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WATER REQUIREMENTS OF ROSELLE (*Hibiscus sabdariffa* L.) PLANTS UNDER DIFFERENT RATES OF ORGANIC MANURES AND YEAST AS RELATION TO LEAF ANATOMICAL STRUCTURE

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ABSTRACT: Three field experiments were carried out during three successive summer seasons of 2006, 2007 and 2008 at the Experimental Farm, El-Kassasein Research Station, Ismailia governorate, to investigate the ameliorative effect of poultry manures at rates (10, 20, 40 or 60m^3/fed.) and different concentrations of active yeast extract (2, 4, 6 or 8 g/L.) on roselle plants (*Hibiscus sabdariffa* L.) cultivated in new reclaimed soil under limited water supply, the plants received 560, 1120, 1680 or 2240 m^3 water/fed. /season. The results indicated that, fresh weight of fruits yield per fed. increased with increasing water supply, poultry manures and active dry yeast. On the other side proline, total soluble sugar contents and osmotic pressure of roselle plant leaves significantly increased with decreasing amount of water supply, while application of poultry manures and active dry yeast significantly decreased them. The interaction between poultry manures and active dry yeast had ameliorative effect against shortage of water supply by decreasing proline and total soluble sugars content and osmotic pressure of roselle plant leaves. This decreasing was clear with applied poultry manures of 40 m^3 /fed. and active dry yeast at 8 g/L. In addition, increasing the anatomical characters recorded (midvien thickness and width, midvien vascular bundle thickness and width,

blade thickness, palisade and spongy tissue thickness, average xylem vessel diameter and No. of xylem rows in midvien vascular bundle) due to the high levels of yeast and poultry manures.

Key words: Poultry manures, active dry yeast, water relations, anatomy, Roselle plants. (*Hibiscus sabdariffa* L.)

INTRODUCTION

Roselle plants (*Hibiscus sabdariffa* L.) now cultivated in Egypt, its origin in Sudan, Ceylan and tropical regions of Mexico. Sepals contain anthocyanin, mixture of organic acids (malic, citric, tartaric and hibiscus acid). Its tasted acid tonic, well tolerated by patients with fever. It also use to give medicine an acidic flavor and as a refreshing lissome which is mildly laxative. It is also prepared as sachets of powdered rose hip teas (Paris, 1977). It has antibacterial, antifungal and diuretic activities (Caceres *et al.*, 1987; Shihata *et al.*, 1983 and Guerin and Reveillere, 1984). Roselle plants contain anthocyanin glycoside and flavones pigments in the sepals. Economically, it is one of the important crops in preparing both hot and cold soft drinks known as Karkade (Osman and Jacoub, 1970). Muller and Fanz (1992) reported that, the aqueous extraction of dried calyces has many medicinal properties as decreasing blood pressure.

Water is a principal limitation to agricultural production during drought and in arid regions of the world. Exposure of plants to a water-limiting environment during various developmental stages appears to activate various physiological and anatomical changes.

Accumulation of organic acids and osmolytes, and changes in carbohydrate metabolism, are typical physiological and biochemical responses to drought stress.

One of the most important responses of plants to abiotic stresses is an overproduction of different types of compatible solutes. One of these solutes, proline (Ashraf and Harris, 2004 and Serraj and Sinclair, 2002) is widely distributed in plants and it accumulates in larger amounts than other amino acids in drought stressed plants (Ashraf, 2004). Similarly, total free amino acids, proline and total soluble sugars in leaves increased in alfalfa plants. (Irigoyen *et al.*, 1992).

Drip irrigation system has already been established as recommended method for corps production especially under sandy soil conditions. Drip irrigation is asides giving a saving of 32% as compared with surface irrigation system. Yousef (2002) on chamomil applied irrigation at rate 2802 m^3/fed/season and Abou El-Khair (2004) on garlic applied 2400 m^3/fed/season, gave the highest production under sandy soil conditions.

Biodynamic agriculture is one of the more recent methods used to improve the yield and quality of roselle plant without using any synthetic chemicals for fertilization or pest and diseases control. Organic fertilization is very important factor for providing plants with their nutritional requirements without having an undesirable impact on the environment. Such agricultural methods are particularly interest and significantly important in the newly reclaimed lands, where they not only help in increasing and stabilizing soil fertility, but also sustain and improve the chemical and physical characteristics of that soil. This approach is particularly important in the newly reclaimed lands, where it improve chemical and physical characteristics of the soil sustain and soil fertility to support high crop yield (Lampkin, 1990). Mohamed and Matter (2001) and Yousef (2002) reported that the organic fertilizers consider save for human health.

Foliar spray of yeast on fruit plants has recently received apparent interest. The various positive effects of applying active dry yeast were attributed to its content of different nutrients, higher percentage of proteins, large amount of vitamin B and natural plant growth hormones (cytokinins). In addition, application of active dry yeast is very effective in releasing CO_2 which improves net photosynthesis (Ferguson *et al.*, 1987).

Subba Roa (1984) and Ahmed *et al* (1995) mentioned that, active dry yeast as a foliar fertilizer enhanced growth and trees nutritional status. El-Ghadban *et al* (2003) found that spraying castor bean (*Ricinus communis* L.) with 3g/L active dry yeast and complete fertilizer (sengral) caused the highest values of vegetative growth, fruits, seeds and concentration of fixed oil in seeds.

The highest dry weight of sepals/plant and the maximum values of anthocynin content of roselle plants was obtained when applied the high rate of irrigation, the high level of organic manure and active dry yeast (Ahmed, *et a.l,* 1998; Sidky *et al.*, 1998 and Hasan, 2007).

The present study aimed to evaluate the effect of poultry manures and dry yeast on some water relations (physiological and anatomical aspects) of Roselle plants grown in new reclaimed soils under limited irrigation conditions.

MATERIALS AND METHODS

The field experiment was carried out at the Experimental Farm of Horticultural Research Station, El-Quassassin, Ismailia Governorate, Egypt, during the three seasons of 2006, 2007 and 2008.

Seeds of Roselle plants were obtained from the Department of Medicinal and Aromatic Plants, Horticultural Research Institute, Agricultural Research Center, Dokki, Ministry of Agriculture, Egypt.

Seeds were sown on 20th April for three successive seasons. Five seeds were sown per hill in the row. The experiment was irrigated with drip irrigation system twice/week. Pipe lines from plastic material of (16 mm diameter) were arranged in the lateral sides. The space between pipe lines were 60 cm, and 50 cm between plants on the row. Each plot was (3 X 3 m^2) and contained 5 rows cultivated with 30 plants. The seedlings were thinned to one plant per hill after one month from sowing.

Treatments Application

Irrigation treatments

Drip irrigation system was used in this experiment, the dropper gave 4 L/h, discharge for each at 0.5 Bar. The amount of applied water irrigation as liter/plant and m^3/fed. for irrigation treatments were determined during the growth period and shown in Table (1a).

At first and second seasons, the amount of water was 560 m^3/fed, 1120 m^3/fed. and 1680 m^3/fed.

While at the third season; 1120 m^3/fed,1680 m^3/fed. and 2240 m^3/fed. were applied.

Fertilizer treatments

Poultry manures (PM) was added once 15th June beside the plants in channel and covered it by sandy soil at 4 rates (10, 20, 30 and 40m^3/fed.). The chemical composition of the air dry poultry manures (PM) is shown in Table (1b).

Table 1a. Irrigation treatments and water amount added per plant and per fed. during the plant growing season

The irrigation period (minute) /time	The amount of irrigation water (liter)/time/plant	The amount of irrigation water (liter)/ week/plant	Water quantity (liter)/plant /season	Water quantity (m^3)/fed. /season
15 minute	1 liter/plant	2 liters/plant	40 liters/plant	560 m^3/fed.
30 minute	2 liters/plant	4 liters/plant	80 liters/plant	1120 m^3/fed.
45 minute	3 liters/plant	6 liters/plant	120 liters/plant	1680 m^3/fed.
60 minute	4 liters/plant	8 liters/plant	160 liters/plant	2240 m^3/fed.

Table 1b. Poultry manures analysis in the three seasons

Characters	1st season	2nd season	3rd season
Moisture content %	23.62	27.31	25.74
C/N ratio %	7.45	6.78	8.36
Organic matter%	44.53	49.82	46.56
Organic carbon %	23.67	24.86	30.72
Macro elements :			
N%	3.57	3.82	3.94
P%	1.14	1.18	1.15
K%	1.92	1.87	1.69
Micro elements :			
Cu (ppm)	31.00	35.00	34.00
Zn (ppm	180.00	176.00	192.00
Mn(ppm	168.00	183.00	192.00
Fe(ppm)	280.00	227.00	334.00
E.C (mmohs/cm)	7.24	6.80	7.54
pH	7.40	7.90	8.10

Active dry yeast treatments

Active dry yeast solution was prepared as described by Skoog and Miller (1957), at rates of 2, 4, 6 and 8 g/L. The plants were sprayed by these treatments three times, the first one applied after one month of cultivation whereas the second and third ones were applied every month. The composition of active dry yeast solution employed in the experiment was recorded by Nagodawithana (1991).

The treatments were arranged in a split split plot design with three replicates. The irrigation was arranged in the main plots, while the various levels of organic manures (poultry manures, PM) were assigned at random in the sub plot. Whereas active dry yeast solution rates were randomly arranged in the sub sub plots. Two lines were left between each two irrigation experimental plots avoid the overlapping in filtration.

Recorded Data

Fresh weight of fruits yield

At the harvest time (October 15^{th}) in the three seasons, three plants from the middle lines of experimental unit were used to recorded fresh weight of fruits ton/fed .Total fruits yield (ton/fed.) was calculated on the base of fruits yield per plant X number of plants per fed..

Proline content, Total soluble sugars (TSS) and Osmotic pressure were measured At the flowering stage (September 15^{th}) in the three seasons.

Proline content

Proline content was determined using the method of Bates *et al.*, (1973). Pure proline was used as a standard.

Total soluble sugars (TSS)

Total soluble sugars were measured in an ethanol extract of roselle fresh leaves, using phenol-sulfuric method according to Dubois *et al.* (1956). Pure glucose was used as standard.

Osmotic pressure

Osmotic pressure in fresh leaves was determined according to Gosev (1960).

Anatomical study

Specimens of selected moderate irrigation treatments (1680 m^3/fed.) at the age of 120 days (at the 3^{rd} season) from 6^{th} leaf from the apex of roselle plants were sectioned as described by Willy (1971). The sections were photographed by using light microscope (Olympus) with digital camera (Canon Power Shot S80) connected to computer; the photographs were taken by Zoom Browser Ex program. The dimensions of leaf sections were measured by using Corel Draw program ver. 11.

Statistical Analysis

The obtained data were statistically treated by using ANOVA according Snedecor and Cochran (1980). The differences between means were examined by LSD at 5% using spss prog. Ver.16.

RESULTS AND DISCUSSION

Fresh Weight of Fruits Yield per fed.

Data in Table 2 show the effect of irrigation, poultry manures and active dry yeast on fresh weight of fruits yield per fed. (ton) of Roselle plant.

The results in table 2-a show the main effect of irrigation, poultry manures and dry yeast treatments, the data presented clear that, significantly increased the fresh weight of fruits yield per fed. (ton) as irrigation amount was increased from 560 to 1680 m^3/fed/season in the first and second season, and the increasing of water irrigation amount to 2240 m^3/fed/season in the third season gave more significant increase in the fresh weight of fruits yield per fed.

The positive response of water irrigation amount are in harmony with many authors, as yousf (2002) on *Matricaria chamomilla* L. found that, increasing water irrigation amount resulted significant increase to fresh and dry weight of inflorescences per plant and Hasan, Hayat (2007) found the same trend on roselle plant.

As for the main effect of poultry manures, the data indicate that, there is a significantly increase in fresh weight of fruits yield per fed. as increasing the rate of poultry manures from 10 to 40 m^3/fed.in the three seasons.

Application the highest rate of poultry manures up to 40 m^3/fed.resulted the highest fresh weight of fruits yield per fed. (16.486, 15.439 and 19.062 ton) with an increase of (30.55, 22.99 and 14.77 %) fresh weight compared to the less rate (10 m^3/fed.) in the three seasons, respectively.

Also, the main effect of active dry yeast, the results show that, the increased rate of active dry yeast from 2 to 8 g/l resulted significant increase in fresh weight of fruits yield/fed. in the three seasons, the maximum values of fresh weight of fruits yield/fed. (14.398, 13.745 and 18.071 ton) obtained by applied the high rate of active dry yeast (8 g/l) in the three seasons, respectively.

As for the effect of interaction between irrigation and poultry manures, the data in Table 2-b1 reveal the fresh weight of fruits yield per fed. as affected by the interaction between irrigation and poultry manures treatments. There was significant increase in fresh weight of fruits yield per fed. as a result of increasing amount of both irrigation and poultry manures in the three seasons. The recorded values were 25.961 and 21.868 ton fresh weight when applied the highest rate of irrigation and poultry manures in the first and second seasons. In the third season, when increasing of irrigation water amount to 2240 m^3/fed/season combined with the highest rate of poultry manures (40 m^3/fed.) resulted the highest fresh weight of fruits yield per fed. (22.694 ton).

The effect of interaction between irrigation and active dry yeast, the data in Table 2-b2 showed that, the fresh weight of fruits yield per fed. as affected by the interaction between irrigation and active dry yeast treatments in this work and the maximum values of fresh weight of fruits yield obtained when applied irrigation water amount at 1680 m^3/fed/season combined with active dry yeast at 8 g/l gave 22.092 and 19.068 ton fresh weight of fruits yield per fed. in the first and second seasons.

On the other hand the data show that the interaction did not significant increase the fresh weight of fruits yield per fed. in the third season.

As for as, the effect of interaction between poultry manures and active dry yeast treatments resulted in similar significant increase in fresh weight of fruits yield per fed. in the three seasons. However, applied the treatment of poultry manures at 40 m^3/fed.combined with active dry yeast at 8 g/l resulted the highest significant values of fresh weight of fruits yield per fed. (17.794, 16.25 and 19.502 ton) in the third seasons, respectively.

Regarding, the effect of general interaction between irrigation, poultry manures and active dry yeast, the data in Table 2-c show insignificant increase on fresh weight of fruits yield per fed. in third season only.

Table 2. Effect of irrigation, poultry manures, dry yeast treatments and their interactions on fresh weight of fruits (ton)/fed. of roselle plants during three seasons of 2006, 2007 and 2008

a- The main effects

Irrigation: Treatments \ Season	1st	2nd	3rd	Poultry manures: Treatments \ Season	1st	2nd	3rd	Active dry yeast: Treatments \ Season	1st	2nd	3rd
560 m³/fed	7.652	7.941		10 m³/fed.	11.450	11.890	16.247	2 g/l	12.778	12.646	17.134
1120 m³/fed	12.302	12.898	12.743	20 m³/fed	12.737	12.243	17.156	4 g/l	13.245	12.975	17.406
1680 m³/fed	20.716	18.784	18.206	30 m³/fed	13.958	14.570	17.888	6 g/l	13.805	13.464	17.740
2240 m³/fed			21.816	40 m³/fed	16.486	15.439	19.062	8 g/l	14.398	13.745	18.071
L.S.D. at 5%	0.684	0.962	0.987	L.S.D. at 5%	1.126	1.006	0.987	L.S.D. at 5%	0.895	0.598	1.232
L.S.D. at 1%	1.265	1.236	1.652	L.S.D. at 1%	1.368	1.468	1.265	L.S.D. at 1%	1.698	1.369	1.985

Table 2- b_1. Interaction between irrigation and poultry manures

Season	1st				2nd				3rd			
Irrigation \ Poultry manures	10 m³/fed	20 m³/fed	30 m³/fed	40 m³/fed	10 m³/fed	20 m³/fed	30 m³/fed	40 m³/fed	10 m³/fed	20 m³/fed	30 m³/fed	40 m³/fed
560 m³/fed	5.496	6.745	8.267	10.099	5.404	7.378	8.594	10.374				
1120 m³/fed	11.354	12.577	11.873	13.399	11.732	12.894	12.880	14.0707	11.6200	12.186	12.684	12.462
1680 m³/fed	16.282	18.886	21.733	25.961	16.128	16.436	20.678	21.868	16.268	17.584	18.928	20.020
2240 m³/fed									20.846	21.686	22.022	22.694
L.S.D. at 5%	0.896				1.026				0.965			
L.S.D. at 1%	1.698				2.023				1.654			

Table 2- b_2. Interaction between irrigation and active dry yeast

Season	1st				2nd				3rd			
Yeas / Irrigation	2 g/l	4 g/l	6 g/l	8 g/l	2 g/l	4 g/l	6 g/l	8 g/l	2 g/l	4 g/l	6 g/l	8 g/l
560 m^3/fed	7.084	7.490	7.826	8.190	7.154	7.616	8.106	8.862				
1120 m^3/fed	11.802	12.054	12.446	12.880	12.026	12.740	13.496	13.286	12.264	12.661	12.752	13.258
1680 m^3/fed	19.432	20.174	19.726	22.092	18.740	18.536	18.760	19.068	17.640	17.029	18.466	18.760
2240 m^3/fed									21.476	21.616	21.854	22.162
L.S.D. at 5%	0.758				1.069				N.S			
L.S.D. at 1%	1.654				2.052				N.S			

Table 2- b_3. Interaction between poultry manures and active dry yeast

Season	1st				2nd				3rd			
Yeast / Poultry manures	2 g/l	4 g/l	6 g/l	8 g/l	2 g/l	4 g/l	6 g/l	8 g/l	2 g/l	4 g/l	6 g/l	8 g/l
10 m^3/fed.	10.486	10.728	11.242	11.704	10.318	10.696	11.606	13.118	15.582	16.730	17.416	18.788
20 m^3/fed	12.110	12.502	13.048	13.258	12.124	11.718	11.970	13.118	16.016	17.066	17.584	18.914
30 m^3/fed	13.160	13.664	14.168	14.812	13.720	14.238	14.378	13.860	16.534	17.338	18.046	19.012
40 m^3/fed	15.330	16.044	16.744	17.794	14.392	15.232	15.862	16.256	16.814	17.472	18.466	19.502
L.S.D. at 5%	0.685				0.859				N.S			
L.S.D. at 1%	1.632				1.856				N.S			

Table 2-c. Interaction between irrigation, poultry manures and active dry yeast

Irrigation	Season	1st				2nd				3rd			
	Yeas / Poultry manures	2 g/l	4 g/l	6 g/l	8 g/l	2 g/l	4 g/l	6 g/l	8 g/l	2 g/l	4 g/l	6 g/l	8 g/l
560 m^3/fed	10 m^3/fed.	5.026	5.390	5.614	5.936	4.410	4.662	5.936	6.608				
	20 m^3/fed	6.258	6.608	7.042	7.056	6.454	6.804	7.364	8.862				
	30 m^3/fed	7.574	7.910	8.414	9.142	8.190	8.596	8.722	8.848				
	40 m^3/fed	9.450	10.024	10.248	10.640	9.534	10.416	10.402	11.130				
1120 m^3/fed	10 m^3/fed.	10.934	11.200	11.466	11.788	11.200	11.074	12.754	11.886	11.088	11.578	11.956	11.844
	20 m^3/fed	12.138	12.404	12.026	13.034	12.110	12.684	12.950	13.846	11.774	12.460	12.124	12.362
	30 m^3/fed	11.410	11.802	13.152	12.236	12.208	13.216	13.076	12.936	12.448	12.502	12.600	13.146
	40 m^3/fed	12.726	12.810	13.566	14.462	12.600	13.930	15.232	14.504	13.720	14.070	14.364	15.694
1680 m^3/fed	10 m^3/fed.	15.498	15.610	16.618	17.374	15.344	16.352	16.142	16.674	15.288	15.876	16.534	17.346
	20 m^3/fed	17.934	18.508	19.390	19.684	17.822	15.680	15.910	16.660	17.122	17.262	18.102	17.580
	30 m^3/fed	20.496	21.294	22.092	23.062	20.762	20.804	21.336	19.824	18.242	18.494	19.222	19.754
	40 m^3/fed	23.814	25.298	26.418	28.280	21.028	21.322	21.966	23.114	19.908	20.048	20.020	20.104
2240 m^3/fed	10 m^3/fed.									20.384	20.594	21.126	21.252
	20 m^3/fed									21.280	21.490	21.770	22.148
	30 m^3/fed									21.504	21.770	22.330	26.712
	40 m^3/fed									22.736	22.638	22.666	22.722
L.S.D. at 5%		0.789				0.685				N.S			
L.S.D. at 1%		1.698				1.985				N.S			

But this interaction has significantly effect in the first and second seasons. While increasing the amount of irrigation water to1680 m^3/fed/season combined with the highest rate of poultry manures at 40 m^3/fed.plus the highest rate of the active dry yeast 8 g/l resulted the maximum values of fresh weight of fruits yield per fed. of roselle plant (28.280 and 23.114 ton) in the first and second seasons respectively. Increasing irrigation water amount to 2240 m^3/fed./season in combination with poultry manures at 30 m^3/fed.plus the highest rate of active dry yeast at 8 g/l gave the highest of fresh weight of fruits yield per fed. (26.712 ton) in the third season.

Proline Content

Data in Table 3 show the effect of water amount supply, poultry manures and foliar application of active dry yeast on proline content of Roselle plant leaves.

The results of main effect Table 3-a indicate that, the proline percentage was significantly affected with irrigation treatments. The maximum proline content (5.50, 5.70 and 5.94 μg/g fresh wt. in the three seasons, respectively) was obtained by irrigated Roselle plants with 560m^3/fed/season. Increasing the amount of water supply to 1680 and 2240 m^3/fed/season resulted in minimizing proline content in roselle plant leaves (5.29, 5.41 and 5.63μg/g fresh wt. in the three seasons, respectively). Increase in proline content in the plant tissues represent as a symptom to abiotic stresses (drought, salinity, frost, waterlogging and high and low temperatures). The present study indicated that irrigation Roselle plants with 560m^3/fed/season represent a drought stress on the plants.

Proline oxidation proceeds readily in turgid tissues and this processes stimulated by high concentration of proline. This suggests that proline oxidation could function as a control mechanism for maintaining low cellular levels of proline in turgid cells. However, proline oxidation is reduced to negligible rate under water stress. It seems likely that inhibition of proline oxidation is necessary in maintaining high levels of proline found under water stress (Stewort, 1977).

Proline is a non-protein amino acid that forms in most tissues subjected to water stress and, together with sugar, it is readily metabolized upon recovery from drought (Kameli and Losel, 1993 and Singh *et al.*, 2000). In addition to acting as an osmoprotectant, proline also serves as a sink for energy to regulate redox potentials, as a hydroxyl radical scavenger (Sharma and Dietz, 2006), as a solute that protects macromolecules against denaturation, and as a means of reducing acidity in the cell (Kishor *et al.,* 1995 and Kishor *et al.*, 2005). However, Vendruscolo *et al.* (2007) stated that proline might confer drought stress tolerance to wheat plants by increasing the antioxidant system rather than as an osmotic adjustment.

Proline content of roselle plant leaves decreased with gradual increase in poultry manures (10, 20 and 40m^3/fed.) added to the soil and increase in the concentration of active dry yeast extract (2, 4, 6 and 8g/L) in the foliar applied solution through the three studied seasons Table 3-a. The present results are in harmony with those obtained by Nour (2005) on cowpea.

Plants under stress (irrigated at rate 1120 m^3/fed, fertilized at rate 10 m^3 poultry manures/fed.and sprayed with 2 gm/L of active dry yeast) produced the maximum values of proline percentage (Allen, 1995).

The data in Table 3-b represents the interaction effect between each two factors. In the case of interaction between irrigation levels and poultry manures quantities, proline content in plant leaves significantly decreased by increasing water supply and poultry manuress in the three studied seasons. But the maximum proline content was recorded in the leaves of roselle plants obtained 560 or 1120m^3 water/fed/season + 10m3/fed.poultry manures. The effect of interaction between irrigation levels and concentrations of active dry yeast extract has similar trend that obtained by the interaction between irrigation levels and poultry manures quantities. The interaction between poultry manuress and active dry yeast has significant effect on proline content of roselle leaves. High quantities of poultry manuress and high concentrations of active dry yeast (40m^3/fed.poultry manures + 8g/L active dry yeast) significantly reduced leaves proline content, while high proline content was obtained by fertilizing by 10m^3/fed.poultry manures and spray plants with 8g/L active dry yeast.

Data in the Table 3-c represent the interaction between irrigation, poultry manures and active dry

Table 3. Effect of irrigation, poultry manures, active dry yeast treatments and their interactions on proline (µg/g fresh wt.) content of roselle plants leaves during the three seasons of 2006, 2007 and 2008

a- The main effects

Irrigation				Poultry manures				Active dry yeast			
Season / Treatments	1st	2nd	3rd	Season / Treatments	1st	2nd	3rd	Season / Treatments	1st	2nd	3rd
560 m³/fed	5.50	5.70		**10 m³/fed.**	5.53	5.73	5.97	**2g/L**	5.76	5.86	6.06
1120 m³/fed	5.42	5.55	5.94	**20 m³/fed**	5.49	5.62	5.85	**4g/L**	5.52	5.69	5.90
1680 m³/fed	5.29	5.41	5.74	**30 m³/fed**	5.38	5.53	5.69	**6g/L**	5.29	5.43	5.66
2240 m³/fed			5.63	**40 m³/fed**	5.22	5.35	5.56	**8g/L**	5.05	5.25	5.45
L.S.D. at 5%	0.053	0.062	0.022	**L.S.D. at 5%**	0.043	0.047	0.033	**L.S.D. at 5%**	0.032	0.044	0.031
L.S.D. at 1 %	0.088	0.103	0.036	**L.S.D. at 1%**	0.059	0.064	0.045	**L.S.D. at 1%**	0.043	0.058	0.042

Table 3-b₁.Interaction between irrigation and poultry manures

Season	1st				2nd				3rd			
Poultry manures / Irrigation	10 m³/fed	20 m³/fed	30 m³/fed	40 m³/fed	10 m³/fed	20 m³/fed	30 m³/fed	40 m³/fed	10 m³/fed	20 m³/fed	30 m³/fed	40 m³/fed
560 m³/fed	5.63	5.54	5.47	5.35	5.87	5.86	5.59	5.50				
1120 m³/fed	5.53	5.49	5.45	5.22	5.76	5.49	5.60	5.37	6.13	6.10	5.75	5.77
1680 m³/fed	5.42	5.43	5.22	5.09	5.56	5.50	5.40	5.19	5.97	5.68	5.68	5.62
2240 m³/fed									5.82	5.76	5.64	5.28
L.S.D. at 5%	0.075				0.081				0.056			
L.S.D. at 1%	0.126				0.110				0.077			

Table 3- b$_2$. Interaction between irrigation and active dry yeast

Season	1st				2nd				3rd			
Irrigation \ Yeast	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L
560 m^3/fed	5.80	5.60	5.39	5.20	5.93	5.84	5.63	5.41				
1120 m^3/fed	5.79	5.54	5.31	5.05	5.86	5.74	5.33	5.28	6.14	6.07	5.89	5.65
1680 m^3/fed	5.68	5.42	5.18	4.89	5.80	5.48	5.32	5.05	6.04	5.89	5.58	5.43
2240 m^3/fed									5.98	5.73	5.51	5.28
L.S.D. at 5%	0.056				0.076				0.055			
L.S.D. at 1%	0.074				0.101				0.072			

Table 3- b$_3$. Interaction between poultry manures and active dry yeast

Season	1st				2nd				3rd			
Poultry manures \ Yeast	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L
10 m^3/fed.	5.90	5.72	5.39	5.11	6.06	5.88	5.60	5.38	6.21	6.09	5.90	5.69
20 m^3/fed	5.88	5.52	5.37	5.19	5.80	5.77	5.47	5.43	6.08	5.96	5.72	5.63
30 m^3/fed	5.72	5.49	5.24	5.06	5.96	5.68	5.40	5.09	6.07	5.84	5.66	5.19
40 m^3/fed	5.53	5.34	5.17	4.83	5.64	5.43	5.24	5.09	5.87	5.70	5.37	5.29
L.S.D. at 5%	0.065				0.087				0.063			
L.S.D. at 1%	0.086				0.116				0.084			

Table 3-c. Interaction between irrigation, poultry manures and active dry yeast

Irrigations	Season	1st				2nd				3rd			
	Yeast / Poultry manures	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L
560 m³/fed	10 m³/fed.	6.00	5.83	5.47	5.23	6.07	6.03	5.77	5.60				
	20 m³/fed	5.90	5.47	5.43	5.37	6.00	5.97	5.83	5.63				
	30 m³/fed	5.70	5.60	5.37	5.20	5.97	5.77	5.50	5.13				
	40 m³/fed	5.60	5.50	5.30	5.00	5.70	5.60	5.43	5.27				
1120 m³/fed	10 m³/fed.	5.90	5.73	5.40	5.10	6.10	5.97	5.60	5.37	6.33	6.23	6.13	5.83
	20 m³/fed	5.93	5.57	5.37	5.10	5.70	5.67	5.17	5.43	6.20	6.17	6.13	5.90
	30 m³/fed	5.77	5.57	5.37	5.10	6.00	5.90	5.37	5.13	6.07	5.96	5.63	5.33
	40 m³/fed	5.57	5.30	5.10	4.90	5.63	5.43	5.20	5.20	5.97	5.90	5.67	5.53
1680 m³/fed	10 m³/fed.	5.80	5.60	5.30	5.00	6.00	5.63	5.43	5.17	6.20	6.10	5.93	5.63
	20 m³/fed	5.80	5.53	5.30	5.10	5.70	5.67	5.40	5.23	6.00	5.80	5.47	5.47
	30 m³/fed	5.70	5.30	5.00	4.87	5.90	5.37	5.33	5.00	6.10	5.90	5.60	5.10
	40 m³/fed	5.43	5.23	5.10	4.60	5.60	5.27	5.10	4.80	5.87	5.77	5.33	5.50
2240 m³/fed	10 m³/fed.									6.10	5.93	5.63	5.60
	20 m³/fed									6.03	5.90	5.57	5.53
	30 m³/fed									6.03	5.67	5.73	5.13
	40 m³/fed									5.77	5.43	5.10	4.83
L.S.D. at 5%		0.112				0.151				0.109			
L.S.D. at 1%		0.149				0.201				0.145			

yeast. It is evident that the interaction treatments have significant effect on proline content of roselle plant leaves. The lowest values of proline were obtained as a result of combination treatment of 1680 or 2240 m^3/fed. /season + 40m^3/fed. poultry manures + 8g/L active dry yeast (4.60, 4.80 or 4.83µg/g fresh wt. in the three seasons, respectively). While the highest values of proline content (6.00, 6.07 or 6.33µg/g fresh wt. in the three seasons, respectively) were obtained when using the lowest levels of water irrigation (560 or 1120 m^3/fed.) plus the lowest quantity of poultry manures (10 m^3/fed.) + the less weight of active dry yeast (2g/L). The increase in poultry manures quantity and concentration of active dry yeast resulting significant decrease in leaf proline content of roselle plants supplied 560 m^3 water/fed/season.

Interaction treatment of poultry manures and active dry yeast have ameliorative effect against water stress this due to the following reasons. Organic manures provided better soil environment in terms of physical and chemical properties (Mishra *et al.*, 1990; Hati *et al.*, 2001). Organic fertilizers represent as storage-house for essential nutrients needed for plant growth, however Shepherd and Withers (1999) mentioned that poultry manures contains approximately 40% of total N in a relatively easily available mineral form (ammonical plus Uric N). In addition, poultry manuress improve soil water holding capacity, thus the organic manures (poultry manuress) keeping water to save it to plants. On the other hand, the various positive effects of applying active dry yeast were attributed to its content of different nutrients, higher percentage of proteins, large amount of Vitamin B and natural plant growth hormones (cytokinins) (Ferguson *et al.*, 1987).

Total Soluble Sugars (TSS) Percentage in Leaves

Data in Table 4 indicate that TSS contents in leaves of roselle plants significantly affected by irrigation levels, poultry manures quantities and active dry yeast concentration.

The main effect of irrigation rate of 560 and 1120 m^3/fed/season resulted in highly significant increase in TSS content in leaves compared to the treatments of 1680m^3/fed/season in the first and second seasons. While the minimum value obtained in the third season resulted from the treatment of 2240 m^3/fed/season of irrigation water amount with highly significant differences comparing with the other treatments Table 4-a_1. It is obviously notice from Table 4-a that TSS content of Roselle leaves significantly decreased with increasing poultry manures quantities or active dry yeast concentrations. The lowest values of TSS recorded by fertilizing plants with 40 m^3/fed.and spraying plants by 8g/L active dry yeast during the three seasons. The results are in harmony with those obtained by Ismail (2004) on snap bean. Regarding to the interaction between irrigation and poultry manures, the data in Table 4-b_1 show that, the TSS content in leaves affected by this interaction. Application with 1680m^3/fed/season of irrigation water amount combined with 40m^3/fed.of poultry manures gave the lowest values with significant decrease in TSS content of leaves in both the first and second seasons. Moreover, raising irrigation water amount to 2240m^3/fed/season combined with 40m^3/fed.of poultry manures resulted in significant decrease in TSS content in leaves in the third season.

Generally, total soluble sugar contents of roselle leaves increased by increasing water supply quantity in combination with increasing concentrations of active dry yeast, but with insignificant values Table (4 -b_2).

Concerning the effect of interaction treatments between irrigation and active dry yeast, the data show insignificant effect for that interaction. However, a decrease in T.S.S. percentage in leaves when increasing the rates of irrigation water amount from 560 to 2240 m^3/fed/season and active dry yeast treatments from 2 to 8 gm/L during the three seasons.

The data in Table 4-b_3 clear the effect of interaction between poultry manures and active dry yeast that it has insignificant effect on TSS content of roselle leaves. However, the plants received 40m^3/fed. poultry manures combined with 8g/L active dry yeast gave the lowest TSS content of leaves (12.56, 13.00 and 12.00g/100g fresh wt.) during the three seasons, respectively.

As for the effect of general interaction treatments between the three factors (irrigation, poultry manures and active dry yeast), the data in Table 4-c show that, these interaction treatments had not any significant effect on TSS content

Table 4. Effect of irrigation, poultry manures, active dry yeast treatments and their interactions on T.S.S. percentage in leaves per plant of roselle plants during the three seasons of 2006, 2007 and 2008

a- The main effects

Irrigation				Poultry manures				Active dry yeast			
Season / Treatments	1st	2nd	3rd	Season / Treatments	1st	2nd	3rd	Season / Treatments	1st	2nd	3rd
560 m^3/fed	15.67	16.63		10 m^3/fed.	14.53	15.03	14.92	2g/L	13.92	14.39	14.08
1120 m^3/fed	13.65	13.96	14.98	20 m^3/fed	13.89	14.39	14.08	4g/L	13.72	14.44	13.58
1680 m^3/fed	11.65	12.08	13.85	30 m^3/fed	13.44	14.19	13.39	6g/L	13.61	14.03	13.44
2240 m^3/fed			12.02	40 m^3/fed	12.75	13.28	12.08	8g/L	13.36	14.03	13.36
L.S.D. at 5%	0.435	0.577	0.780	L.S.D. at 5%	0.312	0.360	0.571	L.S.D. at 5%	0.356	0.371	0.433
L.S.D. at 1%	0.722	0.958	1.293	L.S.D. at 1%	0.427	0.493	0.782	L.S.D. at 1%	0.845	0.698	0.575

Table 4-b_1.Interaction between irrigation and poultry manures

Season	1st				2nd				3rd			
Poultry manures / Irrigation	10 m^3/fed	20 m^3/fed	30 m^3/fed	40 m^3/fed	10 m^3/fed	20 m^3/fed	30 m^3/fed	40 m^3/fed	10 m^3/fed	20 m^3/fed	30 m^3/fed	40 m^3/fed
560 m^3/fed	17.08	15.75	15.25	14.58	17.42	16.50	16.42	16.17				
1120 m^3/fed	14.08	14.00	13.42	13.08	14.75	14.00	14.08	13.00	16.42	15.50	14.67	13.33
1680 m^3/fed	12.42	11.92	11.67	10.58	12.92	12.67	12.08	10.67	15.00	14.17	13.50	12.75
2240 m^3/fed									13.33	12.58	12.00	10.17
L.S.D. at 5%	0.540				0.623				NS			
L.S.D. at 1%	0.740				0.889				NS			

Table 4-b$_2$. Interaction between irrigation and active dry yeast

Season	1st				2nd				3rd			
Yeast / Irrigation	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L
560 m^3/fed	16.00	15.67	15.58	15.42	16.67	16.92	16.50	16.42				
1120 m^3/fed	13.83	13.75	13.58	13.42	14.08	14.25	13.67	13.83	15.50	15.17	14.67	14.58
1680 m^3/fed	11.92	11.75	11.67	11.25	12.42	12.17	11.92	11.83	14.17	13.42	14.00	13.83
2240 m^3/fed									12.58	12.17	11.67	11.67
L.S.D. at 5%	NS				NS				NS			
L.S.D. at 1%	NS				NS				NS			

Table 4-b$_3$. Interaction between poultry manures and active dry yeast

Season	1st				2nd				3rd			
Yeast / Poultry manures	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L
10 m^3/fed.	14.89	14.56	14.56	14.11	15.33	15.33	14.67	14.78	15.33	14.78	14.78	14.78
20 m^3/fed	14.11	13.89	13.89	13.67	14.33	14.78	14.33	14.11	14.67	14.33	13.89	13.44
30 m^3/fed	13.78	13.56	13.33	13.11	14.67	14.11	13.78	14.22	13.56	13.67	13.11	13.22
40 m^3/fed	12.89	12.89	12.67	12.56	13.22	13.56	13.33	13.00	12.78	11.56	12.00	12.00
L.S.D. at 5%	NS				NS				NS			
L.S.D. at 1%	NS				NS				NS			

Table 4-c. Interaction between irrigation, poultry manures and active dry yeast

Irrigation	Season	1st				2nd				3rd			
	Yeas / Poultry manures	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L
560 m^3/fed	10 m^3/fed.	17.67	17.00	17.00	16.67	17.00	17.67	17.33	17.67				
	20 m^3/fed	16.00	15.67	15.67	15.67	16.33	16.67	16.67	16.33				
	30 m^3/fed	15.67	15.33	15.00	15.00	17.00	16.33	16.00	16.33				
	40 m^3/fed	14.67	14.67	14.67	14.33	16.33	17.00	16.00	15.33				
1120 m^3/fed	10 m^3/fed.	14.33	14.00	14.00	14.00	15.67	15.33	13.67	14.33	16.67	17.00	15.67	16.33
	20 m^3/fed	14.33	14.00	14.00	13.67	14.00	14.33	14.00	13.67	15.67	16.00	15.00	15.33
	30 m^3/fed	13.67	13.67	13.33	13.00	14.00	14.33	13.67	14.33	15.67	15.00	14.33	13.67
	40 m^3/fed	13.00	13.33	13.00	13.00	12.67	13.00	13.33	13.00	14.00	12.67	13.67	13.00
1680 m^3/fed	10 m^3/fed.	12.67	12.67	12.67	11.67	13.33	13.00	13.00	12.33	15.67	13.67	15.67	15.00
	20 m^3/fed	12.00	12.00	12.00	11.67	12.67	13.33	12.33	12.33	15.00	14.00	14.33	13.33
	30 m^3/fed	12.00	11.67	11.67	11.33	13.00	11.67	11.67	12.00	13.00	13.67	13.33	14.00
	40 m^3/fed	11.00	10.67	10.33	10.33	10.67	10.67	10.67	10.67	13.00	12.33	12.67	13.00
2240 m^3/fed	10 m^3/fed.									13.67	13.67	13.00	13.00
	20 m^3/fed									13.33	13.00	12.33	11.67
	30 m^3/fed									12.00	12.33	11.67	12.00
	40 m^3/fed									11.33	9.67	9.67	10.00
L.S.D. at 5%		NS				NS				NS			
L.S.D. at 1%		NS				NS				NS			

of roselle leaves in the present study during the three seasons. The lowest values of TSS content obtained from the combined treatment between 1680m^3/fed/season water irrigation amount + 40m^3/fed.poultry manures + 8g/L active dry yeast in the first and second seasons, while in the third season the decrease carried out from the interaction between 2240m^3/fed/season water irrigation amount + 40m^3/fed.poultry manures + 8g/L active dry yeast gave 10.00 TSS content.

In the present study, application of poultry manures and active dry yeast showed ameliorative effect on water relations of roselle plants grown under drought stress condition by improving soil water relations (increase water holding capacity of the soil) but did not decrease sugars biosynthesis. However, Ghosh *et al.* (2004) found that the total chlorophyll content in sole sorghum leaves was higher in poultry manures treated plots this followed by increase in total carbohydrate contents. In addition, Ferguson *et al.* (1987) reported that application of active dry yeast is very effective in releasing CO_2 which improves net photosynthesis and sugars biosynthesis.

Leaf Osmotic Pressure

Data in Table 5 show the effect of irrigation, poultry manures and active dry yeast on osmotic pressure in leaves of Roselle plant.

The results in Table 5-a indicate that the increase in water irrigation amount from 560 to 1680m^3/fed/season in the first and second seasons significantly decreased the osmotic pressure in roselle leaves, and the increase in water irrigation amount to 2240 m^3/fed/season in the third season highly significant decreased leaves osmotic pressure.

The main effect of poultry manures was recorded in table 5-a_1. The data indicate that there was highly significant decrease in the osmotic pressure of roselle leaves by increasing the rate of poultry manures from 10 to 40 m^3/fed.on the three seasons. The same trend was observed as a result of foliar application of active dry yeast. However, the minimum values of osmotic pressure in leaves (11.52, 12.32 and 11.48) obtained by applied the high rate of active dry yeast (8g/L) in the three seasons, respectively. Similar results obtained by Ahmed *et al* (1998) and Hassan (2007) on roselle plants, El-Ghadban *et al.* (2003) on castor bean and Ahmed (1998) on marjoram plants.

The effect of interaction between irrigation and poultry manures on osmotic pressure of Roselle leaves recorded in table 5 - b_1, the data revealed a significant decrease in osmotic pressure of roselle leaves by increasing the amount of water supply from 560 to 2240m^3/fed/season and quantity of poultry manures from 10 to 40 m^3/fed.in the three studied seasons. These results are in harmony with those obtained by Ismail (2004) on snap bean and Nour (2005) on cowpea.

Table 5-b_2 shows the effect of interaction between irrigation and active dry yeast. the recorded data showed that the osmotic pressure of roselle leaves affected by the interaction between irrigation and active dry yeast treatments and the minimum values were obtained when applied water irrigation amount at 1680m^3/fed/season combined with active dry yeast at 8g/L in the first and second seasons. However, using the treatment of irrigation rate at 2240m^3/fed/season combined with active dry yeast at 8g/L resulted in the lowest values of osmotic pressure of leaves.

The effect of interaction between poultry manures and active dry yeast treatments were shown in Table 5-b_3. The results appeared no significant effect of interaction between poultry manures and active dry yeast on osmotic pressure of roselle leaves in the three seasons. Application the treatment of poultry manures at 40m^3/fed.combined with active dry yeast at 8g/L resulted in the lowest values of osmotic pressure in roselle leaves (10.71, 11.17 and 10.37) during the three seasons, respectively.

Table 5-c show the effect of interaction between amount of water supply, poultry manures and active dry yeast. The recorded data show insignificant decrease in the osmotic pressure of Roselle leaves as a result of increasing the amount of water supply and quantity of poultry manures and concentration of active dry yeast collectively in the three seasons. While increasing the amount of irrigation water to 1680 m^3/fed/season combined with the highest rate of poultry manures at 40m^3/fed.and the highest rate of active dry yeast at 6g/L resulted the minimum value of osmotic pressure in leaves of Roselle plant (8.57 and 5.57) in the first and second seasons, respectively.

Table 5. Effect of irrigation, poultry manures, active dry yeast treatments and their interactions on osmotic pressure in leaves per plant of roselle plants during the three seasons of 2006, 2007 and 2008

a- The main effects

Irrigation

Season / Treatments	1st	2nd	3rd
560 m^3/fed	13.88	15.16	
1120 m^3/fed	11.67	12.08	13.34
1680 m^3/fed	9.80	10.21	11.77
2240 m^3/fed			10.22
L.S.D. at 5%	0.447	0.726	0.148
L.S.D. at 1%	0.741	1.205	0.245

Poultry manures

Season / Treatments	1st	2nd	3rd
10 m^3/fed.	12.71	13.57	12.92
20 m^3/fed	12.04	12.55	12.18
30 m^3/fed	11.59	12.37	11.50
40 m^3/fed	10.90	11.44	10.52
L.S.D. at 5%	0.311	0.452	0.459
L.S.D. at 1%	0.426	0.620	0.629

Active dry yeast

Season / Treatments	1st	2nd	3rd
2g/L	12.08	12.63	12.29
4g/L	11.88	12.75	11.74
6g/L	11.77	12.23	11.60
8g/L	11.52	12.32	11.48
L.S.D. at 5%	0.360	NS	0.397
L.S.D. at 1%	0.985	NS	0.526

Table 5- b_1. Interaction between irrigation and poultry manures

Season	1st				2nd				3rd			
Poultry manures / Irrigation	**10 m^3/fed**	**20 m^3/fed**	**30 m^3/fed**	**40 m^3/fed**	**10 m^3/fed**	**20 m^3/fed**	**30 m^3/fed**	**40 m^3/fed**	**10 m^3/fed**	**20 m^3/fed**	**30 m^3/fed**	**40 m^3/fed**
560 m^3/fed	15.41	13.95	13.43	12.72	16.79	14.76	14.67	14.40				
1120 m^3/fed	12.20	12.12	1.53	11.20	12.90	12.12	12.20	11.11	14.49	13.86	12.98	12.04
1680 m^3/fed	10.54	10.06	9.82	8.80	11.03	10.78	10.22	8.79	12.81	11.80	11.38	11.11
2240 m^3/fed									11.45	10.87	10.14	8.41
L.S.D. at 5%	0.539				0.783				NS			
L.S.D. at 1%	0.739				1.026				NS			

Table 5- b$_2$. Interaction between irrigation and active dry yeast

Season	1st				2nd				3rd			
Yeast / Irrigation	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L
560 m^3/fed	14.24	13.88	13.79	13.90	15.12	15.56	14.93	15.02				
1120 m^3/fed	11.95	11.86	11.70	11.53	12.22	12.39	11.78	11.95	13.60	13.53	13.25	13.00
1680 m^3/fed	10.06	9.90	9.82	9.43	10.55	10.31	9.98	9.98	12.56	11.37	11.55	11.62
2240 m^3/fed									10.72	10.32	9.99	9.84
L.S.D. at 5%	NS				NS				NS			
L.S.D. at 1%	NS				NS				NS			

Table 5- b$_3$. Interaction between poultry manures and active dry yeast

Season	1st				2nd				3rd			
Yeast / Poultry manures	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L
10 m^3/fed.	13.10	12.74	12.74	12.29	13.76	14.01	13.08	13.44	13.29	12.59	12.95	12.83
20 m^3/fed	12.27	12.04	12.04	11.82	12.49	12.95	12.50	12.27	12.83	12.49	12.01	11.38
30 m^3/fed	11.92	11.71	11.47	11.26	12.85	12.29	11.94	12.39	11.81	11.82	11.03	11.34
40 m^3/fed	11.04	11.04	10.83	10.71	11.41	11.76	11.40	11.17	11.24	10.06	10.40	10.37
L.S.D. at 5%	NS				NS				NS			
L.S.D. at 1%	NS				NS				NS			

Table 5-c. Interaction between irrigation, poultry manures and active dry yeast

Irrigation	Season	1st				2nd				3rd			
	Yeast / Poultry manures	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L	2g/L	4g/L	6g/L	8g/L
560 m^3/fed	10 m^3/fed.	16.07	15.32	15.32	14.93	15.99	17.40	16.35	17.40				
	20 m^3/fed	14.22	13.86	13.86	13.86	14.58	14.97	14.93	14.58				
	30 m^3/fed	13.86	13.52	13.16	13.16	15.32	14.58	14.22	14.58				
	40 m^3/fed	12.80	12.81	12.80	12.40	14.58	15.29	14.22	13.52				
1120 m^3/fed	10 m^3/fed.	12.46	12.12	12.12	12.12	13.86	13.52	11.77	12.46	14.58	14.58	14.22	14.58
	20 m^3/fed	12.46	12.12	12.12	11.78	12.12	12.46	12.12	11.77	13.50	14.58	13.50	13.86
	30 m^3/fed	11.78	11.78	11.43	11.12	12.12	12.46	11.78	12.46	13.86	13.50	12.46	12.12
	40 m^3/fed	11.12	11.43	11.12	11.12	10.77	11.12	11.43	11.12	12.46	11.46	12.80	11.43
1680 m^3/fed	10 m^3/fed.	10.78	10.78	10.78	9.82	11.43	11.12	11.12	10.46	13.52	11.43	13.50	12.80
	20 m^3/fed	10.14	10.14	10.14	9.82	10.77	11.43	10.46	10.46	13.52	11.77	11.43	10.46
	30 m^3/fed	10.14	9.82	9.82	9.51	11.12	9.82	9.82	10.14	11.43	11.50	10.80	11.78
	40 m^3/fed	9.19	8.87	8.57	8.57	8.87	8.89	8.54	8.87	11.78	10.77	10.46	11.43
2240 m^3/fed	10 m^3/fed.									11.78	11.77	11.12	11.12
	20 m^3/fed									11.46	11.12	11.09	9.83
	30 m^3/fed									10.14	10.46	9.82	10.14
	40 m^3/fed									9.50	7.95	7.95	8.26
L.S.D. at 5%		NS				NS				1.373			
L.S.D. at 1%		NS				NS				2.016			

Increasing irrigation water amount to 2240 m^3/fed/season when combined with poultry manures at 40m^3/fed/season plus 4 or 6g/L of active dry yeast resulted in the lowest osmotic pressure of Roselle leaves (7.95) during the third season.

The increase in bound water and the decrease in free water stress were mainly due to the increases in cell sap concentration and its osmotic pressure resulted from the conversion of starch into soluble carbohydrates (Lancher, 1993). Osmotic pressure in plant tissues changed according to the concentration of the osmolytes (e.g., soluble sugars and proline). The present results showed that proline and soluble sugars content increased in roselle leaves with decreasing water supply. On the other hand, adding poultry manures to the soil and spraying Roselle plants with active dry yeast decreased the osmolytes concentrations and osmotic pressure. In other words, fertilizing new reclaimed soils by poultry manures and spraying plants with active dry yeast reduced the effect of water supply shortage by improving soil water relations which help plants to grow normally as their growth under mesophytic conditions.

Anatomical Characteristics

Anatomical features of roselle plants fertilized by different amounts of poultry manures, sprayed with active dry yeast and grown under 1680 m^3/fed. water treatments were shown by Table 6 and Fig.1.

The effect of poultry manures on the anatomical characteristics of roselle plants showed in table 6-a. Generally, the increasing in poultry manures concentration increased the anatomical characters recorded (midvien thickness and width, midvien vascular bundle thickness and width, blade thickness, palisade and spongy tissue thickness, average xylem vessel diameter and No. of xylem rows in midvien vascular bundle). Increasing the amount of poultry manures from 10 to 40m^3 increased the midvien thickness, midvien width, average of midvien bundle thickness, midvien bundle width, blade thickness, palisade tissue thickness, spongy tissue thickness, and diameter of xylem vessel by 16.8, 22.8, 26.2, 27.8, 24.8, 17.6, 34.1 and 25.5% respectively.

The stimulation role of organic manure on plant tissues was reported by Abed (1990) and Mohamed (1996) on cassava plants, Medani (1998) on *Ambrosia artimsiifolia* L., Mohamed (1999) on *Mentha longifolia* L., Agamy (2000) on *Ocimum basilicum* L. and *Cotula cinerea* Del., Mohamed (2000) on wheat and broad bean plants and Mohamed *et al.* (2001) on roselle plants.

Table 6-b represents the main effect of spray roselle plants with different concentration of active dry yeast. The data showed significant difference between the treated and untreated plants. Leaf thickness gradually increased by increasing yeast concentration, however, increasing yeast dose from 2g/L to 4, 6, and 8g/L the blade thickness increased by 5.2, 14.2 and 19.2%, respectively and the palisade tissue thickness by 8.2, 11.8 and 15.2 respectively.

Table 6-c and Fig. 1 show a positive correlation between dry yeast and poultry manures concentrations, however the anatomical characters recorded (midvien thickness and width, midvien vascular bundle thickness and width, blade thickness, palisade and spongy tissue thickness, average xylem vessel diameter and No. of xylem rows in midvien vascular bundle) increased with increasing yeast and poultry manures concentrations. This results agree with these reported by Mohamed (2005) found that foliar application of active dry yeast had stimulative effect on leaf blade tissues as it was increased lamina, palisade tissue and spongy tissue thickness. In addition, increased the number of the xylem vessels. The stimulative effect of the active dry yeast on roselle leaves may be due to the fact that yeast is a natural source for cytokinins that stimulate cell division and expansion; in addition, it is a source for amino acids and most nutrients which play a role in cell division and expansion.

Conclusion

Results of the present study indicated that application of poultry manuress and active dry yeast has ameliorative effect against water deficit stress by improving soil water relations which leads to improving water relations of the plant tissues and increasing blade, palisade tissue and spongy tissue thickness and number of xylem elements.

Table 6. Effect of poultry manures, active dry yeast and their interactions on anatomical characteristics of roselle plant leaves during third season

a- The main effects Poultry manures

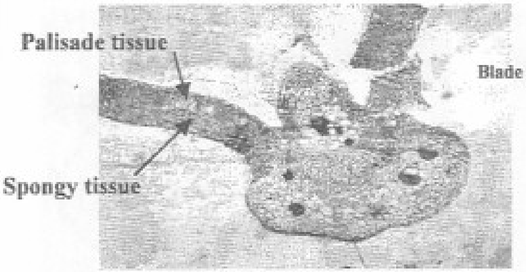
Poultry manuress m^3/fed.	Midvien thick. (µ)	Midvien width (µ)	Midvien bundle thick. (µ)	Midvien bundle width(µ)	Blade thick. (µ)	Palisade tissue thick. (µ)	Spongy tissue thick. (µ)	Average xylem vessel diameter (µ)	No. of xylem rows in midrib V.B.
	(µm)								
10	3934.69	3952.72	809.41	2003.10	683.22	278.00	334.78	85.88	22
20	4143.69	4314.54	903.35	2314.57	743.28	294.10	378.94	95.66	22
30	4475.75	4300.85	902.97	2478.10	751.97	311.78	370.94	95.88	22
40	4593.85	4852.97	1021.38	2560.25	852.57	327.04	448.69	107.75	25

Table 6- b. The main effects Active dry yeast

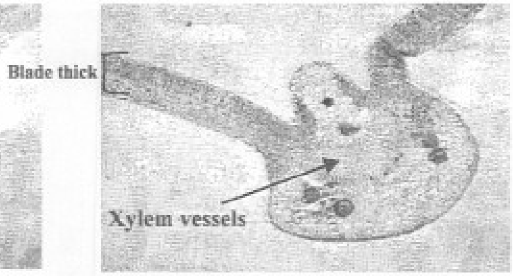
Treatment of dry yeast g/L	Midvien thick. (µ)	Midvien width (µ)	Midvien bundle thick. (µ)	Midvien bundle Width (µ)	Blade thick. (µ)	Palisade tissue thick. (µ)	Spongy tissue thick. (µ)	Average xylem vessel diameter(µ)	No. of xylem rows in midrib V.B.
	(µm)								
2	4062.25	3925.25	781.25	2073.76	691.16	278.29	339.10	87.75	20
4	4253.38	4264.32	879.04	2260.60	726.94	301.22	354.82	92.38	22
6	4313.81	4574.44	966.85	2468.38	789.19	311.13	407.88	100.10	24
8	4518.54	4657.07	1009.97	2553.28	823.75	320.28	431.57	104.94	26

Table 6-c. Interaction between poultry manures and active dry yeast

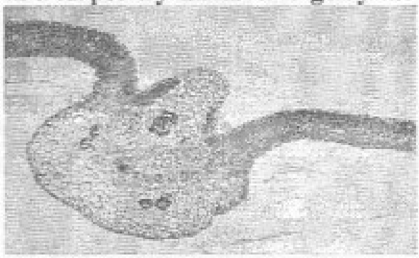
Poultry manures m^3/fed.	Active dry yeast (g/L)	Midvien thick. (µ)	Midvien width (µ)	Midvien bundle thick. (µ)	Midvien bundle width(µ)	Blade thick. (µ)	Palisade tissue thick. (µ)	Spongy tissue thick. (µ)	Average xylem vessel diameter(µ)	No. of xylem rows in midrib V.B.
10	2	3615.25	3718.75	803.13	1874.13	631.75	271.13	292.25	79.00	20
	4	3795.88	3802.88	758.25	1880.75	657.63	275.38	310.88	82.63	20
	6	3863.50	4057.63	826.13	2059.50	700.25	280.25	352.00	85.63	23
	8	4464.13	4231.63	850.13	2198.00	743.25	285.25	384.00	96.25	23
20	2	3788.38	3352.38	771.63	1723.13	704.00	270.00	361.25	86.13	15
	4	4182.75	4388.75	756.13	2440.50	728.63	2٨6.38	372.75	93.25	24
	6	4201.75	4729.13	998.50	2474.75	751.25	298.75	382.75	94.50	24
	8	4401.88	4787.88	1087.13	2619.88	789.25	321.25	399.00	108.75	25
30	2	4424.38	4055.38	743.75	2384.38	616.38	258.13	288.00	90.50	21
	4	4430.00	4066.75	944.13	2284.88	662.38	277.50	315.38	91.75	21
	6	4472.25	4513.38	890.75	2606.13	854.00	358.25	428.00	98.75	23
	8	4576.38	4567.88	1033.25	2637.00	875.13	3٥3.25	452.38	102.50	24
40	2	4421.00	4574.50	806.50	2313.38	812.50	313.88	414.88	95.38	23
	4	4604.88	4798.88	1057.63	2436.25	859.13	365.63	420.25	101.88	23
	6	4717.75	4997.63	1152.00	2733.13	851.25	307.25	468.75	121.50	24
	8	4631.75	5040.88	1069.38	2758.25	887.38	321.38	490.88	112.25	30



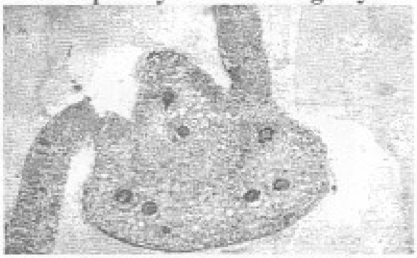
10 m^3 /fed. poultry manures + 2 g/L. yeast



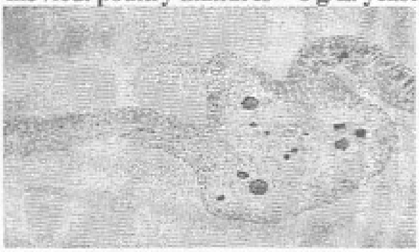
10 m3 /fed. poultry manures + 4 g/L. yeast



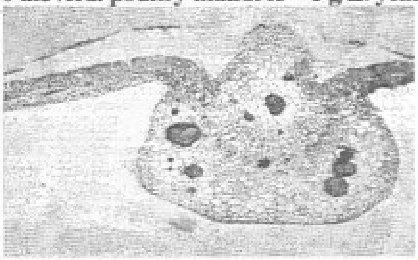
10 m3 /fed. poultry manures + 6 g/L. yeast



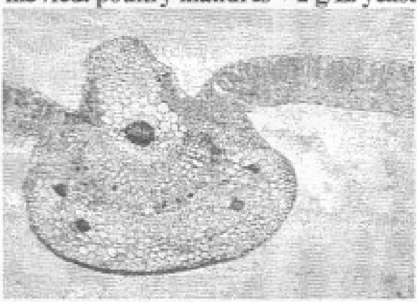
10 m3 /fed. poultry manures + 8 g/L. yeast



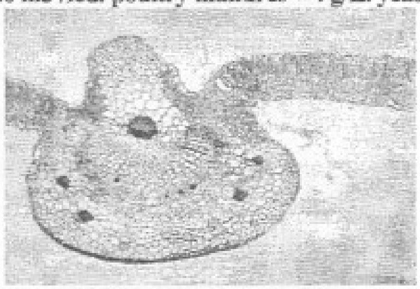
20 m3 /fed. poultry manures + 2 g/L. yeast



20 m3 /fed. poultry manures + 4 g/L. yeast



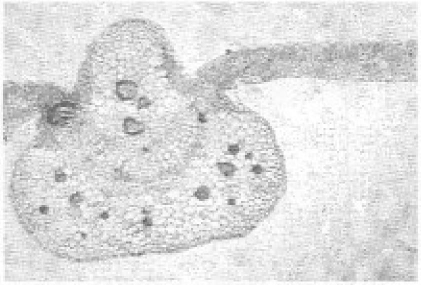
20 m3 /fed. poultry manures + 6 g/L. yeast



20 m3 /fed. Poultry manures + 8 g/L. yeast

Fig.1. Effect of Interaction between poultry manures and active dry yeast on anatomical characteristics of roselle plant leaves during third season (X100)

Fig. 1. Cont.



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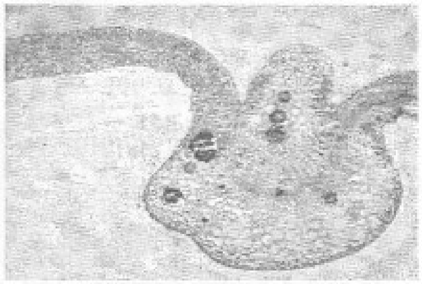

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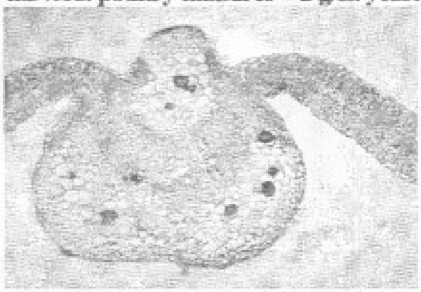
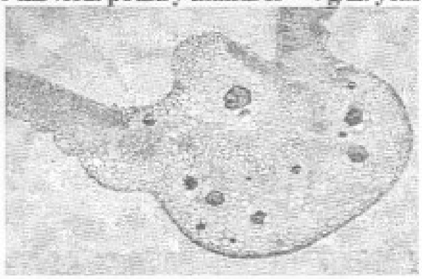
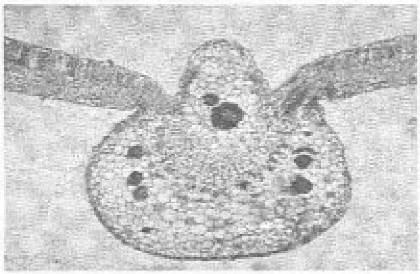


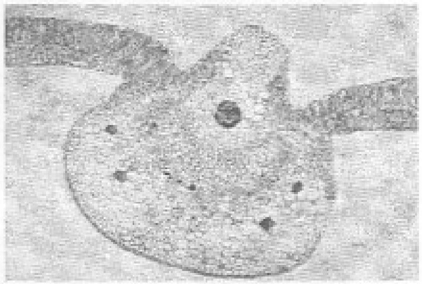
30 m3 /fed. poultry manures + 6 g/L. yeast



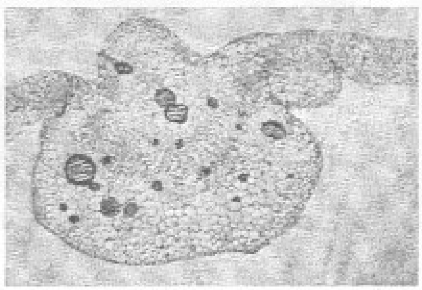
30 m3 /fed. poultry manures + 8 g/L. yeast



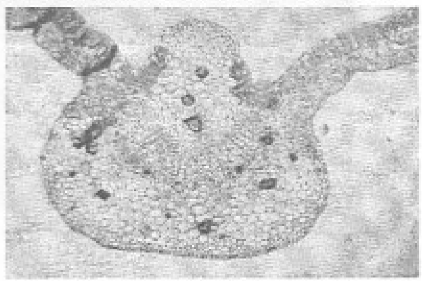
40 m3 /fed. poultry manures + 2 g/l yeast



40 m3 /fed. poultry manures + 4 g/l yeast



40 m3 /fed. poultry manures + 6 g/L. yeast



40 m3 /fed. poultry manures + 8 g/L. yeast

REFERENCES

Abed, A. M. 1990. The effect of fertilizers and growth regulators on growth, development and yield of Casseva plants in Fayoum. Ph.D. Thesis, Fac. Agric. Fayoum, Cairo Univ.

Abou El-Khair, E.E.M. 2004. Effect of irrigation and fertilization treatments on garlic crop and its storage ability under sand soil condations. Ph. D. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Agamy, R.A. 2000. The effect of some fertilizers and growth regulators on botanical characters of *Ociumum basillicum*, L. and *Cotula cinerea* Del. Ph.D. Thesis, Fac. Agric. Fayoum, Cairo Univ., Egypt.

Ahmed, E.T. 1998. Influence of concentration and time of spraying active dry yeast on growth and volatile oil content of marjoram plant. J. Agric. Sci., Mansoura Univ., 23 (11): 5067 – 5081.

Ahmed, F.F., M.M.A. Ragab, A.A. Gobara and A.E.M. Mansour. 1995. The beneficial of supplying active dry yeast to some nutrients foliage spraying for Anna apple trees (*Malus domestical* L.). Symposium on Foliar Fertilization A Technique ro Improve Productivity and Decrease Pollution, Cairo, Egypt.

Ahmed, Shadia, K., E.O. El-Ghawas and A.F. Aly. 1998. Effect of active dry yeast and organic manure on roselle plant. Egypt. J. Agric. Res., 76 (3): 1115 – 1143.

Allen, R.D. 1995. Discussion of oxidative stress tolerance using transgenic plants. Plant Physiol., 107 : 1049 – 1054.

Ashraf, M. 2004. Some important physiological selection criteria for salt tolerance in plants. Flora, 199: 361-376.

Ashraf, M. and P.J.C. Harris. 2004. Potential biochemical indicators of salinity tolerance in plants. Plant Sci., 166: 3-16.

Bates, L.S., R.D. Waldens and I.D. Teare. 1973. Rapid determination of free proline for water relation studies. Plant and Soil, 7(39): 205-207.

Caceres, A.L., M. Giron and A.M. Martinez. 1987. Diuretic activity of plants used for the treatments of urinary ailments in Guatemala. J. Ethnopharmacology, 19 (3): 133 – 245.

Dubios, M., K.A. Gilles, J. Hamilton, R. Rebers and F. Smith. 1956. Colorimetric method for determination of sugars and related substances. Annal. Chem., 28: 350.

El-Ghadban, E.A.E., Shadia, A. Kutb and M.I. Eid. 2003. Effect of foliar spraying with active dry yeast and complete fertilizer (Sengral) on growth, yield and fixed oil of (*Ricinus communis,* L.). Egypt. Pharm. J., 1: 55 – 66.

Ferguson, J.J., W.T. Avigne, L.H. Allen and K.E. Koch. 1987. Growth of CO_2 enriched sour orange seedlings treated with gibberellic acid sytokinins. Proc. Florida State Hort. Soc., 99: 37 – 39.

Ghosh, P.K., K.K. Ajay, M.C. Bandyopadhyay, K.G. Manna, A.K. Mandal and K.M.H. Misra. 2004. Comparative effectiveness of cattle manure, poultry manures, phosphocompost and fertilizer-NPK on three cropping systems in vertisols of semi-arid tropics. II. Dry matter yield, nodulation, chlorophyll content and enzyme activity. Bioresource Technology, 95: 85-93.

Gosev, N.A. 1960. Some method in studying plant water relations. Leningrad Acod. Of Sci., U.S.S.r.

Guerin, J.C. and H.P. Reveillere. 1984. Antifungal activity plant extracts used in therapy. I. Study of 41 plant extracts against 9 fungal species. Annals Pharmacutigues Francaises, 42 (6): 553 – 559.

Hasan, Hayat, A.E.R. 2007. Physiological studies on roselle (*Hibiscus sabdariffa,* L.) plant. Ph. D. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Hati, K.M., K.G. Mandal, A.K. Misra, P.K. Ghosh and C.L. Acharya. 2001. Effect of irrigation regimes and nutrient management on soil water dynamics, evapo-transpiration and yield of wheat in Vertisol. The Indian J. Agric. Sci. 71 (9), 581–587.

Irigoyen, J.J., D.W. Emerich and M. Sanchez-Diaz. 1992. Water stress induced changes in concentrations of proline and total soluble sugars in nodulated alfalfa (*Medicago sativa* L.) plants. Physiol. Plant., 84: 55-60.

Ismail, T.B.A. 2004. Effect of drip irrigation rates, organic fertilization and plant density on yield and quality of snap been. Ph. D. Thesis, Fac. Agric., Sues Canal Univ., Egypt.

Kameli, A. and D.M. Losel. 1993. Carbohydrates and water status in wheat plants under water stress. New Phytol., 125: 609-614.

Kishor, P.B.K., S. Sangama, R.N. Amrutha, P.S. Laxmi, K.R. Naidu and K.S. Rao. 2005. Regulation of proline biosynthesis degradation, uptake and transport in higher plants: its implications in plant growth and abiotic stress tolerance. Curr. Sci., 88: 424-438.

Kishor, P.B.K., Z. Hong, G. Miao, C.A.A. Hu and D.P.S. Verma. 1995. Overexpression of D – 1 pyrroline-5- carbooxylate synthetase increases pro line overp roduction and confers osmotolerance in transgenic plants. Plant Physiol., 108: 1387-1394.

Lampkin, N. 1990. Organic Farming. Press Book . United Kingdom p:63

Lancher, L. 1993. Physiological Plant Ecology. Ecophysiology and Stress Physiology of Functional Groups. 3rd (ed). Springier Press. Berlin, New York, London, Paris, Tokyo.

Medani, R.A. 1998. Effect of N., P, K, on growth anatomical characters and some chemical constituents od damsisa plant. J. Afric. Sci Mansoura Univ., 23(11): 4869-4881.

Mishra, R.C., Sabu, P.K. and S.K. Uttaray. 1990. Response of soybean to nitrogen and phosphorus application. J. Oilseed Res. 7, 6–9.

Mohamed, S.A. 1996. Influence of some environment treatments on the growth and yield of cassava (*Manibor esculenta* Cantz.) Ph.D. Thesis, Fac. Of Agic., Fayoum, Cairo Univ.

Mohamed, S.A. 2000. Effect of mineral and biofertilization on growth, yield and chemical consituents and anatomical structure of wheat (*Triticum aestivum* L.) and broad bean (*vicia faba* L.) plants grown under reclaimed soil conditions. Annals of Agric. Sc. Moshtohor, Vol. 38 (4): 2039-1063.

Mohamed, S.A. and F.A.M.A. Matter. 2001. Effect of ammonium nitrate and organic fertilizers on growth, volatile oil yield and chemical constituents of marigold (*Tagetes minuta* L.) plant. Fayoum J. Agric. Res. & Des., Vol. 15 (10): 95 – 107.

Mohamed, S.A., A.A. El- Shewy and H. Mahfouz. 2001. Effect of organic and mineral fertilizers on growth, yield and chemical constituents and anatomical structure of wheat plants. Egypt. J. Appl. Sci. 16(4): 124-141.

Mohamed, S.E.A. 2005. Photochemical studies on common bean (*Phaseolus valgaris* L.) plants as affected by foliar fertilizer and active dry yeast under sandy soil conditions. Egypt. J. Appl. Sci., 20 (5B) 2005

Mohamed, S.F. 1999. Botanical studies on two wild medicinal plants (Damsisa and wild mint) in Fayuom. Pp. 25-97, M. Sc. Thesis, Fac. Agric., Fayoum, Cairo Univ., Egypt.

Muller, B.M. and G. Franz. 1992. Chemical structure and biological activity of polysaccharides from *Hibiscus sabdariffa*. Faculty of Pharmacy, Univ. of Regensburg, W-8-84000, Germany Planta Medica, 58, 1: 60 – 67.

Nagodawithana, W.T. 1991. Yeast technology. Universal Foods corporation Milwaukee. Wisconsin, Published by Van Nostrand Reinbold New Yourk, p: 274.

Nour K.A.M. 2005. Response of some cowpea (*Vigna unguivulate*,L.) cultivars to some irrigation level by drip system and organic manure under sand soil condition. Ph.D. Thesis, Fac. Agric., Mansoura Univ.

Osman, A.E. and V. Jacoub. 1970. Effect of the cultivation locality on the taste flavour and colour of roselle. Agric. Res. Rev., Egyptian Ministry of Agric., 48: 181 – 192.

Paris, F.S. 1977. Guide to Medicinal Plants. Luther Worth Press; Guildfard and London.

Serraj, R. and T.R. Sinclair. 2002. Osmolyte accumulation: can it really help increase crop yield under drought conditions? Plant Cell Environ., 25: 333-341.

Sharma, S.S. and K.J. Dietz. 2006. The significance of amino acids and amino-acid derived molecules in plant responses and adaptation to heavy metal stress. J. Exp. Bot., 57: 711-726.

Shepherd, M.A. and P.J. Withers. 1999. Applications of poultry litter and triple superphosphate fertilizer to a sandy soil: effect on soil phosphorus status and profile distribution. Nutrient Cycling Agroecosystem 54, 233–242.

Shihata, I. M., A. B. Hassan and G. Y. El-Mayah. 1983. Antibacterial and antifungal activities of *Hibiscus sabdariffa* and *Lawsonia inermis* extracts. Bulletin of Animal Health and Production in Africa, 31 (4): 331 – 335 .

Sidky, Mahasen, M.A., I.M.A. Harridi and I.A.I. Mousa. 1998. Using chemical and organic fertilizers of the nutrition of roselle (*Hibiscus sabdariffa,* L.) plants irrigated at different intervals. Egyptian Journal of Applied Science, 12 (9): 123 – 135.

Singh, D.K., P.W.G. Sale, C.K. Pallaghy and V. Singh. 2000. Role of proline and leaf expansion rate in the recovery of stressed white clover leaves with increased phosphorus concentration. New Phytol., 146: 261-269.

Skoog, E. and C.O. Miller. 1957. Biological Action of Growth Substances. Cambridge Univ. Press. Camb., 1957 – 2000.

Snedecor, G.W. and W.G. Cochran. 1980. Statistical Methods. 7th Ed. The Iowa State Univ., Press, Amer., Iowa, USA.

Stewart, C.R. 1977. Inhibition of proline oxidation by water stress. Plant Physiol., 59 : 930 – 932.

Subba Rao, N.S. 1984. Biofertilizers in Agriculture Oxford. IBH Company. New Delhi.

Vendruscolo, E.C.G., I. Schuster, M. Pileggi, C.A. Scapim, H.B.C. Molinari, C.J. Marur and L.G.E. Vieira. 2007. Stress-induced synthesis of proline confers tolerance to water deficit in transgenic wheat. J. of Plant Physiol., 164: 1367-1376.

Willey, R.L. 1971. Microtechnique. A Laboratory Guide. Mac Millan Publishing Co. Inc. New York.

Yousef, R.M.M 2002. Effect of irrigation and fertilization on *Matricaria chamomilla,* L. growth and productivity in sandy soil. Ph. D. Thesis, Fac. Agric., Zagazig Univ., Egypt.

الاحتياجات المائية لنباتات الكركدية تحت معدلات مختلفة من التسميد العضوى والخميرة وعلاقتها بالتركيب التشريحى للورقة

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أجريت ثلاث تجارب حقلية خلال ثلاثة مواسم ٢٠٠٦ و٢٠٠٧ و٢٠٠٨ فى مزرعة التجارب البحثية بمحطة بحوث البساتين بالقصاصين، محافظة الإسماعيلية، لدراسة التأثير الملطف لسماد الدواجن بمعدلات ١٠ و٢٠ و٤٠ و٦٠م^{3}/فدان والرش بمحلول الخميرة بمعدلات ٢ و٤ و٦ و٨جم/لتر على نبات الكركدية المنزرع فى أراضى حديثة الاستصلاح تحت رى محدد (٥٦٠ و١١٢٠ و١٦٨٠ و٢٢٤٠ م^{3}/فدان/موسم. أوضحت النتائج أن محصول الثمار الطازج للفدان قد زاد مع زيادة الكمية المضافة من الماء وسماد الدواجن والرش بالخميرة، وعلى الجانب الآخر وجد أن هناك زيادة معنوية لمحتوى أوراق الكركدية من البرولين والسكريات الذائبة الكلية وكذلك الضغط الأسموزى مع نقص كمية الماء المستخدم فى الرى بينما أدى التسميد بسماد الدواجن أو رش النبات بمحلول الخميرة إلى نقصهم معنويا. أدى التأثير المشترك بين سماد الدواجن ومحلول الخميرة إلى تلطيف الأثر الناتج عن الإجهاد المائى بنقص معنوى فى محتوى الأوراق من البرولين والسكريات الذائبة الكلية وكذلك الضغط الأسموزى، ويزداد هذا النقص مع زيادة كمية سماد الدواجن حتى ٤٠ م^{3}/فدان وزيادة تركيز محلول الخميرة حتى ٨جم/لتر. بالإضافة إلى زيادة الصفات التشريحية الممثلة فى (عرض وسمك العرق الوسطى، عرض وسمك الحزمة الوعائية، سمك النصل، سمك النسيج الأسفنجى والعمادى، متوسط قطر وعاء الخشب وعدد صفوف الخشب فى الحزمة الوعائية) الذى يعزى إلى المستويات العالية من سماد الدواجن والخميرة.