowing, that, reflected emergence of seedling, was clearly distinguishing salt- tolerant population as Makka, Rammah1, Nubaria1, and Sohage, in all studied four salinity gradients. Also, counting after 21 days which indicates establishment, supported the former findings with additional prove of law salinity tolerance of Pakistani population. Sohage and Egaseed cultivars, scored about 70 cm of plant height under low salinity level (4.0ds/m) and both of Italian and Australian cultivars, gave as low as about 45 cm of plant height under the high level of salinity (10.50 ds/m). Sohage, Siwa 1 and Nubaria 1, significantly exhibited the heaviest stem weight (5.37, 5.34 and 5.29 g/stem, respectively). While the least significant stem dry weight was recorded by any of Australian and Italian cultivars (4.34 and 3.32 g/ stem, respectively). Makka cultivar significantly maintained superiority in root dry weight (9.12 g. plant^{-1}), followed by Sohage cultivar (8.66 g. plant^{-1}). The highest plant dry weight was obtained from any of Siwa 2, Frafra, and Sohage cultivars, when sown in 4.0 ds/m salinity level (1.05, 1.15 and 1.14 g. plant $^{-1}$, respectively). The least plant dry weight was recorded by Italian cultivar sown in salinity of 10.5 ds/m (0.57 g. plant $^{-1}$).

***Keywords**:* Alfalfa, establishment, plant height, productivity soil salinity

INTRODUCTION

Soil salinity is affecting an estimated 6% of the world land surface area or 12780 million hectares (Chinnusamy *et al*., 2005, and Munnus,2011). Mass, 1987, stated that salinity is a complex issue to characterize, because of those several factors that influence plant response to salinity including genetic make- up, soil, water, environment and cultural factors. The most variable property of soil is supposed to be salinity (Miyamoto *et al*.,1984). The effect of salinity on plants depends on the stage of plant development (Bernstein and Hayward, 1957). Evaluation of crop salt- tolerance from greenhouse experiment may not correlate with yield evaluation (Cluff, 1997). Consequently, efficient field experiments are confronted with a combination of these parameters (Mc-kimmie and Dobrenz, 1987).

Alfalfa "*Medicago sativa*, L" is a worldwide perennial warm- season legume. Basic production regions include the United States, Canada, Italy, France, China, South Russia, Argentina, Chile, South Africa, Australia and New Zealand (Yuegao and Cash, 2009). In Egypt, the total cultivated area was about 79 thousand Fadden (one faddan= 4200 m^2) (F.A.O. Agricultural Statistic Bulletin, 2019). The great shortage in animal protein forced the expansion of forage production. Alfalfa represents a promising choice, since the available land and water are of low quality (mostly salt- affected).

Mass and Hoffman, 1977, characterized alfalfa as moderately sensitive to salts with EC values of 2.0 ds/m (1280 ppm). A reduction of 7% in forage yield was expected with each increase in salinity of one ds/m (Rawlins, 1979). On the other hand, Longenecker and lyerly 1974, hand characterized alfalfa as a tolerant to salts with EC values from 6.0 to 8.0 (3840 to 5120 (ppm) with scored reduction in growth and yield. Munnus, 2005, reached that alfalfa was a more salt tolerant crop. He also added that alfalfa was as tolerant as barley and cotton, with retarded growth. Soil salinity requires that alfalfa being irrigated frequently until seed germinates (Lindsey *et al*., 1970). A yield reduction has been observed in alfalfa yield, when grown under 3 to 5 EC (1920 to 3200ppm) (Miyamoto *et al*., 1984). The emergence of cultivars seeds declined when salinity exceeded 4.3 (2752 ppm). High salinity (5000 ppm) (EC= 7.81) resulted in deformed cotyledons and more chlorosis (Johnson, 1989). The least seed injury in alfalfa was scored at salinity level of EC= 4.0 (2560 ppm) and 10mm sowing depth (Assadian and Miyamoto, 1987).

The main objectives of this recent study were to quantify salt- tolerance of eleven local and introduced alfalfa populations/cultivars, in terms of germination, and early season growth.

MATERIALS AND METHODES

The present study was carried out during the period between September 2016 until September 2018. The main objective was to evaluate local and introduced alfalfa " *Medicago sativa*, L." populations under gradual soil salinity conditions. The trial conducted was in Nubaria experimental station of Agricultural Research Center, in North Tahrir Region. A diagonal diagram for soil sampling was made.

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Physical and chemical properties of the experimental location were presented in (Table 1).

Table 1. Physical and chemical properties of study site soil

Physical properties						
Strip	Soil depth	Particle size			Texture	$CaCo_3$ %
		Sand%	Silt%	Clay%		
1	0-15	42	52	6	Sandy loam	13.65
	15-30	48	44	8		13.10
	30-45	39	50	11		12.40
II	0-15	38	55	7	Sandy loam	12.80
	15-30	36	51	13		13.00
	30-45	35	49	10		12.10
III	0-15	39	55	6	Sandy loam	20.10
	15-30	34	65	10		18.30
	30-45	33	53	14		17.10
IV	0-15	32	63	5	Sandy loam	19.75
	15-30	35	54	11		17.10
	30-45	34	52	14		16.90

Chemical properties

Ship	Ec ds/m	pH	Na^+	K^+	Ca^{++}	Mg^{++}	Hco_3^-	CL^-	SO_4^-
I	2.89-5.19	8.2-8.4	14.00	0.21	13.0	6.2	13.20	16.00	12.30
II	4.89-7.02	8.3-8.6	14.30	0.22	13.10	5.9	13.60	17.60	13.20
III	6.76-9.23	8.4-8.6	14.60	0.20	13.20	6.2	13.40	18.30	13.70
IV	8.74-12.24	8.3-8.5	14.40	0.23	13.00	6.1	13.35	18.40	14.10

E.C.; Electrical conductivity, pH; soil reaction; HCO; bicarbonate, CL^-; chloride, SO_4^-; sulphate; Ca^{++}; Calcium, Na^{++}; Sodium, K^+; Potassium.

Depending on the aforementioned soil analysis, the experimental site was divided to four strips with different soil salinity gradient. Strip I showed Ec values between 2.89 and 5.19 ds/m. Strip II had salinity gradient between 4.89 and 7.02 ds/m. Strip III had Ec values between 6.76 and 9.23. Strip IV had salinity between 8.74 and 12.24 ds/m. The four major strips were considered as a gradient of soil salinity levels.

Eleven genotypes of alfalfa "*Medicago sativa*,L." represented the available local and introduced population (Table 2), were evaluated under each of the aforementioned soil salinity gradients in four separate experiments (Table 3).

In each experiment (Soil salinity level), the studied alfalfa genotypes were tested in a randomized complete block design (RCBD) with six replicates. The plot area was 2.4 m^2, represented by three rows of four meters long, at 0.2 meter apart. The seeding rate was 60 Kg. ha^{-1}.

Table 2. Pedigree of the evaluated local and introduced alfalfa cultivars populations.

Origin	Cultivar/ population	Pedigree
Local	Makka	Local variety produced and realized by Makka CO / Egypt
	Rammah1	Local variety produced and realized by ARC/Egypt
	Nubaria1	Local variety produced and realized by ARC/Egypt
	Siwa1	Local population from Siwa oasis sandy soil
	Siwa2	Local population from Siwa oasis loam soil
	Frafra	Local population from Farafra oasis
	Sohage	Local population from Sohage governorate
	Egaseed	Local variety produced and realized by Egaseed ,Co/Egypt.
Introduced	Sopsta	Introduced variety from Italy.
	Siriver	Introduced variety from Australia
	Pakistani	Introduced population from pakistan

Methods of soil samples analysis included the following:

1- Particle size distribution was carried out using the international pipette method after Richards (1954).
2- Bulk density: was determined according to the core method developed by Vomocil (1965).
3- Organic matter content was determined using the modified Walkley and Black method described by Hesse (1971).
4- Calcium carbonate content was determined volumetrically by using calciminer, according to Avery and Bascomb (1974).
5- pH (Soil reaction): was measured by using a Backman's Rhode, according to Page *et al*., (1982).
6- Total soluble salts: expressed as electrical conductivity values (EC) was measured by using electrical conductivity meter, according to Rhoades (1982).

Table 3. Designation of soil salinity gradients for each evaluation experiment

Experiment	Soil Salinity gradient (ds/m)	Mean Ec (ds/m)	S_x^-
1	2.89-5.19	3.910	± 0.8494
II	4.89-7.02	6.030	± 0.8084
III	6.76-9.23	7.928	± 0.9880
IV	8.74-12.24	10.53	± 1.3659

The sowing date was mid- September 2017. Mono superphosphate (15.5% P_2O_5 was added before sowing at the rate of 350 Kg. ha^{-1}). A normal irrigation practice for alfalfa in EL-Tahrir area was applied. The first cutting was taken after 60 days from sowing. Field germination counts were taken after 7, 14 and 21 days from sowing. Early season growth (establishment) included the following:

A. Field germination percentage.

Field germination counts were taken after 7, 14 and 21 days from sowing.

B: Early season growth (First cutting)

The first cutting was taken after 60 days from sowing.

B1: Plant height (cm.)

Recorded as an average of ten measurements in each plot to the upper most tip of alfalfa plant height was measured at 35, 45 and 60 days from sowing.

B2. Dry weight of alfalfa plant parts:

B2-1: Leaves dry weight (g): from each plot twenty random plants were uprooted after 40 and 60 days from sowing. Plants were separated into leaves, stems, and roots. Plant parts were dried in an oven at 70 ^{0}C until weight consistency.

B2-2: Stem dry weight (g): from each plot twenty random plants were uprooted after 40 and 60 days from sowing. Plants were separated into leaves, stems, and roots. Plant parts were dried in an oven at 70 ^{0}C until weight consistency.

B2-3: Roots dry weight (g): from each plot twenty random plants were uprooted after 40 and 60 days from sowing. Plants were separated into leaves, stems, and roots. Plant parts were dried in an oven at 70 ^{0}C until weight consistency.

B3. Whole plant fresh and dry weight (g): Total weight of 20 plants representing each plot were weighted just after clipping, then samples were placed in an oven at 70 ^{0}C until weight consistency.

B4. Number of root nodules. Plant^{-1}: for each of the uprooted plants from each plot, the number of root nodules were counted and averaged per plant. Data was transformed before statestical analysis.

Statistical analysis

Analysis of variance for the collected data was performed as described by Snedecor and Cochran (1980). Combined analysis over experiments was performed when there was homogeneity in experimental error. Numerical data were transformed before analysis. MSTAT-C package (1996) was used for performing the analysis. Comparisons among means of the studied treatments were carried out according to least significant difference test at 0.05 and 0.01 levels of probability.

RESULTS AND DISCUSSION

A. Field germination percentage:

Collected data for germination percentages at successive recording dates (7, 14 and 21 days) of each experiment were statistically analyzed separately. Mean squares of germination percentage for alfalfa populations at successive recording dates for different salinity gradient/ experiment, were illustrated in Table (4). The germination percentage over the evaluated populations significantly differed from recording date to the other (P≥ 0.01) under all salinity gradient experiments (significant effect of recording date).

Table 4. Mean squares of germination percentage for alfalfa populations at successive recording dates.

S.O.V.	d.f.	M.S			
		Salinity gradient/ experiment			
		2.89-5.19 (Exp. I)	4.89-7.02 (Exp. II)	6.76-9.23 (Exp. III)	8.74-12.24 (Exp. IV)
Recording date (D)	2	17.33**	11.39**	10.16**	23.27**
Error	15	0.290	0.410	0.447	0.295
Population (P)	10	17.63**	25.17**	15.63**	19.94**
D× P	20	0.307$^{n.s.}$	0.111$^{n.s.}$	0.754$^{n.s.}$	0.176$^{n.s.}$
Error	150	0.423	0.482	1.085	0.467

****; significance at 0.01 level. n.s.; not significantly different.**

Also, the studied alfalfa populations gave significantly different field germination scores over recording dates in all four experiments (significant effect of population). Meanwhile, the studied populations maintained similar magnitude and /or trend of germination percentage, irrespective of recording date (insignificant interaction between date× population), Means of field germination percentage for alfalfa populations at successive counting dates (7, 14 and 21 days from sowing) for each salinity gradient (experiment) are shown in Table (5). Under the first experiment (salinity of 2.89-5.19 ds/m) germination percentage over populations increased proportional to the counting date from 49.85 to 52.05 to 64.70% for 7,14 and 21 days from sowing. Meanwhile, Makka, Rammah1 and Sohage populations scored over 60% germination as an average over the three counting dates. The least germination percentage was recorded for Pakistani population which was 21.39% over the three counting dates. The second salinity gradient (experiment 2) (4.89-7.02 ds/m) showed lower germination percentage at the three successive recording dates (46.51, 50.99, and 58.33% after 7,14, and 21days from sowing). Only, Makka and Sohage populations had showed over recording dates an average germination percentage over 60%. The least average germination percentages were scored by Pakistani population. Sopsta, population of European origin, showed an average of less than 50% germination.

As for the third salinity gradient (6.76 to 9.23 ds/m), germination at any of three recording dates were of lower magnitude (45.61, 51.67 and 41.14% after 7, 15, and 21 days, respectively). The reduction of germination percentage at 21 days, recording relative to 14 days, might be due to germination failure and seedling death. Populations that recorded an average germination percentage over 50% were Makka, Rammah1, Siwa1, and Sohage (51.11, 56.11, 50.28, and 51.94 percent, respectively). The Pakistani population expressed the least germination percentage (16.94 percentages).

Regarding the fourth salinity gradient level (8.74 to 12.24 ds/m), all tested populations, showed over 60% germination as an average of the three recording dates, except for, populations of global north and eastern origin (Sposta, Siriver and Pakistani). It was valuable to notice that the average germination over populations in any of the recording dates was of better magnitude relative to other studied salinity gradients.

Commonly, counting of germination after seven days from sowing, that, reflected emergence of seedling, was clearly distinguishing salt- tolerant population as Makka, Rammah1, Nubaria1, and Sohage, in all studied four salinity gradients. Also, counting after 21 days which indicates establishment, supported the former findings with additional prove of law salinity tolerance of Pakistani population. It was worthy to notice that, alfalfa populations, expressed, reasonably, good emergence and establishment at the high salinity level experiment. Also, populations of arid origin showed the best emergence and establishment records at all salinity gradient experiments.

Field evaluation of germination percentage, stand for, stand density and establishment. 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 germinating seeds (Khaje-hossini and Powell, 2003). That is critically affecting plant density (Gamze *et al*., 2005). Germination and development of seedling in saline soils is reduced with variable responses of cultivars (Hampson and Simpson, 1990). Establishment of crops in saline soils depends on the ability of cotyledons to break through a soil crust and subsequently the ability of seedling to survive in saline conditions (Maranon, *et al*., 1989). Alfalfa as a moderately salinity tolerant crop, showed that alfalfa cultivars from the arid Indian and African centers, excelled in salinity resistance during germination (Rumbaugh and Pendery,

1990). This might support the finding of the recent study, which approved relative salinity resistance for cultivars of warm and desert regions of Egypt. In the meantime, Torabi *et al.*, (2011) reached salinity levels, ecotypes, and the interaction between salinity and ecotypes had a significant effect on germination percentage. They added that ecotypes originating from arid and cold areas are more tolerant than other areas. Scata *et al*., 2012, evaluated twelve alfalfa cultivars to salinity. They obtained a significant difference in germination percentage among cultivars.

Differences among cultivars in first count of germination percentage, was explained by Hauser and Horie, 2010, as the effect of osmosis, in decreasing the water potential gradient between the soil and root ending to reduced water uptake. Also, ion toxicity during germination can disrupt the metabolism of carbohydrates, which result in delay in seedling development (Farissi *et al.*, 2011). Cordiero *et al.*,2014, reached that, saline originated alfalfa genotypes, displayed greater salinity tolerance for germination and seedling traits, relative to non- saline origin genotypes. The major affected measurements were early count of germination and development of germination by subsequent recording dates.

Table 5. Field germination percentage of alfalfa populations at successive recording dates (7, 14 and 21 days) from sowing.

(Exp.) Salinity gradient	Recording date	Populations											Mean
		1	2	3	4	5	6	7	8	9	10	11	
2.89-5.19 (Exp. I)	7	57.50	59.17	55.00	49.17	52.50	50.00	55.83	54.17	46.67	50.00	18.33	49.85
	14	56.67	62.50	54.17	51.67	52.5	52.50	60.00	60.83	46.67	52.50	22.50	52.05
	21	75.00	74.17	70.00	66.67	63.33	67.50	79.17	70.00	51.67	70.83	23.33	64.70
	Mean	63.06	65.28	59.72	55.83	56.11	56.64	65.00	61.67	48.33	57.78	21.39	
	$L.S.d._{0.5}$												
4.89-7.02 (Exp. II)	7	56.67	52.50	52.50	48.33	49.17	50.83	55.00	47.50	43.33	45.83	10.00	46.51
	14	60.83	53.33	55.83	55.83	55.83	53.33	62.50	53.33	46.67	49.17	14.17	50.99
	21	66.67	65.00	60.00	61.67	64.17	62.50	67.50	65.83	53.33	58.33	16.67	58.33
	Mean	61.39	56.94	56.11	55.28	56.39	55.56	61.67	55.56	47.78	51.11	13.61	
	$L.S.d._{0.5}$												
6.76-9.23 (Exp. III)	7	50.83	55.00	49.17	49.17	45.00	46.67	50.00	44.17	40.00	47.50	24.17	45.61
	14	57.50	60.83	48.33	60.00	50.83	59.17	60.00	52.50	51.67	55.00	12.500	51.67
	21	45.00	52.50	44.17	41.67	39.17	43.33	45.83	43.33	40.83	42.50	14.17	41.14
	Mean	51.11	56.11	47.22	50.28	45.00	49.72	51.94	46.67	44.17	48.33	16.94	
	$L.S.d._{0.5}$												
8.74-12.24 (Exp. IV)	7	53.33	55.53	56.67	50.63	58.33	55.83	55.00	55.83	46.67	47.50	19.17	50.46
	14	54.17	63.33	61.67	56.67	61.67	59.17	59.17	60.00	54.17	53.33	22.50	55.08
	21	73.33	75.83	70.00	72.50	77.50	75.00	73.33	71.67	66.67	70.00	23.33	68.11
	Mean	60.28	65.00	62.78	60.00	65.83	63.33	62.50	62.50	55.83	56.94	21.67	
	$L.S.d._{0.5}$												

Populations; 1; Makka, 2; Rammah1, 3; Nubaria1, 4; Siwa1, 5; Siwa2, 6; Frafra, 7; Sohage, 8; Egaseed, 9; Sopsta, 10 Siriver 11; Pakiskani.

B: Early season growth (First cutting)

Early season responses of evaluated alfalfa populations were traced by subsequent recording of growth indicating characters. Plant height was measured after 30, 45, and 60 days from sowing. Plant parts dry weight (Leaves, stems, and roots) were measured after 40 and 60 days from sowing. While plant fresh and dry weight were measured after 60 days from sowing. Dry mutter percentage and number of branches were recorded after 60 days from sowing. The number of root nodules that reflect the efficiency of symbiosis, also, was measured after 60 days from sowing alfalfa genotypes.

B1: Plant height (cm.)

Mean squares of plant height, as affected by salinity gradient (experiment) and alfalfa population, after 30, 45, and 60 days from sowing are presented in Table (6). Plant height significantly ($P \geq 0.01$) responds to salinity levels (experiments) at early seeding stage (30 days from sowing). That response, extended during the two other measurements (45 days and 60 days from sowing). The responses of alfalfa populations were significantly ($P \geq 0.01$) different at the three recording dates. Meanwhile, the interaction between salinity level (experiment) and population reached the level of significance, only, after 45 days from sowing. At early (30 days from sowing) and late (60 days from sowing) plant height's recording dates, alfalfa populations (cultivars) showed similar magnitude and/ or trend of response reflected in plant height (insignificant salinity level × genotype interaction).

Table 6. Mean squares of plant height, as affected by salinity gradient (experiment) and alfalfa population, after 30, 45, and 60 days from sowing.

S.O.V.	d.f.	M.S.		
		Plant height 30 days	Plant height 45 days	Plant height 60 days
Experiment (E)	3	692.9^{**}	1327^{**}	13.99^{*}
Rep/ Exp	20	91.86	166.3	451.2
Genotype (G)	9	172.5^{**}	395.4^{**}	524.4^{**}
E× G	27	$32.47^{n.s.}$	50.75^{*}	$74.17^{n.s.}$
Error	180	22.49	29.88	51.65
C.V.		16.61%	15.32%	12.26%

* and **; significance at 0.05 and 0.01 levels of probability, respectively. $^{n.s.}$; not significantly different.

Means of plant height (cm) after 30 days from sowing, for alfalfa genotypes as affected by soil salinity levels (experiments) are presented in Table (7). Alfalfa plant height after 30 days from sowing was significantly reduced when soil salinity level raised over 5.0 ds/m .33.42 cm tall alfalfa was obtained at moderate salinity level (2.89-5.19

ds/m), while, 25.7 to 27.6 cm tall alfalfa resulted with soils of EC between 4.89 to 12.24 ds/m . That reduction in plant height at 30 days stand age reached 17.41 to 23.99% of the respective value under the least tested soil salinity level. Over salinity levels, only the Italian and Australian populations exhibited the least growth rate expressed by plant height during the early 30 days of the stand life (23.36 and 24.42 cm, respectively). The other local cultivars significantly enjoyed similar plant height between 31.46 and 27.79 cm. The interaction between cultivars and salinity levels had not reached the level of significance because of similar array of genotypes ranks within each salinity level.

Table 7. Means of plant height (cm) after 30 days from sowing (cm) for alfalfa genotypes as affected by soil salinity levels (experiments).

Genotypes		Salinity level (Experiments) (ds/m)				Mean
		2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 10.50)	
1	Makka	36.18	29.83	28.83	27.17	30.50 a
2	Rammah1	36.33	27.33	28.83	25.00	29.38 a
3	Nubaria1	30.67	28.33	27.17	25.00	27.79 a
4	Siwa1	36.50	31.83	28.83	26.50	30.92 a
5	Siwa2	33.17	26.83	26.83	30.67	29.38 a
6	Frafra	37.67	30.83	29.83	27.50	31.46 a
7	Sohage	36.00	27.50	25.83	28.83	29.54 a
8	Ega seed	34.67	27.67	27.67	25.00	28.75 a
9	Italian	30.17	19.83	22.00	21.50	23.36 b
10	Australian	23.50	26.00	28.33	19.83	24.42 b
Mean		33.42 a	27.60 b	25.70 b	27.42 b	
$L.S.D_{0.01\ gen.}$						4.558
$L.S.D_{0.01\ exp.}$				5.248		
$L.S.D_{0.01\ inter}$				n.s.		

Means of plant height after 45 days from sowing (cm) for alfalfa genotypes as affected by soil salinity levels (experiments) are presented in Table (8). Over the tested alfalfa genotypes, plant height after 45 days at moderate salinity level (42.60cm) was significantly reduced by about 19.83%, when genotypes were evaluated under a salinity level over 5.0 ds/m (34.15, 33.85 and 32.10cm for nearly 4.0, 6.0, 8.0 and 10.50 ds/m salinity levels, respectively). Plant height reduction at 45-day alfalfa stand was proportional to each increase in soil salinity, although, the differences that correlated with salinity over 5.0 ds/m were not significant.

Table 8. Means of plant height after 45 days from sowing (cm) for alfalfa genotypes as affected by soil salinity levels (experiments).

Genotypes		Salinity level (Experiments) (ds/m)				Mean
		2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 10.50)	
1	Makka	46.50	38.17	34.17	33.83	38.17 a
2	Rammah1	43.33	34.50	35.17	31.00	36.00 a
3	Nubaria1	41.33	30.50	32.17	30.83	33.71 a
4	Siwa1	42.83	37.00	33.00	36.83	37.42 a
5	Siwa2	46.83	34.33	35.17	36.50	32.21 b
6	Frafra	44.50	38.00	37.17	35.00	38.67a
7	Sohage	44.17	35.00	32.17	33.33	36.17 a
8	Egaseed	48.17	36.33	33.00	32.83	37.58 a
9	Italian	24.33	21.667	31.33	22.33	24.92 c
10	Australian	44.00	36.00	35.17	28.50	35.92 a
Mean		42.60 a	34.15 b	33.85 b	32.10 b	
$L.S.D_{0.01\ gen.}$						5.699
$L.S.D_{0.01\ exp.}$				7.061		
$L.S.D_{0.01\ inter}$				6.224		

At 45 days from sowing, growth potentiality of alfalfa genotypes over salinity levels, were similar, ranging between 38.67 and 33.71 cm, except for, Siwa2 and Italian populations that gave significantly descending plant height as 32.21 and 24.92 cm, respectively. The least growth potential (plant height) was expressed by Italian population, under any of the studied salinity levels (between 21.67 and 31.33 cm). While the highest plant height at 45 days stand were provided by any of the other studied populations under the least salinity level (between 48.17 and 43.33cm for Egaseed and Ramah1, respectively).

The meaning of plant height after 60 days from sowing (cm) for alfalfa genotypes as affected by soil salinity levels (experiments) are shown in Table (9). Over the evaluated alfalfa cultivars, plant height after 60 days (at first cutting date) was reduced, when soil salinity level reached 8.0 ds/m (experiment three). The difference between alfalfa plant heights under 4.0 or 6.0 ds/m was significantly similar (65.52 and 57.83 cm, respectively). Also, significantly similar plant heights were recorded under any of 8.0 or 10.50 ds/m salinity levels (56.33 and 54.83 cm, respectively). In the meantime, alfalfa cultivars expressed significantly similar plant height ranged between 57.28 for Farafra cultivar to 61.46 cm for Sohage cultivar, but Italian cultivar that gave significantly lower plant height (45.83 cm). Although, Sohage and Egaseed cultivars, scored about 70 cm of plant height under low salinity level (4.0ds/m) and both of Italian and Australian cultivars, gave as low as about 45 cm of plant height under the high level of salinity (10.50 ds/m), the difference between those extreme limits, failed to reach the level of significance. This might be due to that similar array of cultivar's plant height within each salinity level.

Table 9. Means of plant height after 60 days from sowing (cm) for alfalfa genotypes as affected by soil salinity levels (experiments).

Genotypes		Salinity level (Experiments) (ds/m)				Mean
		2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 (10.50)	
1	Makka	65.83	56.67	58.33	55.83	59.17 a
2	Rammah1	69.15	60.00	59.17	53.33	60.42 a
3	Nubaria1	66.83	62.50	59.17	51.67	60.04 a
4	Siwa1	69.17	57.50	58.33	58.33	60.83 a
5	Siwa2	66.67	61.67	55.00	60.83	61.04 a
6	Frafra	59.17	58.33	54.17	57.50	57.28 a
7	Sohage	70.83	55.00	60.00	60.00	61.46 a
8	Egaseed	70.00	60.83	54.17	60.00	61.25 a
9	Italian	50.67	43.03	45.17	44.17	45.83 b
10	Australian	66.67	62.50	60.00	46.67	58.96 a
Mean		65.52 a	57.83 a	56.33 b	54.83 b	
$L.S.D_{0.01\ gen.}$						6.889
$L.S.D_{0.01\ exp.}$				8.527		
$L.S.D_{0.01\ inter.}$				n.s.		

B2. Dry weight of alfalfa plant parts:

Analysis of variance for alfalfa plant part's dry weight (leaves, stems and root) after 40, and 60 days from sowing as affected by soil salinity level (experiment) and genotype are presented in Table (10). Salinity levels significantly ($P \geq 0.01$) affected alfalfa leaves, stems, and roots dry weight, in both recording dates (40, and 60 days from sowing, except for, leaves dry weight after 60 days from sowing. Alfalfa genotypes (cultivars) have

significantly similar dry leaves weight at any of 40 or 60 days from sowing. Differences among cultivars in stems dry weight had not reached until 60 days from sowing. Roots dry weight were significantly (P≥ 0.05) different among cultivars at any of the recorded dates (40 and 60 days from sowing). The interaction between salinity level and alfalfa genotype had not reached the level of significance in any of the studied plant part's dry weight. The might due to sampling error correlated with measuring such characters (high coefficient of variability values).

Table 10. Analysis of variance of alfalfa plant part's dry weight (leaves, stems and roots), after 40 and 60 days from sowing as affected by soil salinity level (experiments), and genotype

S.O.V.	d.f.	M.S.					
		Leaves		Stem		Roots	
		40 days	60 days	40 days	60 days	40 days	60 days
Experiments (E)	3	2.311**	0.1649$^{n.s.}$	1.674**	0.2555**	0.6685**	0.4690**
Rep/Exp	20	0.1879	0.1059	0.1004	0.0469	0.0502	0.00867
Genotypes (G)	9	0.0534$^{n.s.}$	0.0142$^{n.s.}$	0.0431$^{n.s.}$	0.0244*	0.0217*	0.0475*
E× G	27	0.0540$^{n.s.}$	0.0169$^{n.s.}$	0.0259$^{n.s.}$	0.0099$^{n.s.}$	0.0070$^{n.s.}$	0.0204$^{n.s.}$
Error	180	0.0389	0.0134	0.0182	0.0085	0.0072	0.0164
C.V.%		36.15%	41.22%	39.53%	37.80%	36.87%	34.06%

B2- 1. Leaves dry weight (g):

Means of alfalfa plant's leaves dry weight (g) after 40 and 60 days from sowing as affected soil salinity levels (experiments) and genotypes are illustrated in Table (11). Over the studied alfalfa genotypes, after 40 days from sowing, the highest significant dry weight of leaves (g) was reached at low salinity level experiment (16.16 g /plant). Whereas the second significant rank of leaves dry weight was developed under the highest studied salinity level (fourth experiment) (11.40 g/ plant). The third significant rank of leaves dry weight was expressed by the third level of soil salinity (8.0 ds/m) (9.062 g/plant). While the least significant value of leaves dry weight was that scored under moderate salinity (6.0 ds/m) (7.07 g/plant). It was worth to notice that the raise in soil salinity from 4.0 to 6.0 ds/m was associated with overall reduction in leaves dry weight/ plant of alfalfa genotypes. Meanwhile, plants under higher salinity level (8.0 and 10.50 ds/m), trained heavier weight of leaves/ plant. This might be a phenomenon in alfalfa adaptation to salinity level. In the meantime, genotypes of alfalfa had significantly similar dry weight leaves/ plant, ranged between 9.04 and 11.83 g/ plant.

After 60 days from sowing, dry weight of leaves/ plant, was significantly ascending with rise in soil salinity level (5.40, 6.25, and 6.61 g/plant for 4.0, 6.0 and 8.0 ds/m salinity levels, respectively). That that trend might indicate good adaptation of alfalfa to moderate salinity levels, which encouraged the makeup of leaves. While, at 10.5 ds/m salinity level, a significant reduction in leaves dry weight/plant was scored (4.25 g/plant). That reduction might indicate intolerance over alfalfa genotypes to high salinity level. Alfalfa genotypes expressed insignificant leaves dry weight values ranged between 4.87 to 6.46 g/ plant, over soil salinity levels. It was worth to notice that, leaves dry weight/ plant after 60 days from sowing was relatively lower that the respective recorded values after 40 days from sowing. This might indicate a tendency for leaves shattering.

The interaction between soil salinity level and alfalfa genotype failed to reach the significance level. This might due to the effect of sampling error associated with measuring such character.

Table 11. Means of alfalfa plant's leaves dry weight (g) after 40 and 60 days from sowing as affected by soil salinity levels (experiments) and genotypes.

Genotypes	After 40 days				Mean	After 60 days				Mean
	Soil salinity level (Exp.) (ds/m)					Soil salinity level (Exp.) (ds/m)				
	2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 (10.50)		2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 (10.50)	
Makka	13.04	6.90	9.14	14.12	10.8	4.17	6.43	7.62	3.87	5.52
Rammah1	15.30	6.95	9.02	10.79	10.51	4.81	6.27	5.45	4.89	5.35
Nubaria1	13.82	6.26	8.23	7.86	9.04	6.24	6.66	6.38	4.67	5.99
Siwa1	18.64	6.61	7.31	12.94	11.37	4.20	8.38	7.59	3.84	6.00
Siwa2	18.79	6.26	8.28	13.02	11.59	6.71	7.77	7.29	4.05	6.46
Frafra	18.16	7.15	8.30	11.37	11.25	5.32	5.51	7.74	4.89	5.87
Sohage	15.89	9.13	9.50	9.80	11.08	5.32	4.69	8.98	4.36	5.84
Ega seed	19.10	7.22	10.68	10.84	11.96	5.85	5.86	4.90	4.02	5.16
Italian	10.25	5.99	10.50	11.87	9.650	5.46	4.85	5.49	3.66	4.87
Australian	18.62	8.21	9.06	11.42	11.829	5.91	6.03	4.62	4.20	5.19
Mean	16.16	7.07	9.002	11.40		5.40	6.25	6.61	4.25	
L.S.D$_{0.01\ exp.}$			0.2251					0.1690		
L.S.D$_{0.01\ gen.}$					n.s.					n.s.
L.S.D$_{0.01\ inter.}$			n.s.					n.s.		

B2-2; stem dry weight (g):

Means of alfalfa stems dry weight/ plant after 40 and 60 days from sowing as affected by soil salinity levels (experiment) and genotypes are presented in Table (12).

After 40 days from sowing, stem dry weight was significantly reduced by about 39%, when alfalfa was sown in highly saline soil of 10.50 ds/m (11.79 *vs.* 4.65 g/ stem for salinity of 4.0 *vs.* 10.50 ds/m respectively). Sowing in higher

levels of salinity was associated with significantly lower stem dry weight. (5.07, 5.80, and 4.65 g/ stem under 6.0, 8.0 and 10.50 ds/m levels, respectively). Over salinity levels, alfalfa genotypes had significantly similar stem dry weigh between 5.55 and 8.24 (g).

After 60 days from sowing, dry wright of stem over the studied genotypes, was significantly descending with each increase in soil salinity level (6.53, 5.31, 3.98 and 3.70 g/stem for 4.0, 6.0, 8.0 and 10.50 (ds/m) salinity levels, respectively). Over salinity levels, Sohage, Siwa 1 and Nubaria 1, significantly enjoyed the heaviest stem weight (5.37, 5.34 and 5.29 g/stem, respectively). While the least significant stem dry weight was recorded by any of Australian and Italian cultivars (4.34 and 3.32 g/ stem, respectively).

The interaction between salinity level and alfalfa genotype in any of measuring dates failed to reach the level of significance, because of heterogeneity of errors. Also, lower magnitude of stem dry weight after 60 days from sowing under the first level of salinity (4.0ds/m) relative to the first recording date, might indicate a sampling error and or suppression due to longer exposure to salinity hazard.

Table 12. Means of alfalfa plant's stem dry weight (g) after 40 and 60 days from sowing as affected by soil salinity levels (experiments) and genotypes.

Genotypes	After 40 days				Mean	After 60 days				Mean
	Soil salinity level (Exp.) (ds/m)					Soil salinity level (Exp.) (ds/m)				
	2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 (10.50)		2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 (10.50)	
Makka	9.79	3.91	5.23	6.28	6.30	5.83	5.55	4.59	3.11	4.77
Rammah1	11.91	4.59	4.64	5.76	6.73	5.97	6.45	4.23	4.40	5.26
Nubaria1	9.08	4.05	4.36	4.71	5.55	7.31	5.44	4.03	4.41	5.29
Siwa1	13.28	4.46	4.37	6.96	7.27	6.55	6.32	4.57	3.91	5.34
Siwa2	13.93	3.83	4.64	6.20	7.15	5.84	7.26	3.73	3.80	5.16
Frafra	12.35	5.58	5.07	5.62	7.15	7.01	4.70	5.07	3.76	5.14
Sohage	12.73	6.86	5.32	5.01	7.48	7.55	4.56	5.46	3.91	5.37
Ega seed	16.15	4.78	6.54	5.51	8.24	7.98	5.06	2.80	3.43	4.52
Italian	7.79	3.21	5.34	5.74	5.52	4.58	3.36	2.63	2.72	3.32
Australian	10.89	5.27	5.19	6.21	6.89	6.65	4.45	2.73	3.51	4.34
Mean	11.79	4.65	5.07	5.80		6.53	5.31	3.98	3.70	
$L.S.D_{0.01\ exp.}$		0.1646					0.1125			
$L.S.D_{0.01\ gen.}$					n.s.					0.0590
$L.S.D_{0.01\ inter.}$		n.s.					n.s.			

B2-3; Roots dry weight (g):

Means of alfalfa plant's root dry weight (g) after 40 and 60 days from sowing as affected by soil salinity level (experiments), and genotype are illustrated in Table (13).

After 40 days from sowing, overall, the studied alfalfa genotypes, plant root dry weight (g), significantly descended from 7.67 to 4.30 to 3.50 to 2.974 g. $plant^{-1}$ with sowing in salinity levels of (4.0), (6.0), (8.0), and (10.50) ds/m, respectively. The magnitude of significant reduction in root dry weight after 40 days from sowing reached 43.94, 18.60, and 15.03% of that respective less salinity level, respectively.

Overall salinity levels, the heaviest root dry weight produced by Makka cultivar, followed by Egaseed (5.67 and 5.15 g/plant, respectively). Whereas the least root dry weight value was presented by the Italian cultivar (3.89 g. $plant^{-1}$).

Table 13. Means of alfalfa plant's root dry weight (g) after 40 and 60 days from sowing as affected by soil salinity levels (experiments), and genotypes.

Genotype	After 40 days				Mean	After 60 days				Mean
	Soil salinity level (Exp.) (ds/m)					Soil salinity level (Exp.) (ds/m)				
	2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 (10.50)		2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 (10.50)	
Makka	7.58	5.65	4.42	5.03	5.67	12.69	9.42	8.58	5.79	9.12 a
Rammah1	8.15	3.65	3.29	2.82	4.48	10.01	5.93	6.76	6.38	7.27 e
Nubaria1	6.31	3.62	2.68	2.30	3.93	8.76	6.30	7.52	4.97	6.89 g
Siwa1	7.05	4.57	3.31	2.68	4.40	11.60	7.96	5.52	5.24	7.58 el
Siwa2	7.99	4.09	2.60	2.16	4.21	10.34	8.04	5.86	6.03	7.57 d
Frafra	8.45	4.38	3.637	3.09	4.89	9.13	8.14	8.36	6.06	7.92 c
Sohage	8.62	4.05	3.71	4.00	5.10	9.33	10.39	9.17	5.76	8.66 b
Egaseed	9.17	4.21	4.47	2.77	5.15	9.26	6.21	7.67	5.12	7.07 f
Italian	5.42	4.35	3.79	1.98	.089	7.55	6.68	5.87	4.00	6.02 h
Australian	8.01	4.44	3.15	2.98	4.64	8.73	5.57	9.23	4.782	7.08 f
Mean	7.67	4.30	3.50	2.974		9.74	7.46	7.45	5.41	
$L.S.D_{0.01\ exp.}$		0.1164					0.0484			
$L.S.D_{0.01\ gen.}$					0.0496					0.0846
$L.S.D_{0.01\ inter.}$		n.s.					n.s.			

After 60 days from sowing, over the studied genotypes, plants developed heavier roots with adaptation to salinity condition. 9.74, 7.46, 7.45 and 5.41 g. $plant^{-1}$, dry roots were expressed under 4.0, 6.0, 8.0 and 10.50 (ds/m) levels of salinity. The magnitudes of reduction in root dry weight per plant were reduced by 23.40, 0.1340, and 27.38% of that respective less salinity level. It was worth to notice that alfalfa plants developed heavier roots with exposure to

salinity for longer time. Over salinity levels, Makka cultivar significantly maintained superiority in root dry weight (9.12 g. plant^{-1}), followed by Sohage cultivar (8.66 g.plant^{-1}). The least root dry weight. plant^{-1} was presented by Italian cultivar (6.02 g.plant^{-1}). Egaseed cultivar, that showed the second significant rank among cultivars in root dry weight after 40 days from sowing, showed a drastic significant inferior rank after 60 days from sowing. While Sohage cultivar showed a continuous tendency to proliferate roots, irrespective of the measuring date.

The interaction between salinity levels and alfalfa cultivars had not reached the level of significance. This might be due to heterogeneity of errors, and/ or errors correlated with sampling.

B3- Whole plant fresh and dry weight:

Mean squares of plant fresh and dry weight for alfalfa genotypes (cultivars) as affected by sail salinity levels (exp.) at first cutting (60 days from sowing) are presented in Table (14). Plant fresh and dry weights were significantly (P≥0.01) affected by soil salinity levels. While the studied alfalfa cultivars were significantly similar in fresh and dry plant weight. The interactions between salinity level and alfalfa cultivar were significant (P≥0.05) for fresh and dry plant weights.

Table 14. Mean squares of alfalfa genotypes plant fresh and dry weight as affected by soil salinity levels (Exp.) at first cutting (60 dazes from sowing),

S.O.V.	D.f.	M.S.	
		Fresh weight	Dry weight
Experiments (E)	3	52.55**	1.213**
Rep/Exp	20	2.999	0.078
Genotypes (G)	9	2.499$^{n.s.}$	0.075$^{n.s.}$
E× G	27	1.908*	0.053*
Error	180	1.268	0.032

Means of alfalfa genotypes plant fresh weight at first cutting (60 days from sowing) as affected by soil salinity levels at sowing (experiment) is shown in Table (15).Alfalfa plant fresh weight over all studied cultivars was reduced by about 22% when soil salinity level at sowing was changed from 4.0 to 6.0 ds/m (5.82 *vs* 4.55 g/ plant, respectively).

Table 15. Means of alfalfa plant fresh weigh (g) at first cutting (60 days from sowing) as affected by genotype and soil salinity level at sowing (experiment):

Genotypes		Salinity level (Experiments) (ds/m)				Mean
		2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 (10.50)	
1	Makka	5.21	4.50	3.80	3.98	4.37
2	Rammah1	5.61	3.95	3.72	3.83	4.27
3	Nubaria1	5.06	4.02	4.04	3.57	4.17
4	Siwa1	5.13	5.32	3.36	4.28	4.52
5	Siwa2	6.40	4.35	4.12	3.51	4.60
6	Frafra	7.59	4.62	4.17	3.43	4.95
7	Sohage	6.87	4.88	3.47	3.85	4.77
8	Egaseed	6.47	4.58	4.48	4.62	5.04
9	Italian	4.84	4.70	3.53	3.42	4.12
10	Australian	5.51	4.56	4.25	3.33	4.29
Mean		5.82	4.55	3.89	3.78	
L.S.D$_{0.01\ gen.}$						n.s.
L.S.D$_{0.01\ exp.}$			0.8995			
L.S.D$_{0.01\ inter.}$			1.282			

Further change in soil salinity level to 8.0 ds/m, gave less fresh weight. plant^{-1}, with insignificant effect (3.89 *vs* 4.55 g. plant^{-1} for 6.0 and 8.0 ds/m, respectively). The least fresh weight. Plant^{-1} was shown with planting in soil salinity of 10.5 ds/m (3.78 g. plant^{-1}). Over the studied soil salinity levels, alfalfa cultivars gave similar plant fresh weights ranged between 4.12 to 5.04 g.plant^{-1}. The highest significant plant fresh weight was scored for Farafra cultivar when sown in 4.0 ds/m level of soil salinity (7.59 g.plant^{-1}). Whereas, the least significant plant fresh weight was recorded for any of the studied cultivars when sown in 10.5 ds/m level of soil salinity (between 4.62 g.plant^{-1} (Egaseed) and 3.33 g.plant^{-1} (Australian)).

The meaning of alfalfa plant dry weight at first cutting (60 days from sowing as affected by genotype and soil salinity level at sowing (experiment), are presented in Table (16). Alfalfa plant dry weight was significantly reduced by about 21% when soil salinity at sowing was raised from 4.0 to 6.0 ds/m (0.92 *vs* 0.73 g.plant^{-1} ,respectively). The soil salinity raise over 6.0 ds/m was associated with a reduction in alfalfa plant dry weight, although, it has not reached the level of significance (0.63, and 0.62 g. plant^{-1} for 8.0 and 10.5 ds/m of soil salinity levels, respectively). The evaluated alfalfa cultivar gave similar plant dry weight ranged between 0.63 to 0.79 g. plant^{-1}. The highest plant dry weight was obtained from any of Siwa 2, Farafra, and Sohage cultivars, when sown in 4.0 ds/m salinity level (1.05, 1.15 and 1.14 g.plant^{-1}, respectively). The least plant dry weight was recorded by Italian cultivar sown in salinity of 10.5 ds/m (0.57 g.plant^{-1}). The former was significantly like all figures of plant dry weight that were recorded by any of the studied alfalfa cultivars when sown under any of 8.0 or 6.0 ds/m soil salinity levels, except for, Siwa 1, Farafra, and Sohage cultivars, that showed significantly higher dry plant weight under 6.0 ds/m salinity level. It was worthy to notice that, plant dry weight of all evaluated alfalfa cultivars, were suppressed by soil salinity over 4.0 ds/m, except for, Siwa 1, Farafra, and Sohage cultivars that surpassed the other cultivars when sown in 6.0 ds/m salinity level. High soil salinity (8.0and 10.5 ds/m) Significantly gave the least plant dry weight irrespective of the cultivar.

Table 16. Mean of alfalfa plant dry weight at first cutting (60 days from sowing) as affected by genotype and soil salinity levels at sowing (experiments):

Genotypes		Salinity level (Experiments) (ds/m)				Mean
		2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 (10.50)	
1	Makka	0.87	0.72	0.66	0.67	0.73
2	Rammah1	0.93	0.64	0.65	0.50	0.68
3	Nubaria1	0.78	0.62	0.62	0.60	0.65
4	Siwa1	0.85	0.83	0.70	0.56	0.73
5	Siwa2	1.05	0.68	0.64	0.74	0.77
6	Frafra	1.15	0.77	0.58	0.68	0.79
7	Sohage	1.14	0.82	0.64	0.53	0.78
8	Egaseed	1.00	0.71	0.55	0.65	0.77
9	Italian	0.67	0.74	0.70	0.57	0.63
10	Australian	0.86	0.74	0.54	0.69	0.71
Mean		0.92	0.73	0.63	0.62	
L.S.D$_{0.01\ exp.}$				0.1451		
L.S.D$_{0.05\ gen.}$						n.s.
L.S.D$_{0.01\ inter.}$				0.237		

B4- Number of nodules. plant^{-1}:

Number of nodules. plant^{-1} was traced as an indicator of symbiosis success in relation to soil salinity level at sowing and genotype. Mean squares of alfalfa genotype's number of nodules. plant^{-1} as affected by soil salinity level at sowing (experiment) are shown in Table (17). Soil salinity levels had an insignificant effect on the number of nodules. Plant^{-1}. Also, genotypes respond similarly indicating a similar number of nodules. plant^{-1}. The interaction between salinity level and cultivar was significant (P≥ 0.05), indicating different magnitude or direction of cultivars response to salinity levels.

Table 17. Mean squares of alfalfa genotypes number of modules. Plant^{-1}as affected by soil salinity levels (experiments):

S.O.V.	d.f.	M.S.
Experiments (E)	3	0.6751$^{n.s.}$
Rep/Exp	20	0.5419
Genotypes (G)	9	0.1103$^{n.s.}$
E× G	27	0.1207*
Pooled Error	180	0.0743
C.V.%		39.2

Means of alfalfa genotype's number of nodules. plant^{-1} at first cutting (60 days from sowing) as affect by soil salinity level at sowing (experiment) are presented in Table (18). Over the studied genotypes, number of nodules. plant^{-1} were similar among soil salinity levels, ranging between 5.78 to 8.05 nodules.plant^{-1}. Also, the evaluated cultivars had similar number of nodules ranged between 6.17 to 8.58 nodule. plant^{-1}. Under low salinity level, Italian and Australian cultivars, expressed the highest significant number of nodules.plant^{-1} (10.5 and 10.83 nodules. plant^{-1}). Also, under moderate (6.0ds/m) salinity level, Egaseed and Italian cultivars enjoyed the highest significant number of nodules. plant^{-1} (10.17 and 10.17 nodules.plant^{-1}, respectively). Under high level of soil salinity (8.0 and 10.5 ds/m) The most effective symbiosis was shown by Makka cultivar (8.17 and 6.5 nodules.plant^{-1}).

Table 18. Mean of alfalfa genotype's number of nodules. plant^{-1} at first cutting (60 days from sowing) as affected by soil salinity levels at sowing(experiments)

Genotypes		Salinity level (Experiments) (ds/m) 2.89-5.19 (4.0)	4.89-7.02 (6.0)	6.76-9.23 (8.0)	8.74-12.24 (10.50)	Mean
1	Makka	6.67	6.50	8.17	6.5	6.96
2	Rammah1	8.33	7.83	5.17	5.83	6.79
3	Nubaria1	8.67	5.17	6.50	4.33	6.17
4	Siwa1	8.67	5.33	5.83	5.50	6.33
5	Siwa2	7.00	8.67	6.00	6.00	6.92
6	Frafra	6.83	5.50	7.33	6.83	6.63
7	Sohage	6.83	8.67	5.00	6.00	6.63
8	Egaseed	6.17	10.17	6.33	5.67	7.08
9	Italian	10.5	10.17	7.33	6.33	8.58
10	Australian	10.83	8.17	5.83	4.83	7.42
Mean		8.05	7.62	6.35	5.78	
L.S.D$_{0.01\ gen.}$						n.s.
L.S.D$_{0.05\ exp.}$			n.s.			
L.S.D$_{0.01\ inter.}$						

Also, Farafra cultivar had heavy nodulation under high soil salinity level (6.83 nodule. Plant^{-1}). The least symbiosis tendency was shown by Australian cultivar under the very high soil salinity level (4.83 nodules .plant^{-1}). It was valuable to notice that sampling error of that recent character might masked the differences among the studied factors.

Evaluation of alfalfa germplasm was very frequent in the available literature. Mousa *et al*., (1996), evaluated six alfalfa varieties regarding development and productivity. They found significant differences among varieties in plant height, number of tillers/ plants, leaf/ stem ratio total fresh and dry forage yields. These differences were scored in early (first) cutting and seasonal yields. Oushy *et al*., (1999) evaluated alfalfa genotypes in sandy soil. Their results showed a significant difference among cultivars in leaf/ stem ratio. Also, the magnitude of leaves/ plant ratio was descending with the progress of crop life- cycle. Abd EL- Galil *et al*., (2000), evaluated five local and two introduced varieties of alfalfa in two sites (Ismaelia and the new valley). Productivity of varieties varied within location, with progress of season. Abd EL- Aziz and Helmy (2001), traced variations among five local (Ismailia 1, Iamailia 94, Siwa1, New valley and salt tolerant) and one introduced (WL- 605) varieties of alfalfa. Varieties varied in dry forage yield, plant height and leaf/ stem ratio. The highest dry forage yields and leaf/ stem ratio were produced by WL- 605, New valley and Iamailia 94. Meanwhile, Siwa and Ismailia 1 varieties enjoyed the highest figures of plant height. Oushy *et al*., (2007), evaluated five varieties of alfalfa, i.e; three introduced (U.S. Origin) and two local (Iamailia and Siwa), at two different locations (Ismailia and New Valley). Local cultivars were surpassing the other introduced varieties in forage yield potentiality in each cutting and overall cutting. Abd El- Galil and Hamed (2008), tested nine cultivars of alfalfa in the new valley region. Fresh and dry forage yields, plant height, tillers number and leaf/ stem ratio were variable among cultivars. The most correlated characters to other phonological traits were fresh and dry forage yield. Benabderrahim *et al*., (2009), evaluated twenty cultivars of alfalfa regarding forage yield and forage characters. The most noticeable variations among the studied cultivars were related to plant height and total fresh and dry forage yields. They noticed a negative correlation between dry matter percentage and plant height. While a positive correlation was noticed between stem diameter and dry matter percentage. Avci *et al*., (2010) evaluated some selected alfalfa lines for forage yield and quality. Differences among the tested lines in dry forage yield and plant height were highly significant. Rezaei *et al*., (2010), evaluated phenotypic variability among eighty-one ecotypes of alfalfa collected from Iran. All tested forage characters were variable among the tested cultivars. They found that stem characters have stronger influence on forage yield, relative to leaves characters. They concluded that the most important characters that contribute to forage yield are plant height and stem weight. Davodi *et al*., (2011), assessed the relationships among forage yield and characters of alfalfa under dry land farming system. They found that dry forage yield was positively correlated with each of plant height and stem numbers. In the meantime, dry forage yield was negatively correlated with leaf/ stem ratio. Ham dAlla *et al*., (2013), evaluated six varieties of alfalfa for forage yield and yield components, under arid conditions of the new valley. Varieties, significantly varied in plant height, number of tillers/ m^2 , leaf/stem ratio, seasoned fresh and dry forage yields. The most important characters that influenced forage yield were number of tillers/m^2, plant height and leaf/ stem ratio.

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قدرة عشائر البرسيم الحجازي المحلية والمستوردة على التأسيس تحت ظروف متدرجة من ملوحة التربة

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الملخص

الأهداف الأساسية للدراسة الحالية هو تقدير قدرة احدى عشر صنف محلي ومستورد من البرسيم الحجازي على تحمل الملوحة معبراً عنها بنسبة الإنبات والنمو خلال بداية التأسيس تحت أربعة مستويات متدرجه من ملوحة التربة. وعموماً، فإن عد نسبة الإنبات الحقلي بعد سبعة أيام من الزراعة أظهرت قدرة عشائر مكة ورماح 1 ونوبارية 1 وسوهاج على تحمل الأملاح في المستويات الأربعة المدروسة. أيضاً فإن عد الإنبات بعد 21 يوم قد دعم النتائج الأولية السابقة وأثبت بما لا يدعو إلى الشك أن الصنف "باكستاني" غير متحمل للأملاح. كما اتضح أن العشائر التي تطورت ونشأت في المناطق الجافة قد سجلت أفضل قيم للإنبثاق تحت جميع مستويات الملوحة. وبالرغم أن الأصناف "سوهاج" و "أجاسيد" قد سجلا قيم إرتفاع نبات بلغت 70 سم تحت مستوى الملوحة المنخفض (4 ديسيمتر/متر) وأن كلاً من الصنفين "استرالي" و"ايطالي" قد سجلا إرتفاع نبات بلغ 45 سم تحت مستوى الملوحة المرتفع (50,10 ديسيمتر/متر).وقد سجلت الأصناف "سوهاج" و "سيوة1" و"نوبارية1" فروقا معنوية وكان أثقل وزن للساق (5.37 و 5.34 و 5.29 جم/ ساق على الترتيب)، بينما سجل أقل وزن جاف للساق من أي من العشيرتين "أسترالي" و "إيطالي" (4.34 و 3.32 جم/ ساق على الترتيب). وقد تفوق الصنف "مكة" معنوياً في الوزن الجاف للجذر (9.12 جم/ نبات) يليه الصنف "سوهاج" (8.66 جم/ نبات). وقد سجل أعلى وزن جاف للنبات من الأصناف "سيوة2" و "فرافرة" و"سوهاج" وذلك عند زراعتها تحت مستوى ملوحة 4.00 ديسيمتر /متر (1.05 و 1.15 و 1.14 جم / نبات على الترتيب).