Effect Of Salicylic Acid & Seaweed Extract In The Content Of Sepals Of Some Active Medical Compounds For Several Varieties Of Roselle Hibiscus Sabdariffa L

Article · April 2017

CITATIONS
0

READS
74

3 authors, including:

Ali Saleh
Al-Furat Al-Awsat Technical University
19 PUBLICATIONS **2** CITATIONS
SEE PROFILE

Madeha h.hussain
Middle Technical University
5 PUBLICATIONS **2** CITATIONS
SEE PROFILE

Journal of Multidisciplinary Engineering Science and Technology (JMEST)
ISSN: 2458-9403
Vol. 4 Issue 4, April - 2017

Effect Of Salicylic Acid & Seaweed Extract In The Content Of Sepals Of Some Active Medical Compounds For Several Varieties Of Roselle Hibiscus Sabdariffa L.

Ali Saleh Hassoon
Plant Production. Dept.
Al-Musaib tech. College
Al-Furat Al-Awsat Tech. University
Iraq
alisalealtaie2015@gmail.com

Eman L. Ramadan
Plant Production. Dept.
Al-Musaib tech. College
Al-Furat Al-Awsat Tech. University
Iraq
Dr.imanlazem11@gmail.com

Madeha H. Hussain
Pharmacy. Dept.
Al-Mansour Medical Institute tech.
Middle Tech. University
Iraq
dr.madeha400@gmail.com

***Abstract*—The experiment was carried out in Al-Mahaweel district (located 25 km north of Babil) in the agricultural season 2016. To study the effect of salicylic acid and seaweed extract In the content of the leaves of some active substances for many varieties of Roselle plant. Experimental factorial is applied according to complete randomized blocks design. Included the first factor three varieties(red, white and lined) The second factor is salicylic acid in three levels (0, 25, and 50) mg.lit^{-1} and The third factor is seaweed extract three levels(0, 7.5, and15) ml. lit $^{-1}$. Results show that red variety dominated on other varieties in (VitaminC, Anthocyanin, Gossypetin, Hibiscetine and Sabdaretine). Also showed Spray treatment by salicylic acid 50 mg.lit^{-1}, As well as spraying treatment by seaweed extract 15 ml. lit^{-1} And their Interaction dominated in all studied parameters.**

Keywords—component; rosella; varieties; salicylic acid; seaweed extract

I. INTRODUCTION

Roselle Hibiscus sabdariffa L., which belongs to the Malvaceae family of medically important plants (1), its importance, is to be used as a refreshing drink for the purpose of moisturizing the body's high temperature. Its red dye is used industrially as natural food-yielding food gums, as well as in the manufacture of jams, ice, and confectionery and food preservation, Its seeds contain a high oil content of 20-25% and 30-35% protein (2), Its leaves are rich in Vitamin C, Citric, Tartaric, and Malic acids. It also contains Protocatechuic Acid (PCA), an important antioxidant as well as its role in the treatment of some cancerous tumors (3).

Faced with the cultivation of plant roselle in Iraq some of the problems that required the need to find mechanisms to overcome them using growth organizations, including salicylic acid Which is an internal growth organization derived from phenols with multiple functions, which plays a major role in increasing the tolerance of plants to the conditions of biological and non-biological stresses (4) It also enters into many physiological processes such as growth, photosynthesis, cellular metabolism, protein synthesis, block closure and gas exchange, as well as its role in enhancing the defense system of the plant against various diseases and increasing the effectiveness of antioxidants and enzymes(5).

Seaweed Extract is an important source of organic matter and nutrients, as well as several important growth regulators, some organic acids, amino acids and vitamins that influence the activities of the plant(6) Its physiological role is to increase growth by stimulating growth of roots, vegetation, and early flowering, increasing the plant's tolerance to stress conditions, regulating the cell's oxidation voltage, delaying aging and increasing leaf content of chlorophyll, antioxidants, phenols, flavonoids(7) (8). Due to the economic importance of the plant and the lack of field studies. Therefore, the study aimed to study the effect of marine algae extract and salicylic acid and its interactions with the content of the leaves of the active substances of several varieties of Gujarat.

II. METHOD AND MATERIAL

The experiment was carried out in Al-Mahaweel district (located 25 km north of Babil) in the agricultural season 2016. To study the effect of salicylic acid and seaweed extract in the content of the leaves of some active substances for many varieties of Roselle plant. The seeds of three varieties of al-Gujarat were obtained from the development of the al-Gujarat tea project in Diwaniyah of Diwaniyah Agriculture Directorate. The soil of the experiment was plowed by the plow-bearing plow with two orthogonal plows and then was cleaned and settled and then divided into three blocks. Each block included 27 experimental units with an area of 3x4 m^2. The experimental unit consisted of 4 lines with a length of 3 meters and the distance between the line and the last 75 cm. The soil was fertilized with phosphate fertilizer in the form of

superphosphate by 160 kg. Hectare^{-1} and one batch before planting and then added 100 kg. Hectar^{-1} Nitrogen Fertilizer Urea Added the first two batches after the second and the second before flowering. The seed was grown on 1/4/2016, And then gave the field irrigation without immersion until the completion of germination and when they reach the height of (10-15) cm were carried out the process of dimming and patching after ,the plants were sprayed as needed with all the operations of the service of the crop of Izzak and the weed and the fight against others. Experimental factorial is applied according to complete randomized blocks design (R.C.B.D). Included the first factor three varieties(red, white and lined) its symbol (V1, V2,V3), respectively and The second factor is salicylic acid in three levels (0, 25, and 50) mg.lit-1 its symbol (S0, S1, S2) respectively, and The third factor is seaweed extract three levels (0, 7.5, and15) ml. lit^{-1} its symbol (A0, A1, A2) respectively. The least significant difference was measured under the 5% probability level using the statistical program Genstat. Active substances (Vitamin C, Anthocyanin, Gossypetin, Hibiscetine, and Sabdaretine) were extracted according to the method mentioned (9) and measured the content of the physical leaves of the active substances through the duration of their retention by a device (HPLC) High-Performance Liquid Chromatography (10).

TABLE I. PHYSICAL AND CHEMICAL PROPERTIES OF SOIL

Character	PH	Ec	N (Mg.Kg)	P (Mg.Kg)	K (Mg.Kg)	Organic Matter (%)	Soil separators			Texture
							Sand	*Loamy*	*Clay*	
Value	7.4	2.3	35	14.28	16.2	0.72	446	403	151	Sand

TABLE II. SEAWEED EXETRCT CONTENT FROM MAJOR AND MINOR NUTRIENTS

Element	N %	P2O5 %	K2O %	Mg (PPM)	Fe (PPM)	Mn (PPM)	Zn (PPM)	Cu (PPM)
concentration	4	4	4	32	30	31	17.5	12.6

III. RESULT

The results of Table (3) show the difference in vitamin C concentration in their leaves, with V1 superior to the rest of the varieties, giving the highest rate of 12.217 mg.lit^{-1}. The lowest concentration was 7.965 mg.lit^{-1} It can be noted that salicylic acid spray significantly increased the concentration of vitamin C in the leaves. The spraying treatment gave S2 the highest rate of 13.802 mg.lit^{-1}. While the control treatment S0 gave the lowest rate of 5.721 mg.lit^{-1}, Also, in addition, seaweed extract was sprayed with increased concentration of the vitamin by raising the level of the spray. It was higher than A2, giving it the highest rate of 15.726 mg.lit^{-1}, while the lowest ratio was 4.383 mg.lit^{-1}when the control treatment A0. In the case of interaction between varieties and salicylic acid, V1S2 gave the highest concentration of vitamin C in leaves 16.223 mg.lit^{-1}while the V2S0 gave the lowest rate of 3.803 mg.lit^{-1}. The interaction between varieties and the seaweed extract significantly affected the concentration of vitamin C in the leaves. The V1A2 gave the highest rate of 18.860 mg.lit^{-1} while V2A0 gave a minimum of 2.973 mg.lit^{-1}. The results of the table show that the interaction between salicylic acid and seaweed extract resulted in significant differences in the concentration of vitamin C in the leaves. The high spray treatment S2A2 was characterized by giving the highest mean 22.073 mg.lit^{-1} while 2.073 mg.lit^{-1} when the control treatment S0A0. Tri interaction showed a significant effect in this effect. The V1S2A2 significantly increased the concentration of vitamin C to 25.500 mg.lit^{-1} mg.lit^{-1} while the mean average of the treatment of V2S0A0 was 1.220 mg.lit^{-1}.

TABLE III. EFFECT OF SALICYLIC ACID AND SEAWEED EXTRACT AND THEIR INTERACTION BETWEEN MANY VARIETIES OF ROSELLE PLANTS IN THE CONCENTRATION OF VITAMIN C (MG.L-1)

V	Salicylic Acid	Seaweed Extract			Mean V×S
		A0	*A1*	*A2*	
V1	S0	3.060	9.680	10.300	7.680
	S1	5.700	11.770	20.780	12.750
	S2	9.160	14.010	25.500	16.223
V2	S0	1.220	4.030	6.160	3.803
	S1	3.310	8.820	14.120	8.750
	S2	4.390	11.150	18.490	11.343
V3	S0	1.940	7.310	7.7900	5.680
	S1	4.110	10.040	16.170	10.106
	S2	6.560	12.730	22.230	13.840
L. S. D (0.05)		0.04567			0.02637
Seaweed / Varieties		*A0*	*A1*	*A2*	Mean V
V1		5.973	11.820	18.860	12.217
V2		2.973	8.000	12.923	7.965
V3		4.203	10.026	15.396	9.875
L. S. D (0.05)		0.02637			0.01522
Seaweed / Salicylic		*A0*	*A1*	*A2*	Mean S
S0		2.073	7.006	8.083	5.721
S1		4.373	10.210	17.023	10.535
S2		6.703	12.630	22.073	13.802
L. S. D (0.05)		0.02637			0.01522
A Mean		4.383	9.948	15.726	
L. S. D (0.05)		0.01522			

The results of Table (4) show that the concentration of anthocyanin dye in the leaves was different according to the different varieties, with the highest rate of 0.503 mg.lit^{-1} with the V2 while the lowest was 0.183 mg.lit^{-1}. The salicylic acid spray was also significantly increased, especially the S2 level, which exceeded the other levels, giving the highest rate of 0.386 mg.lit^{-1}, compared with the level S0, which gave the lowest rate of 0.270 mg.lit^{-1}. Also, the seaweed extract was sprayed. The A2 level significantly increased anthocyanin concentration by 0.430 mg.lit^{-1} while the control treatment of A0 gave the lowest rate of 0.235 mg.lit^{-1}.

Interactions between varieties and salicylic acid showed significant differences in the concentration of anthocyanin, which was increased with salicylic acid spray, especially V1S2, giving the highest values of 0.574 mg.lit^{-1} while the reduction was reduced to 0.135 mg.lit^{-1} V2S0.

As a result of the interaction of varieties with seaweed extract, the combination of V1A2 was superior to the rest of the combinations, especially the combination of V2A0. Anthocyanin levels were found in the leaves of 0.647 mg.lit^{-1} and 1.1221 mg.lit^{-1}. In relation to the interaction between salicylic acid and seaweed extract, it increased to 0.519 mg.lit^{-1} at S2A2 and decreased to 0.224 mg.lit^{-1} at S0A0.

The tri-interaction of the study factors revealed significant differences between the combinations. The combination of V1S2A2 on the other combinations showed that the highest concentration of the anthocyanin dye was 0.779mg.lit^{-1}. While the concentration decreased to a minimum value of 0.110 mg.lit^{-1} at V2S0A0.

TABLE IV. EFFECT OF SALICYLIC ACID AND SEAWEED EXTRACT AND THEIR INTERACTION BETWEEN MANY VARIETIES OF ROSELLE PLANTS IN THE CONCENTRATION OF ANTHOCYANIN (MG.L-1)

V	Salicylic Acid	Seaweed Extract			Mean V×S
		A0	*A1*	*A2*	
V1	S0	0.336	0.472	0.483	0.430
	S1	0.351	0.488	0.679	0.506
	S2	0.366	0.577	0.779	0.574
V2	S0	0.110	0.139	0.157	0.135
	S1	0.123	0.161	0.289	0.191
	S2	0.130	0.248	0.298	0.225
V3	S0	0.228	0.252	0.259	0.246
	S1	0.233	0.285	0.452	0.323
	S2	0.240	0.361	0.481	0.360
L. S. D $_{(0.05)}$		0.009			0.005
Seaweed / Varieties		***A0***	***A1***	***A2***	**Mean V**
V1		0.351	0.512	0.647	0.503
V2		0.121	0.182	0.248	0.183
V3		0.233	0.299	0.397	0.310
L. S. D $_{(0.05)}$		0.005			0.003

Seaweed / Salicylic	*A0*	*A1*	*A2*	Mean S
S0	0.224	0.287	0.299	0.270
S1	0.235	0.311	0.473	0.340
S2	0.245	0.395	0.519	0.386
L. S. D $_{(0.05)}$	0.005			0.003
A Mean	0.235	0.331	0.430	
L. S. D $_{(0.05)}$	0.003			

In Table (5), it can be noted that the variety had a significant effect on the concentration of Gossypetin in the leaves. The V1 was significantly higher than the rest of the varieties and gave the highest concentration of 0.866 mg.lit^{-1} while V2 gave the lowest rate of 0.833 mg.lit^{-1}. As for the effect of Salicylic acid, the table shows that the level of S2 exceeded the other levels. The highest level S2 gave the highest concentration of Gossypetin concentration in the leaves of 0.961 mg.lit^{-1} compared to the S0 level, which gave the lowest rate of 0.705 mg.lit^{-1}.

The results showed that the difference in levels of marine algae extract was significant in this trait. The high A2 level increased the concentration of Gossypetin in the leaves by 1.063 mg.lit^{-1} while the A0 treatment gave the lowest rate of 0.510 mg.lit^{-1}. The results showed that the di interaction between the cultivars and the salicylic acid resulted in an increase in the concentration of Gossypetin in the leaves. The combination V1S2 gave the highest rate of this capacity of 0.971 mg.lit^{-1}. The combination of V2S0 gave the lowest rate of 0.668 mg.lit^{-1}. This effect was also significantly affected by the interaction between the varieties and the seaweed extract, The highest values were at 1.075 mg.lit^{-1} at the combination of V1A2, and the lowest values at the combination of V2A0 were 0.478 mg.lit^{-1}. On the other hand, salicylic acid and seaweed extract showed a clear increase in the concentration of Gossypetin in the leaves. The combination of S2A2 was higher, and the highest rate was 1.129 mg.lit^{-1} while S0A0 gave the lowest rate of 0.305 mg.lit^{-1}. The effect of triple interaction was no different from that of interaction. The combination of V1S2A2 was higher by giving it the highest values of 1.136 mg.lit^{-1}, while the lowest values were 0.239 mg.lit^{-1} at V2S0A0.

TABLE V EFFECT OF SALICYLIC ACID AND SEAWEED EXTRACT AND THEIR INTERACTION BETWEEN MANY VARIETIES OF ROSELLE PLANTS IN THE CONCENTRATION OF ANTHOCYANIN (MG.L-1)

V	Salicylic Acid	Seaweed Extract			Mean V×S
		A0	*A1*	*A2*	
V1	**S0**	0.343	0.866	0.978	0.729
	S1	0.510	1.074	1.112	0.898
	S2	0.738	1.039	1.136	0.971
V2	**S0**	0.239	0.850	0.915	0.668
	S1	0.492	1.059	1.102	0.884
	S2	0.703	1.018	1.123	0.948
V3	**S0**	0.335	0.861	0.966	0.720
	S1	0.502	1.066	1.108	0.892

S2	0.736	1.031	1.128	0.965
L. S. D (0.05)	0.003302			0.001906
Seaweed / Varieties	A0	A1	A2	Mean V
V1	0.530	0.993	1.075	0.866
V2	0.478	0.975	1.046	0.833
V3	0.524	0.986	1.067	0.859
L. S. D (0.05)	0.001906			0.001101
Seaweed / Salicylic	A0	A1	A2	Mean S
S0	0.305	0.859	0.953	0.705
S1	0.501	1.066	1.107	0.891
S2	0.725	1.029	1.129	0.961
L. S. D (0.05)	0.001906			0.001101
A Mean	0.510	0.984	1.063	
L. S. D (0.05)	0.001101			

The results of Table (6) indicate that there was a significant effect of the varieties in the concentration of Hibiscetine in the leaves. The V1 variety significantly exceeded the rest of the varieties and gave the highest rate of 0.272 mg.lit^{-1} while the plants gave the V2 variety, the lowest rate of 0.253 mg.lit^{-1}. It is clear from the results of the same table that the salicylic acid spray has a significant effect on this property. The high-level S2 achieved the highest concentration of Hibiscetine in the leaves of 0.300 mg.lit^{-1}, thus exceeding the S0, which gave the lowest rate 0.203 mg.lit^{-1}.

The higher the level of seaweed extract, the greater the concentration of Hibiscetine in the leaves. The effect increased with the highest level of spraying 0.327 mg.lit^{-1}. When the level A2 and the lowest was 0.163 mg.lit^{-1} when the level was A0. The results of the same table showed significant differences in the di interactions between the varieties and salicylic acid. The combination of V1S2 gave the highest concentration of Hibiscetine in the leaves of 0.312 mg.lit^{-1}. In contrast, the treatment of V2S0 gave the lowest rate of 0.196 mg.lit^{-1}.

TABLE VI EFFECT OF SALICYLIC ACID AND SEAWEED EXTRACT AND THEIR INTERACTION BETWEEN MANY VARIETIES OF ROSELLE PLANTS IN THE CONCENTRATION OF HIBISCETINE (MG.L-1)

V	Salicylic Acid	Seaweed Extract			Mean V×S
		A0	A1	A2	
V1	S0	0.139	0.222	0.266	0.209
	S1	0.183	0.347	0.361	0.297
	S2	0.189	0.363	0.384	0.312
V2	S0	0.131	0.210	0.249	0.196
	S1	0.165	0.321	0.356	0.280
	S2	0.172	0.351	0.329	0.284
V3	S0	0.135	0.221	0.262	0.206
	S1	0.177	0.341	0.358	0.292
	S2	0.181	0.355	0.380	0.305

L. S. D (0.05)	0.01888			0.01090
Seaweed / Varieties	A0	A1	A2	Mean V
V1	0.170	0.310	0.337	0.272
V2	0.156	0.294	0.311	0.253
V3	0.164	0.305	0.333	0.267
L. S. D (0.05)	0.01090			0.00629
Seaweed / Salicylic	A0	A1	A2	Mean S
S0	0.135	0.217	0.259	0.203
S1	0.175	0.336	0.3583	0.289
S2	0.180	0.356	0.364	0.300
L. S. D (0.05)	0.01090			0.00629
A Mean	0.163	0.303	0.327	
L. S. D (0.05)	0.01090			

Table (7) shows the difference in varieties. V1 was superior to the rest of the other varieties by giving the highest value of 0.201 mg.lit^{-1}. While the lowest values were 0.169 mg.lit^{-1} in V2. It was noticed that salicylic acid spray increased the concentration of Sabdaretine in the leaves of the capillaries by increasing the spraying levels. The level of S2 was significantly higher than the rest of the levels, with the highest rate of 0.205 mg.lit^{-1}while the non-spray treatment S0 gave the lowest rate of 0.163 mg.lit^{-1}.

The seaweed extracts sprayed changes in the concentration of sabdaretine in the leaves. This increased the level of spray to reach the highest values at the A2 level of 0.233 mg.lit^{-1}. While the A0 level gave the lowest rate of 0.139 mg.lit^{-1}.

The interaction between the varieties and salicylic acid showed significant differences in the concentration of Sabdaretine in leaves. If the combination of V1S2 showed the highest values, it was 0.231 mg.lit^{-1}. This exceeded the other combinations, especially the combination of V2S0, which gave the lowest values of 0.155 mg.lit^{-1}. As for the interaction between the varieties and the seaweed extract, there were statistical differences in the superiority of the combination V1A2 with the highest values of 0.222 mg.lit^{-1}, while the lowest values showed with the combination of V2A0 0.133 mg.lit-1.

Di interactions between salicylic acid and seaweed extract showed significant differences in the concentration of sabdaretine, which increased the levels of spray, especially the combination of S2A2, which gave the highest values of 0.233 mg.lit^{-1}while decreasing to 0.132 mg.lit^{-1}S0A0. The tri interactions of the study factors showed significant differences between the combinations. The combination of V1S2A2 on the other combinations was higher with the highest values of 0.298 mg.lit^{-1}, while the concentration of Sabdaretine in the leaves decreased to 0.122 mg.lit^{-1}.

TABLE VII EFFECT OF SALICYLIC ACID AND SEAWEED EXTRACT AND THEIR INTERACTION BETWEEN MANY VARIETIES OF ROSELLE PLANTS IN THE CONCENTRATION OF HIBISCETINE (MG.L-1)

V	Salicylic Acid	Seaweed Extract			Mean V×S
		A0	*A1*	*A2*	
V1	S0	0.139	0.176	0.197	0.170
	S1	0.144	0.199	0.263	0.202
	S2	0.153	0.244	0.298	0.231
V2	S0	0.122	0.163	0.180	0.155
	S1	0.138	0.171	0.202	0.170
	S2	0.140	0.193	0.213	0.182
V3	S0	0.135	0.170	0.189	0.164
	S1	0.140	0.182	0.223	0.181
	S2	0.147	0.211	0.250	0.202
L. S. D (0.05)		0.003339			0.001928
Seaweed / Varieties		*A0*	*A1*	*A2*	Mean V
V1		0.145	0.206	0.252	0.201
V2		0.133	0.175	0.198	0.169
V3		0.140	0.187	0.220	0.183
L. S. D (0.05)		0.01090			0.001928
Seaweed / Salicylic		*A0*	*A1*	*A2*	Mean S
S0		0.132	0.169	0.188	0.163
S1		0.140	0.184	0.229	0.184
S2		0.146	0.216	0.253	0.205
L. S. D (0.05)		0.001928			0.001113
A Mean		0.139	0.189	0.223	
L. S. D (0.05)		0.001113			

IV. DISCUSSION

The results of the statistical analysis showed that the superiority of the red variety on the rest of the varieties. In the content of the leaves of the active substances and this may be due to genetic differences that distinguish the red variety from other varieties, and this corresponds with what they reached (11) when studying some active substances of two of varieties roselle. The increase in phenols by the use of salicylic acid may be due to its effect on the activity of vital activities such as absorption, the process of building carbohydrates and proteins. As the result of increasing the area of the paper to increase the activity of enzymes and stimulate the transfer of nutrients from the source (leaves) downstream and thus increase the content of the leaves Of the active substances studied (12).

The acid also contributes to the increased efficiency of photosynthesis to form many compounds such as sugars, amino acids, and nuclear fats. These metabolic products are used as feedstock for the production of secondary metabolites (13). As for the effect of seaweed extract in the rate of qualitative qualities studied, it can be attributed to the role of paper fertilization, which increases the activity and growth of the roots and this leads to an increase in the absorption of nutrients from the soil as well as its impact on the compounds rich in energy needed by the plant to build various compounds that contribute to the revitalization Its various activities thus increase the concentration of secondary compounds produced by the plant, including vitamin C in leaves (14).

And that the increase in the composition of carbohydrate is reflected directly in the increase in the rate of organic acids, including vitamin C and many of the elements processed by the extract help to transfer photosynthesis products to the storage centers, and therefore, this result contributes to the increased concentration of this acid (15).

Plant processing of nutrients is one of the most important factors in increasing its vegetative growth, including the area of one leaf that causes the raising of the efficiency of the plant in the carbonization process, which is accompanied by an increase in the production of secondary compounds, including Gossypetin. The development and increase of vegetative growth are reflected directly in raising the plant production of secondary compounds produced by (16).

Nutrient nutrients processed by the extract help to stimulate and stimulate the formation of enzymes that stimulate the building of secondary Gossypetin compounds and help transport them to storage places. or can be attributed to the role of the potassium element in the transport of carbohydrates between parts of the plant that take multiple metabolic pathways to be subsequently several Gossypetin or Gossypetin, as well as the increased concentration of Hibescitine, as the food extract increases root activity and growth, thus increasing nutrient uptake (14).

The significant increase in anthocyanin dye can be attributed to the effect of the extract in increasing or increasing the efficiency of photosynthesis process and its products such as carbohydrates, especially sugars, which are the main building blocks of anthocyanin dye. In addition, the increase in organic acids, including vitamin C, (17).

V. CONCULUTION

From the results, it was observed that the red variety is superiority of the other varieties in the content of the leaves of the active substances, It also gave the treatment of spraying with a concentration of 50 $mg.lit^{-1}$ Salicylic acid and concentration of 15 $ml.lit^{-1}$ seaweed extract and their interactions best results.

REFERENCES

[1] Abbas M. K. and Ali, S. A. (2011). Effect of foliar application of NPK on some growth characters of two cultivars of Roselle (Hibiscus sabdariffa L.). American Journal of Plant Physiology, 6:220-227.

[2] Louis, S. J., Kadams, A. M., Simon, S. Y. and Mohammed, S. G. (2013). Combining ability in Rosell cultivars for agronomic traits in Yola, Nigeria. Greener Journal of Agricultural Sciences, 3 (2): 145-149.

[3] Kılıç. C.S, Aslan. S, Kartal. M and Coskun. M.(2011).Fatty acid composition of Hibiscus trionum L. (Malvaceae). Rec. Nat. Prod. 5 (1) : 65-69.

[4] Li, Z. G., Xie, L. R., & Li, X. J. (2015). Hydrogen sulfide acts as a downstream signal molecule in salicylic acid-induced heat tolerance in maize (Zea mays L.) seedlings. Journal of plant physiology, 177, 121-127.

[5] Pacheco, A.; Cabral, C.; Fermino, E. and Aleman, C.(2013). Salicylic acid-induced changes to growth, flowering and flavonoids production in marigold plants. Glob. J. Med. Plants Res., 1 (1) :095-100.

[6] Sharma, H.S.S., Fleming, C.C., Selby, C., Rao, J.R., Martin, T.J.G., (2013). Plant bio-stimulants: a review on the processing of macroalgae and use of extracts for crop management to reduce abiotic and biotic stresses. Appl. Phycology. 26, 465–490.

[7] Battacharyya, D., Babgohari, M. Z., Rathor, P., & Prithiviraj, B. (2015). Seaweed extracts as biostimulants in horticulture. Scientia Horticulturae, 196, 39-48.

[8] Elansary, H. O., Skalicka-Woźniak, K., & King, I. W. (2016). Enhancing stress growth traits as well as phytochemical and antioxidant contents of Spiraea and Pittosporum under seaweed extract treatments. Plant Physiology and Biochemistry.

[9] Obouayeba Abba Pacomel, Djyh Nazaire Bernardl,et al,(2014). Phytochemical and antioxidant activity of Roselle Hibiscus Sabdariffa L. petal extracts. Reseach Journal of pharmaceutical Biological and Chemical Sciences ., Vol4(5), P1454.

[10] Suarez,.B,Palacips, N.,Fraga,N., and Rodriguez, R.liquid chromatographic method for quantifying polyphenols in ciders by direct injection .journal of Chromatography A,2005,1066,105-110.

[11] Majeed, K. A, and A. S. Ali. (2011). Effect of foliar application of TOTALGRO on Some growth characters of two cultivars of Roselle (Hibiscus sabdariffa L.). Amer J. Plan. physic6 (4):220-227.

[12] Najafi, S.; Jamei, R. and Farnad, N.(2014). Effect of silver nanoparticles and magnetic field on the yield and chemical composition of (Triticum aestivum L.) seedlings. Bulletin of Environment, Pharma. Life Sci., 3 (2): 263-268.

[13] Turkyilmaz, B.; Aktas, L .Y and Guven, A. (2005). Salicylic acid induced some biochemical and physiological changes in Phaseolus vulgaris L. Science and Engineering J . of Firat Univ.17(2):319-326.

[14] Taiz ,L.and E. Ziger .(2006). Plant Physiology .4thed.Sinauer Associates,Inc. Published Sunderland, Massachusetts.

[15] Sutham, P.(2007). Use of different sources and rates of foliar Potassium with Glyphosate to overcome environmental and management induced K deficiency in Soybean, M.S.thesis.University of Missouri, Columbia ,Missouri.USA.

[16] Allen, V.B. and D.J. Pilpeam.(2006). Handbook of plant nutrition.Taylor and Francis group.NewYork.pp:662.

[17] Madiha, H.; Jalal, A. and Ayad, A.(2014). The effect of some foliar nutrients on vegetative growth characteristics and yield of Rosell (Hibiscus sabdariffa L).Journal of Tikrit University for Agriculture Sciences. Special Issue of the Third Specialized Conference / Plant Production 26-27 / 3/2014.