Minufiya J. Agric. Res. Vol.35 No. 2:503-513 (2010) "http://agri.menofia.edu.eg/megla.html"

EFFECT OF SEA WATER SALINITY ON GROWTH AND ANATOMICAL STRUCTURE OF *FABA BEAN* PLANTS (VICIA) FABA L.

F. A. El-Emary
Dept. of Agric. Botany, Fac. of Agric., Assiut, Al-Azhar Univ. Egypt.
(Received: Mar. 15, 2010)

ABESTRACT: ***Two pots experiments were carried out at the experimental farm of Sakha Agricultural Research Station in North Delta Egypt, during the two winter seasons of 2007/2008 and 2008/2009 to study the effect of diluted sea water salinity (1:7 & 1:5) compared with Nile water on growth and anatomical structure in (leaf, stem & root), as well as yield attributes of two faba bean varieties. (Giza 957 and Reina mora) The obtained results indicated that:----***

a- Reina mora exhibited the superiority in some growth characteristics i.e., dry mater of (shoot and root), chlorophyll A, B and total as well as no. of pods and seeds yield /plant, while Giza 957 recorded the highest value of plant height and leaf area. Irrigation with diluted sea water caused a significant decrease in all growth characters specially at (1:5) compared with the Nile water. Giza 957 was highly affected with sea water salinity compared with Reina mora in both seasons.

b- Anatomical characteristics in leaf, stem and root were decreased in Giza 957 compared with Reina mora under irrigation with diluted sea water at (1:5) specially the leaf structure and diameter of vessels in all plant organs. A slight increase in diameter of stem and root were observed the irrigation with diluted sea water (1:7) in both varieties.

c- Generally, the results confirmed that irrigation with diluted sea water negatively affected on all growth and anatomical characteristics of Vici faba L. specially in leaf structure and reduced the diameter of vessles in all plant organs, may be reflected on seed yield /plant specially at (1:5) with Giza 957 compared with the best anatomical characteristics and yielder variety Reina mora under North Delta Egypt condition.

Key Words *: Vici faba L., growth, anatomical structure, sea water salinity.*

INTRODUCTION

Salinity directly and indirectly affects on anatomical structure and physiological processes . it reflected on morphological, growth and yield of plant. In rare of Nile water, the mixture of sea water must be use with moderate ratio which has no hazard effect on growth, anatomical structure and yield of plant. Faba bean *Vici faba L.* family: leguminosae, is one of the most important legume crops in Egypt. It's an important crop in the Mediterranean area, offering high, quality protein and increasing the input of

combined N_2 into the soil as used in crop rotation with cereal crops (FAO, 1985 and Farag *et al.,* 2005). The estimated average amount of N_2 – fixed by Faba bean is 135 kg ha^{-1} , while it is 97 kg ha^{1} for chickpea, 83 kg ha^{-1} for lentil, 68 kg ha^{-1} for peanut and 40 kg ha^{-1} for soybean (Rizk, 1966). Increased of cultivated area from *Vicia faba L.* deepened on increase amount of Nile fresh water, which is already not sufficient to met all the expected demand. Therefore, the possibility of using sea water for irrigation especially in North Delta Egypt . That is still very limited because such water may contain a considerable amount of harmful salts. The deleterious effects of salts on plant environment are due to direct and indirect impacts. The direct effect may be attributed to the accumulation of levels of toxic ions which, in turn, affect many metabolic reaction occurring in cells. However, The indirect effect is due to high osmotic pressure of salts which decreases the availability of water to plant (Gendy and Hammad, 1993). In the last few decades several methods have been tested for successful using of sea water. Irrigation with diluted sea water were recommended as affective against for some this problems. The main aim from our research is studying of the anatomical structure changes, as well as growth and yield attributes of two *Vicia faba L.* (Giza 957 and Reina mora) varieties irrigated with /or without diluted sea water.

MATERIAL AND METHODS

Pots trials were carried out under normal atmospheric condition at the experimental farm of Agric. Res. Station, Sakha, at Noth Delta Egypt, during 2007/2008 and 2008/2009 seasons. Seeds (Giza 957 and Reina mora) varieties were sown on 10 November during the two winter seasons in fire clay pots 30 cm. diameters, each one filled with 8 kg mixture of clay and sand soil, after germination the seedling were thinned and irrigated with two levels of diluted sea water : 1:7 & 1:5 and control (Nile water) according (Mostafa et al., 2004). Each treatment was represented by 10 replicates. Salts of levels water and its diluted sea water and Nile water used for irrigation are shown in Table 1. The cultural practices, i.e., fertilization and pest control were carried out as commonly used. Ten randomly plants were used for recording the matrices traits.

Table (1): Chemical characteristics of sea water, Nile water and 1:5 & 1:7 diluted sea water during 2007/2008* and 2008/2009 seasons.**

Irrigation water	EC dS/ m at 25° c	pH 1:2.5	Anions (me/L)				Cations (me/L)				SAR
			CO_3^-	HCO_3^-	Cl^-	SO_4^-	Ca^+	Mg^+	Na^+	K^+	
*Sea water	65.0	8.50	-	3.00	309.4	383.1	104.0	143.0	442.0	6.50	39.77
** Sea water	60.0	8.40	-	3.00	285.6	353.4	96.0	132.0	408.0	6.00	38.21
*Nile water	0.64	7.40	-	2.50.	3.00	1.30	1.00	1.4	4.40	0.10	3.95
**Nile water	0.77	7.50	-	2.50	3.70	2.10	1.20	17.0	5.20	0.10	4.33
*Sea water 1:7	9.50	8.25	-	2.50	53.2	57.40	15.2	20.9	76.0	1.00	17.89
**Sea water 1:7	9.20	8.18	-	2.50	51.5	55.50	14.7	20.2	73.6	0.90	17.00
*Sea water 1:5	12.3	8.30	-	2.50	68.9	75.00	19.7	27.1	98.4	1.20	20.35
**Sea water 1:5	11.9	8.26	-	2.50	66.6	72.50	19.0	26.2	95.2	1.20	20.02

Recording of data:

A-Growth and yield attributes:

Plant height (cm), leaf area(cm), number of pods/plant, dry matter of (shoot and root) g/pant were estimated after 12 weeks from sowing. The blade of the 4th leaf was used to determine the photosynthetic pigments (chlorophyll a, b and total) 9 weeks from sowing, according to Inskeep & Blom,(1985). Seed yield/ plant and crud protein were estimated at the end of the growing two seasons. The crud protein in seeds (%) was assay in the dry seed by the Kjeldahal method (AOAC, 1990).

B-Anatomical characteristics:

Some anatomical structure changes in, leaf, stem and root of two *Vicia faba L.* (Giza 957 and Reina mora) varieties affected by irrigation with sea water were measured.

The anatomical studies were carried out only in the second season after five weeks from seedling. For preparing sections, stem and root pieces 4-5 mm in length were taken from 4th internodes and about 2 cm from the tip of main roots; respectively.Concering the leaflets (Lamina), pieces 5 mm in length were taken from fourth leaf (from the shoot apex) including the midrib . All samples were killed and fixed for 48 hours in FAA (10 ml. formalin, 5 ml. glacial acetic acid, 50 ml. ethyl alcohol and 35 ml. water) and washed and dehydrated in alcohol series. The dehydrated samples were infiltrated and embedded in paraffin (52-54°C m.p.). The embedded samples were sectioned on a rotary microtome at a thickness of 8-10 µm. Sections were mounted on slides and deparaffinized. Staining was accomplished with safranine and light green, cleared in xylol and mounted in Canada balsam (Gerlach, 1977). Slides were microscopically examined and measurements and counts were taken and averages of 9 readings of 3 slides were calculated.

C- The relationships between changes in anatomical structure of plant organs, (leaf, stem and root) irrigation with the diluted sea water 1:7 and 1:5 were calculated.

Statistical analysis:

Statistical analysis was performed using ANOVA technique by IRRISTAT computer software package.

RESULTS AND DISCUSSION

1-Growth and yield attributed characteristic of two *Vicia faba L.* (Giza 957 and Reina mora) varieties irrigated with Nil water or diluted sea water:

The highest values i.e, (5.73 & 8 g) dry matter of shoot and roots, (3.3, 2.2 and 9.84 mg /l.) chlorophyll a, b and total, (22.91%) crude protein and (8.10) seed yield/plant recorded with Reina mora while, plant hight,leaf area and no.

of pod/plant were increased with Giza 957 varity.The two varieties irrigated with Nile water (Table 2).Tease agreement with those obtained by El Geremi *et. al.* (2006) and Attwa (2009).The lowest values of all growth and yield characters were cleared with diluted sea water compared with Nile water in both varieties. Salinity effects were greatest by using of (1:5) diluted sea water specially with plant height,leaf area and dry matter of plant in Giza varietie,El desoqui (2008).

Table (2): Growth characteristic and yield attributes of two *Vicia faba L.* (Giza 957 and Reina mora) varieties irrigated with Nile water and (1:7 & 1:5) diluted sea water,2007-2008 & 2008-2099 seasons.

Variety	Salinity level	Plant height cm	Leaf area cm^2	No. of pod / plant	Dry matter of shoot (g)	Dry matter of roots (g)	Chlorophyll A (Mg/L)	B(Mg/L)	Total (Mg/L)	Crude protein %	Seeds yield g/plant
Giza 957	Nile Water	85.00	23.33	3.40	4.70	4.93	5.96	1.50	7.54	22.17	7.30
	Diluted water 7:1	83.33	20.00	2.90	4.47	4.80	5.77	1.41	7.35	20.76	6.89
	Diluted water 5:1	78.00	18.33	2.40	3.87	4.13	5.05	1.38	6.99	18.06	5.06
Reina Mora	Nile Water	76.00	15.33	2.73	5.73	8.00	7.03	2.02	9.84	22.91	8.10
	Diluted water 7:1	73.67	15.17	2.63	5.37	7.46	6.88	1.93	9.34	21.40	7.66
	Diluted water 5:1	72.00	14.17	2.20	4.83	6.90	5.97	1.75	7.85	19.29	6.91
L.S.D 5% V		4.56	1.09	0.60	0.45	0.82	0.39	0.69	0.31	0.93	0.62
L.S.D 5% S		2.0	1.14	0.36	0.25	0.55	0.16	0.21	0.27	0.56	0.31
L.S.D 5% VxS		3.575	1.396	0.522	0.431	1.082	0.305	0.540	0.344	0.812	0.369
1% V×S		5.415	1.988	0.759	0.755	0.305	0.471	0.907	0.489	1.173	0.526

Although, the decreased in all growth and yield characters due to using of the two diluted sea water in both varieties, High tolerant effects were cleared in Reina mora at (1:5) diluted sea water compared with Giza varieties.

:

II- Anatomical structure Changes in plant organs, (leaf, stem and root) of two *Vicia faba L.* (Giza 957 and Reina mora) varieties irrigated with Nile water and diluted sea water

II-A-Leaves:

The micrographs in Fig. (1 &2) and data in Table (3) illustrate that thickness of lamina and all characteristics of midrib in Riena mora were higher than Giza 957 variety. These results agreement with those obtained by Abo-Baker and Khattab (2000b).

Tissues of lamina i.e., upper and lower epidermis layers, Mesophyll thickness and midrib characteristics i.e., (thickness and No. of arch/ bundle were greater with Nile water compared with the diluted sea water in both varieties.

Table (3): Anatomical structure Changes in leaf of two *Vicia faba L.* (Giza 957 and Reina mora) varieties irrigated with Nile water and diluted sea water

variety	Salinity level	Thickness of Lamina (µ)				Midrib characters				
		Upper epidermis	Lower epidermis	Palisade	Mesophyll	midrib width (µ)	Bundle length (µ)	No -Arch	No. of vessel	Diameter of vessel Ø
Giza 957	Nile Water	18.84	13.76	82.5	210.5	349.03	113.0	6	5	7.93
	Diluted water 7:1	7.69	7.57	46.0	128.1	286.85	82.8	5	5	4.42
	Diluted water 5:1	4.82	4.17	25.1	84.6	148.22	35.4	3	3	3.02
Reina Mora	Nile Water	16.21	14.91	97.0	260.2	380.50	100.7	7	5	10.74
	Diluted water 7:1	17.34	10.08	57.4	175.3	302.43	83.3	6	4	7.79
	Diluted water 5:1	6.39	5.77	40.9	172.2	263.17	69.4	4	4	3.92
L.S.D 5% V×S		1.760	3.325	10.62	15.51	3.260	8.18	0.061	0.061	1.636
1% V×S		2.503	5.018	15.62	22.24	4.715	11.65	0.090	0.090	2.446

The obtained results agreement with those by Ateya (2001) on soya bean. The increase of concentrations sea water salinity were significant decrease at all measurements of leaflets in the two varieties specially the diameter of xylem vessles in Giza variety. These results are accordance with Mostafa *et al.* (1984) on *Datura innaxia*, who indicated that salinity caused a little differentiation of the conductive tissues. Measurements of lamina thickness and characteristics of midrib were greater in Reina mora than Giza variety specially (1:5)

II-B-Stems:

Transaction of the stem in Reina mora showed that the thickness of epidermis and cortex and characteristics of major vascular bundle i.e., length of bundle, No. of vessels and xylem arch/ bundle and diameter of xylem vessels, as well as diameter of vascular cylinder and pith were highest

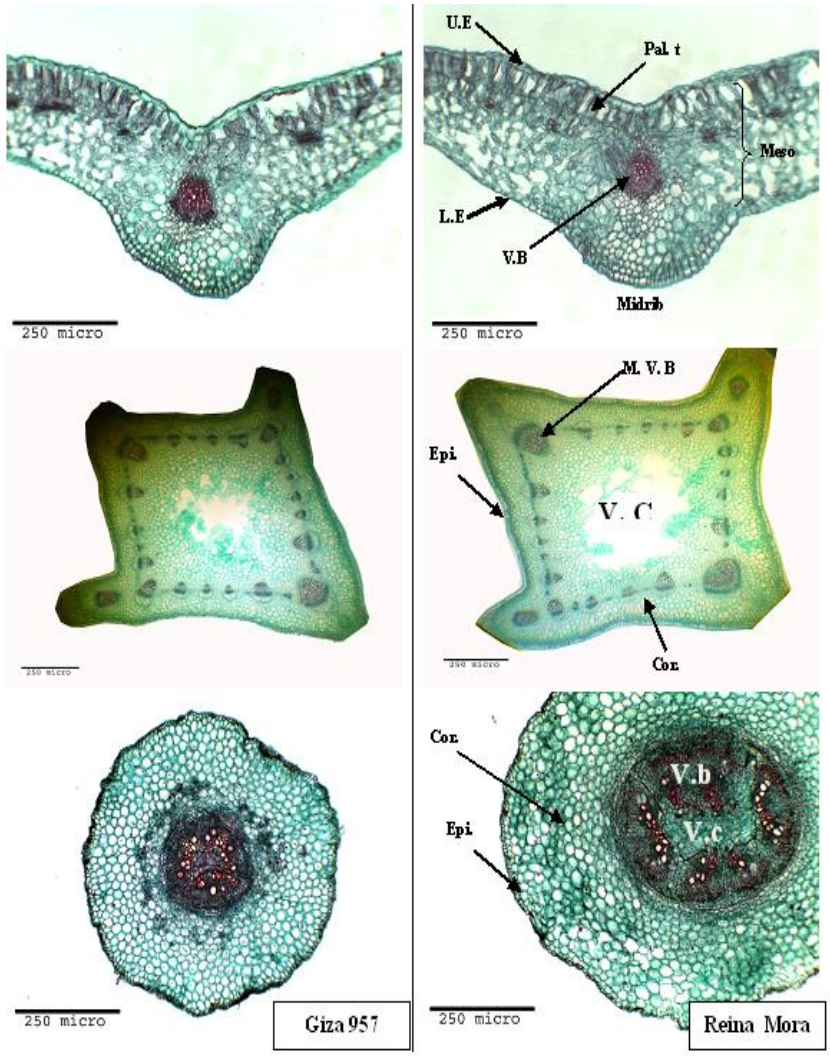

Fig. (1): Transverse sections in (leaf, stem and root) of Giza 957 and Reina Mora faba bean varieties irrigated with Nile water, (x40, leaf and root, x25, stem).

U.E. Upper epidermal cells
L.E, Lower epidermal` cells
Meso, Mesophyll layer
Pal. t, palisade tissue
Cor, Cortex
M.V.B., Major vascular bundle
V.c, Vascular cylinder
V.B, Vascular bundle

Fig. (2): Transverse sections in (leaf, stem and root) of Giza 957 and Reina Mora faba bean varieties irrigated with (1:7 & 1:5) diluted sea water , (x40, leaf and root, x25, stem).

U.E. Upper epidermal cells	Pal. t, palisade tissue	Cor, Cortex	V.B, Vascular bundle
L.E, Lower epidermal cells	Meso, Mesophyll layer	M.V.B., Major vascular bundle	V.c, Vascular cylinder

values with Reina mora compared with Giza 957. Data in Table (4) and Fig. (1&2) these according with Abou-Bakr *et al.*, (2000). The increasing of sea water salinity decreased diameter of vascular cylinder as well as diameter and no. of vessels/ arch, no. of xylem arch and length of bundle in both varieties. Giza 957 was more sensitive to sea water irrigation .

Table (4): Anatomical structure changes in stem of two *Vicia faba L.* (Giza 957 and Reina mora) varieties irrigated with Nile water and diluted sea water

variety	Salinity level	Thickness (µ)		Major of vascular bundle				Diameter of vascular cylinder + pith Ø
		Epidermis	Cortex	Bundle length (µ)	no- of xylem Arch	No. of vessels /xylem arch	Diameter of vessels Ø	
Giza 957	Nile Water	13.68	110.9	127.04	6	5	11.87	726.8
	Diluted water 7:1	24.80	201.8	180.52	6	6	12.52	676.2
	Diluted water 5:1	22.70	323.4	153.71	5	4	9.15	647.0
Reina Mora	Nile Water	14.71	130.3	149.54	7	5	12.98	733.7
	Diluted water 7:1	19.62	164.7	131.36	6	5	16.19	771.3
	Diluted water 5:1	20.13	128.8	145.16	6	5	9.30	732.6
L.S.D 5% V×S		2.687	41.48	5.493	0.062	0.063	2.875	10.77
1% V×S		3.763	59.70	7.813	0.091	0.091	4.155	15.67

On the other hand the epidermal layer and cortex thickness were increase of specially with (1:7) diluted sea water. These are in according by Ateya (2001). The lowest values of all stem parameters were recorded with Giza 957 compared with Reina mora variety specially the diameter of vascular cylinder and pith with irrigation by (1:5) diluted sea water.

II-C-Roots:

Data in Table (5) and Fig. (1 &2) indicated that anatomical root parameters i.e., (epidermis & cortex) thickness, diameter of (vessles & vascular cylinder) and (length & no. of xylem arch) recorded the highest values in Reina mora than Giza 957 variety. These results are in line with those obtained by Badawey (2008). The measured parameters of anatomical root were reduced by using of diluted sea water compared with Nile water in both varieties except the thickness of cortex and diameter of vascular cylinder in Giza variety. On the opposite, No. of bundle was increased with increasing of concentrations of sea water salts (1:5) in both varieties. Tolerance of root tissues to sea water salinity was cleared in Reina mora than Giza 957 specially the diameter of xylem vessels as well as the diameter of roots.

Table (5): Anatomical structure Changes in root of two *Vicia faba L*. (Giza 957 and Reina mora) varieties irrigated with Nile water and diluted sea water

variety	Salinity level	Thickness (µ)		Vascular cylinder		Xylem tissue	
		Epidermis	Cortex	vascular cylinder Ø	No. of bundles	Length of arch (µ)	Vessel Ø
Giza 957	Nile Water	8.15	179.9	218.3	4	49.7	12.40
	Diluted water 7:1	7.86	265,2	304.1	4	33.0	8.98
	Diluted water 5:1	7.16	224.3	235.4	5	50.5	6.24
Reina Mora	Nile Water	11.25	256.4	439.3	4	86.1	15.00
	Diluted water 7:1	7.94	250.9	264.9	5	65.5	9.03
	Diluted water 5:1	7.89	226.6	207.2	5	55.7	10.95
L.S.D 5% V×S		1.807	28.10	25.20	0.062	10.39	2.442
1% V×S		2.601	40.09	35.84	0.091	14.80	3.479

III- The relationships between anatomical structure of plant organs, (leaf, stem and root), two (Giza&Reina mora) varieties irrigation with diluted sea water (1:7 and 1:5):

These results indicated that the interaction between sea water salinity,and lot of growth, anatomical structure of (leaf, stem and root) and seed yield /plant in the two varieties were clearly. The lowest values of all growth parameters and anatomical characteristics were recorded with the irrigation by the height concentrations of sea water salts (1:5), specially the characteristics of the leaf and diameter of xylem vessels in all plant organs. These effects may be reflected on seed yield /plant in(Giza 957) compared with the best anatomical characteristics and yielder variety Reina mora under North Delta Egypt condition.

REFERENCES

Abo-Bakr, M. H. A., A. M. A. Khattab and M. U. El-Sgai (2000). Compartive anatomical study of the primary structure of root, stem and foliage leaf of some species of genus *Vicia*. J. Agric. Sci. Mansoura Univ., 25(7): 4131-4144.

Abo-Bakr, M. H. A. and A. M. A. Khattab (2000b). Compartive anatomical study of the primary structure of root, stem and leaf of some species of genus *Vicia*. J. Agric. Sci. Mansoura Univ., 25(7): 4117-4129.

Aldesuquy, H. S. and A. M. Gaber (2008). Effect of growth regulators on *vicia faba* plants irrigated by sea water Leaf area,pigment content and photosynthetic activity.Biol. plantarum,35(4) 529-527.

AOAC, (1990). Association of Official and Agricultural Chemists Official and

Tentative Methods of Analysis 15th ed. Washington, D.C.

Ateya, A. G. E. (2001). Morphophysiological studies on soybean (*Glycine max* L.) plants. Thesis M.Sc. of Argic. Bot., Fac. of Kafr El-Sheikh, Tanta Univ.

Atwa, A. A. E., R. A. I. Abo Mostafa and Asmaa A. El-basuny (2008) Impact of irrigation water salinity levels on soil chemical properaties and some faba bean varities,J.Agric. Sci. Mansoura Unive. 33(3):2447-2457.

Badawy, K. M. H. (2008). Anatomical, morphological and pathological studies on some faba bean varieties. Dept. of Agric. Botan, Fac. of Agric, Al-Azhar Univ., M.sc.

EL-Gremi, sh. M. A., E. B. A. Belal and M. F. EL-Nady (2006). Response and compatibility of some faba bean cultivators to inoculation with salinity-tolerant rhizobal strain under high salinity conditions.J.Agric. Res. Tanta Univ.,32(2) 273-285.

FAO. (1985). Water Quality Fore Agriculture, Irrigation And Drainage Rome Ref.1,29.

Farag, S.T., M. A. Abd El-Galeel and M. F. El-Nady (2005). Performance of some faba bean *Vicia faba* genotypes under Delta condition. J. Agric. Res. Tanta Univ.,31(2): 136-154.

Gendy, A. A. and A. A. Hammad (1993). The response of soybean plants to different levels of salinity. Zagazig J. Agric. Res. Vol 20(6): 1751-1768.

Gerlach, D. (1977). Botanshe Microtechnik. Eine Einfuhrung Theime Verlag, Stuttgart. BRO

Inskeep, W. P. and P. R. Bloom (1985). Spectroscopy in: M.F. Hipklins and N. R. Baker (eds.) Photosythesis, Energy. Transduction, A plant Physiol., 77: 483-485. legumes. J. of Microbiol. ARE. 1(1): 33-45.

Mostafa, M. A., M. O. El-Sharawy and F. M. El- boraei (2004). Use of sea water for wheat irrigation II. Effect on soil chemical properties, actual evapotranspiration and water use efficiency. International Conf. on Water Resources & Arid Environment..

Mostafa, M. B., A. R. E. Awad, M. H. Owais and A. A. K. Dawh (1984) Anatomical studies on *Datura innoxia* as affected by salinity and growth regulators.Annals ofAgric.Sci.,Moshtohor,Vol.(21).

Rizk, S. G. (1966). Atmospheric nitrogen fixation by legume under Egyptian condition-Grain legumes.J. of Microbiol.A.R.E.1(1):33-45.

أثر ملوحة ماء البحر على النمو و التركيب التشريحي لنباتات الفول البلدي

فؤاد عبد الله أحمد العمري

قسم النبات الزراعي – كلية الزراعة بأسيوط – جامعة الأزهر– مصر.

الملخص العربي

أجريت تجربتين أصص بمحطة البحوث الزراعية بسخا في شمال دلتا مصر موسمى(٢٠٠٧/٢٠٠٨ و٢٠٠٨/٢٠٠٩) بهدف معرفة اثر ملوحة ماء البحر المخفف(١ :٧ – ١: ٥) مقارنة بماء النيل العزب على بعض خصائص النمو و التركيب التشريحي(ورقة– ساق– جذر) والمحصول لصنفين من نباتات الفول البلدي هما (جيزة ٩٥٧ ورينومورا).أوضحت النتائج المتحصل عليها من الدراسة الآتي:–

أ– تفوق الصنف رينومورا علي الصنف جيزة ٩٥٧ في بعض صفات النمو مثل المادة الجافة (للمجموع الخضري والجذري) وكذا محتوي الأوراق من صبغات الكلوروفيل أ ، ب والكلي إضافة إلي عدد القرون ومحصول البذرة لكل نبات في حين ازدادت بعض صفات النمو الأخرى كطول النبات و المساحة الورقية فقط مع الصنف جيزة ٩٥٧ . وقد أدي الري بماء البحر المخفف إلي نقص ملحوظ لجميع خصائص النمو السابقة وبخاصة في التخفيف ١ :٥ مع الصنف جيزة ٩٥٧ مقارنة بالري بماء النيل العزب.

ب– أوضحت الدراسة التشريحية للأوراق والسيقان وكذلك الجذور تفوق الصنف رينومورا علي الصنف جيزة ٩٥٧ تفوقا ملحوظا عند الري بماء النيل العزب في جميع الخصائص المدروسة بينما أظهر استخدام ماء البحر المخفف نقص واضح لهذه الخصائص في كل الأعضاء وبخاصة التركيب التشريحي للأوراق وكذلك قطر الأوعية عند التخفيف ١ :٥ وقد حدثت زيادة طفيفة في قطر السيقان والجذور عند التخفيف ١ :٧ ثم تناقصت مرة أخري مع زيادة التركيز.

ت– تؤكد نتائج الدراسة علي أن استخدام ماء البحر المخفف في الري أثر سلبا علي جميع خصائص النمو والصفات التشريحية لنباتات الفول البلدي وبخاصة الخصائص التشريحية للأوراق فقط إضافة إلي ضيق الأوعية في جميع أعضاء النبات انعكس ذلك علي المحصول وبخاصة (١:٥) مع الصنف جيزة ٩٥٧ مقارنة بالصنف رينومورا المتفوق في الخصائص التشريحية و الإنتاجية وذلك تحت ظروف شمال دلتا مصر.

Effect of sea water salinity on growth and anatomical ……..

F. A. El-Emary