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Effect of Proline and Potassium Humate on Growth, Yield and Quality of Broad Bean under Saline Soil Conditions

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ABSTRACT

In order to investigate the influence of spraying with proline and potassium humate (PH) on productivity and chemical components of Broad bean, cv. Koprosay, two field experiment were conducted at a private Farm in Rowad Village belong to Sahl El-Husseiniya, Sharkia Governorate throughout 2016 and 2017 seasons. Randomized complete blocks design was used with three replications. Height of plant, No. of leaves/plant, total chlorophylls, leaves fresh and dry weight, length and wide of pod, green seeds number per pod, the weight of 100 green seeds, total yield, N, P, K and proline percentages in leaves N, P, K, total carbohydrates and crude protein percentages in green pods were estimated. Spraying broad bean plants with 2 L PH/fad in addition 100 mg proline/L produced the highest values of all estimated traits in both seasons. Accordingly, it could be suggested that spraying broad bean plants grown under saline soil with 2 L PH/fad and 100 mg proline/L to improve growth characters and yield in addition to chemical components of broad bean.

Keywords: Broad bean, foliar spraying, potassium humate, proline, growth, yield, chemical composition.

INTRODUCTION

In most developing countries, legumes are often an integral part of agricultural ecosystems. Broad bean (*Vicia faba* L.) c v Koprosay is one of the most important legumes in Mediterranean agricultural areas (Buttery *et al*., 1992). In Egypt it is consumed in huge quantities as human food.

Salinity is being the most important abiotic stresses in arid and semi-arid regions that reduced yield of main crops by extra than 50%. Also, salinity restrictions soil fertility in irrigated regions, this lead to low rainfall in addition soil leaching in these areas of world (Corwin *et al.*, 1996). Additionally, salinity affects 7% of the world's land area for roughly 930 million hectare (Ghasemi *et al.*, 2002). Also, high salinity sodicity levels lead to potassium deficiency owing to antagonistic effect of sodium on potassium absorption or disturbance of the Na+/K+ ratio (Chhabra, 1983 and Muhammed, 1986). Salinity drives different biochemical and physiological responses in plants in different ways (Zadeh and Naeni, 2007).

The gathering of osmolytes for example proline is a well-known adaptive mechanism in plants in opposition to salt stress conditions. Where, proline causes the expression of salt-stress-responsive proteins and might progress the plant adaptation to salt-stress (Khedr *et al*., 2003). Proline acting these roles by defensive the photosynthetic machinery by performance as an oxygen radical hunter and by displaying an antioxidant activity (Heuer *et al*., 2003 ; Ashraf *et al*., 2008 and Okuma *et al*., 2008). Sairam and Tyagi (2004) reported that proline accumulation balanced the deleterious effects of salinity, which considered as organic nitrogen reserve that used during stress recovery. Abd El-Samad *et al*. (2010) found that spraying broad bean plants with proline progressively increased saccharides as well as proteins. Abd El-Samad and Shadadd (2013) showed that treatment broad bean seeds with proline (100 ppm) increased seedlings growth characteristics even at lowest salinity level tested.

Humic acids are heterogeneous, which include macromolecule, hydrophilic acidic functional groups and hydrophobic groups (Fahramand *et al.*, 201). Physical structure and microbial of soil were significantly affected by humic acid application, which stimulating plant growth, nutrient uptake and yield (Asik *et al*. 2009). El-Desuki (2004) reported that increasing the level of humic acid application from 0 to 6 L/fed gradually increased growth traits of onion. Abd El-Al *et al.*, (2005) indicated that dry matter production of faba bean plants significantly increased by application of humic acid. Faten *et al.* (2005) found that onion growth characters, total yield and components as well as TSS, N, P, K and Fe in bulbs were significantly affected by addition of PH as foliar application. Dhanasekarm (2006) found that total yield of tomato was improved as a result of spraying plants with humic acid as compared with untreated plants. Abdel-Mawgoud *et al*. (2007) indicated that application of humic acid increased number of leaves, fresh and dry weights of tomato plants, total and marketable yield, NPK contents and uptake. Yildirim (2007) found that humic substances promoted growth and increase yield and quality in number of tomato plant species. Gad El-Hak *et al.* (2012), Dawa *et al.* (2013) and Helmy (2013) reported that highest growth parameters, yield and its components of pea resulted from plants spraying with humic acid. Khan *et al.* (2013) stated that growth and seed yield of pea were increased by soil or foliar application of humic acid. Kandil (2014) found that dry weight, 100-seed weight and yield of pea were increased by greater than ever of humic acid. Barakat *et al.* (2015) found that weight of 100 dry seeds, dry seeds yield plant-1 and fed-1 of common bean were positively responded to application of PH on bean. Moustafa *et al.* (2016) concluded that the use of PH as organic fertilizer is recommended to replace partially chemical fertilizer. Abdellatif and Abdel-Ati (2017) stated that humic acid application targeted agreat results on tomato plant growth and productivity as compared with control. Osman *et al.* (2017) recommended that application of PH as a foliar spray for improving the quality and quantity of wheat cultivated in salty lands. Taha and Osman (2018) indicated that addition of PH significantly increased growth parameters and chemical composition related to salt tolerant either inorganic or organic components.

Therefore, this study aimed to investigate the ampact of spraying with PH and proline levels on vegetative growth, yield and its components and chemical constituents of broad bean, Koprosay cultivar under saline soil conditions.

MATERIALS AND METHODS

Two field experiment were conducted at a private Farm in Rowad Village belong to Sahl El-Husseiniya, Sharkia Governorate throughout 2016 and 2017 seasons to investigate the influence of spraying with proline and PH (PH) on productivity and chemical components of Broad bean, cv. Koprosay. Randomized complete blocks design was used with three replications. The studied treatments (spraying with PH "PH"and proline levels) were as follow;

1- Without spraying *i.e*. control treatment.
2- Spraying with PH (1 L/fad).
3- Spraying with PH (2 L/fad).
4- Spraying with proline (50 mg/L).
5- Spraying with proline (100 mg/L).
6- Spraying with PH (1 L/fad) and proline (50 mg/L).
7- Spraying with PH (2 L/fad) and proline (50 mg/L).

8- Spraying with PH (1 L/fad) and proline (100 mg/L).
9- Spraying with PH (2 L/fad) and proline (100 mg/L).

Spraying with PH and proline levels were carried out three times at aforesaid levels after 20, 30 and 40 days from.

Physical and chemical properties of the experimental soil were presented in Table 1.

Table 1. Physical and chemical properties of the experimental soil in two growing seasons.

Soil analyses		2016	2017
A: Mechanical analysis:			
Clay (%)		46.93	50.00
Silt (%)		30.40	29.40
Fine sand (%)		20.70	18.71
Coarse sand (%)		1.97	1.89
Texture class		Clay	Clay
B: Chemical analyses:			
pH (1 : 2.5)		7.89	8.11
EC ds m^{-1} (1 : 5)		5.07	4.90
Organic matter (%)		1.67	2.92
Saturation percentage (SP %)		70.00	72.50
Available N (ppm)		47.50	48.18
Available P (ppm)		4.50	4.80
Exchangeable K (ppm)		375	386
Cations (meq/100 g soil)	Ca^{++}	3.85	4.25
	Mg^{++}	0.77	2.41
	Na^{+}	4.35	2.93
	K^{+}	0.31	0.38
Anions (meq/100 g soil)	CO_3^{--}	-	-
	HCo_3^{-}	0.94	4.61
	Cl^{-}	2.66	2.73
	So_4^{--}	1.88	2.39

The area of experimental unit was (10.5 m^2), which included 5-ridges each of (0.6-m) in width and (3.5-m) in length. A sample of irrigation water was taken and analyzed for the saline content as revealed in Table 2.

Table 2. Chemical analysis of the irrigation water of El-Salam Canal used in the experimental field during the two growing seasons.

Properties		2016	2017
pH		8.02	8.03
E C dS m^{-1}		1.88	1.96
Anions ($meq\ L^{-1}$)	CO_3^{--}	-	-
	HCo_3^{-}	2.36	2.46
	Cl^{-}	7.63	7.55
	So_4^{--}	2.89	2.87
Cations ($meq\ L^{-1}$)	Ca^{++}	3.38	3.36
	Mg^{++}	2.94	2.98
	Na^{+}	6.30	6.40
	K^{+}	0.14	0.15
SAR		3.53	3.54

Broad bean, Koprosay cultivar seeds were sown in hills (2 seeds/hill) by hand at 20 cm apart on 2 rows of each ridge on 1st October in both seasons. Chemical fertilizers (N, P and K) in recommended rates and doses were added. Where, during preparation of soil, 200 kg calcium superphosphate (15.5 % P2O5) per fad was applied. In two equal doses, the first one added previous to first irrigation and second one was prior to the following irrigation, potassium fertilizer (potassium sulphate "48.0 % K2O") at 50 kg/fad and nitrogen fertilizer (ammonium sulfate "20.5 % N") at 200 kg/fad were used. Other agricultural practices were done as reported by Ministry of Agriculture and Land Reclamation recommendations, excluding studied factors.

Samples (5 plants) after 50 days of the sowing were taken randomly from each plot to measure growth traits *viz*:

1- Height of plant (cm).
2- No. of leaves per plant.
3- Total chlorophylls (SPAD), which was assessed by SPAD-502 apparatus (Minolta Co. Ltd., Osaka, Japan).
4- Leaves fresh weight (g).
5- Leaves dry weight (g): The plant samples weighed and oven dried (70 °C in anticipation of stable weight) then, dry matter calculated in expression of g/plant.

The harvest was done after 65 days from sowing and continue 42 days through 6 pickings (green pods were harvested every 7 days). Random samples of green pods at harvesting time (from the fourth picking) were taken from each plot to decide the following traits:

1- Length of pod (cm).
2- Wide of pod (cm)
3- Green seeds number per pod.
4- The weight of 100 green seeds (g).
5- Total yield was considered as the total weight of green pods (t/fad).

A representative samples of 100 g from leaves after 50 days from sowing (to determine N, P, K and proline percentages) and green pods after 93 days from sowing (from the fourth picking) at proper maturity stage (to determine N, P, K, total carbohydrates and crude protein percentages) were dried (70°C until constant weight). Sample of 0.2 g was wet digested according to Peterburgski (1968) to determine; nitrogen and phosphorus contents as scribed by Jackson (1967), crude protein (%) was considered by multiplying total N X 6.25, potassium content according to Black (1965), Total carbohydrates (%) according to Somogy (1952) and proline percentage in leaves according to AOAC (1990).

According to technique of analysis of variance in randomized complete blocks design (Gomez and Gomez, 1984), all obtained data statistically analyzed using "MSTAT-C" computer software package. Means of treatments were compared using LSD method (Snedecor and Cochran, 1980) at 5 % level of probability.

RESULTS AND DISCUSSION

1- Growth traits:

As data obtainable in Table 3 show that spraying broad bean plants with PH and proline treatments in addition control treatment (without foliar spraying) caused significant effects on growth traits *i.e.* plant height, number of leaves/plant, total chlorophylls, fresh and dry weights of broad bean plant after 50 days from sowing date. The best treatment was spraying with PH (2 L/fad) and proline (100 mg/L) in both seasons. Generally, spraying broad bean plants with PH at different rates surpassed spraying with proline at different rates, while lowest means of growth traits were obtained from control treatment in the 1st and 2nd seasons.

The enhancing effect of PH and proline at various rates on growth traits may be due to the favourable effect of PH and proline or potassium and humic acid. Where, potassium acting important function in osmoregulation, photosynthesis, transpiration, open and closure of stomatal, protein synthesis, translating of assimilates into sink organs and enzymes establishment (Milford and Johnston, 2007). Also, humic acid has many beneficial effects on the physical structure and microbial of soil that stimulating plant growth, cell permeability, nutrient uptake and yield (Asik *et al*. 2009). Proline induces the expression of salt-stress-responsive proteins and may improve the plant adaptation to salt-stress (Khedr *et al*., 2003). Besides, proline plays a very important role in the cell's osmotic capacity, membrane stability and detoxification of negative ions in plants under saline conditions (Ashraf, 2009). The obtained results are in accord with those reported by Abd El-Samad and Shadadd (2013), Abd El-Al *et al*., (2005), Gad El-Hak *et al.* (2012), Dawa *et al.* (2013), Helmy (2013), Khan et al. (2013), Barakat *et al.* (2015) and Taha and Osman (2018).

Table 3. Growth characters of broad bean plant after 50 days of sowing date as affected by spraying with PH and proline levels during 2016 and 2017 seasons.

Characters	Plant height (cm)		Number of leaves/ plant		Total chlorophylls (SPAD)		Fresh weight of leaves (g)		Dry weight of leaves (g)	
Treatments	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Without (control)	72.23	73.36	35.11	36.13	73.03	73.10	310.8	315.7	91.72	92.67
PH (1 L/fad)	82.43	79.47	38.32	39.32	73.24	73.24	315.3	322.5	92.51	93.53
PH (2 L/fad)	85.56	86.62	43.14	42.23	73.63	73.51	332.6	346.8	93.62	95.49
Proline (50 mg/L)	84.46	84.57	42.57	41.56	73.41	73.41	328.7	335.9	93.43	94.95
Proline (100 mg/L)	87.72	88.43	44.74	43.67	74.12	74.11	341.8	350.3	95.19	96.43
PH (1 L/fad) + Proline (50 mg/L)	93.35	94.24	49.28	47.43	74.55	74.34	353.9	367.4	99.47	106.3
PH (2 L/fad) + Proline (50 mg/L)	100.3	98.34	51.39	50.36	74.85	74.68	365.7	376.7	105.4	108.6
PH (1 L/fad) + Proline (100 mg/L)	105.1	103.6	53.19	52.31	75.38	75.11	378.6	384.3	108.3	110.5
PH (2 L/fad) + Proline (100 mg/L)	111.4	110.7	55.43	54.69	75.58	75.41	387.3	395.5	112.8	114.3
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5%	1.140	0.270	0.590	1.220	0.310	0.157	1.670	0.750	1.205	0.210

2- Yield and its components:

The data presented in Table 4 show that spraying broad bean plants with PH and proline treatments caused significant increases in yield and its components *i.e.* pod length, pod wide, number of green seeds/pod, weight of 100 green seeds at harvesting time (from the fourth picking) and total yield t/fed (green pods) of broad bean plant in the two seasons of study.

Table 4. Yield components and total of broad bean plant as affected by spraying with PH and proline levels during 2016 and 2017 seasons.

Characters	Pod length (cm)		Pod wide (cm)		No. of green seeds/pod		Weight of 100 green seeds (g)		Total yield (t/fed)	
Treatments	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Without (control)	10.10	10.40	1.50	1.42	3.11	3.21	140.3	143.6	2.153	2.047
PH (1 L/fad)	10.92	11.21	1.61	1.53	3.34	3.45	152.2	155.4	2.546	2.396
PH (2 L/fad)	12.24	12.53	1.92	1.72	4.02	3.98	164.3	168.9	3.128	2.867
Proline (50 mg/L)	11.13	11.42	1.73	1.63	3.53	3.64	155.4	159.6	2.754	2.596
Proline (100 mg/L)	12.31	12.62	2.03	1.81	4.13	4.02	166.5	164.3	3.215	2.939
PH (1 L/fad) + Proline (50 mg/L)	13.13	13.44	2.12	2.04	4.33	4.23	183.4	179.2	3.549	3.397
PH (2 L/fad) + Proline (50 mg/L)	14.34	14.63	2.31	2.23	4.91	4.75	200.6	195.6	3.976	3.879
PH (1 L/fad) + Proline (100 mg/L)	14.51	14.41	2.22	2.12	4.74	4.61	210.6	207.5	3.748	3.684
PH (2 L/fad) + Proline (100 mg/L)	15.42	15.60	2.43	2.31	5.35	5.16	218.7	214.3	4.437	4.298
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5%	0.560	1.040	0.700	1.040	1.010	0.980	1.060	0.650	0.780	1.310

Spraying broad bean plants by PH (2 L/fad) and proline (100 mg/L) significantly produced highest mean values of all studied yield and its components as compared to other studied treatments in the two seasons of study. The second best treatment was spraying with PH (2 L/fad) and proline (50 mg/L) and PH (1 L/fad) and proline (100 mg/L), respectively.

The enhancing effect of proline treatments might be proline acting these functions by defensive the photosynthetic machinery by performance as an oxygen radical scavenger as well as by displaying an antioxidant action (Heuer *et al.*, 2003; Ashraf *et al.*, 2008 and Okuma *et al.*, 2008). Obtained findings are in conformity by those of Faten *et al.* (2005), Dhanasekarm (2006), Abdel-Mawgoud *et al.* (2007), Yildirim (2007), Dawa *et al.* (2013), Khan *et al.* (2013), Abdellatif and Abdel-Ati (2017) and Taha and Osman (2018).

3- Chemical constituents in the leaves and seeds:

The data obtainable in Tables 5 and 6 illustrate that spraying broad bean plants with PH and proline treatments besides control treatment (without foliar spraying) significantly affected chemical constituents in green seeds at harvesting time (from the fourth picking) of broad bean plant in the two seasons of study.

Table 5. Chemical analysis of broad bean leaves after 50 days of sowing date as affected by spraying with PH and proline levels during 2016 and 2017 seasons.

Characters	N (%) in leaves		P (%) in leaves		K (%) in leaves		Proline (%) in leaves	
Treatments	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Without (control)	2.54	2.60	0.302	0.307	2.96	2.98	11.14	11.21
PH (1 L/fad)	2.61	2.65	0.311	0.316	3.06	3.08	10.77	10.54
PH (2 L/fad)	2.68	2.74	0.320	0.332	3.18	3.22	10.25	10.10
Proline (50 mg/L)	2.65	2.69	0.315	0.325	3.14	3.18	9.67	9.32
Proline (100 mg/L)	2.69	2.75	0.322	0.335	3.22	3.25	9.19	8.98
PH (1 L/fad) + Proline (50 mg/L)	2.92	3.03	0.331	0.340	3.31	3.36	8.55	8.70
PH (2 L/fad) + Proline (50 mg/L)	3.17	3.23	0.335	0.348	3.39	3.41	8.21	8.10
PH (1 L/fad) + Proline (100 mg/L)	3.25	3.31	0.339	0.345	3.37	3.43	7.75	7.61
PH (2 L/fad) + Proline (100 mg/L)	3.34	3.39	0.352	0.361	3.43	3.46	7.51	7.32
F. test	*	*	*	*	*	*	*	*
LSD at 5%	0.209	0.252	0.222	0.210	0.374	0.456	0.341	0.292

The highest mean values of studied chemical constituents in the leaves and seeds were obtained due to spraying broad bean plants with PH (2 L/fad) and proline (100 mg/L) in the two seasons of study. The descending order of other studied treatments was PH (1 L/fad) and proline (100 mg/L), PH (2 L/fad) and proline (50 mg/L) during both years. Conversely, the lowest means of all studied chemical constituents in the leaves and seeds was resulted from without spraying during both growing years.

The enhanced effect of proline treatments may be due to proline stimulating the expression of salt-responsive proteins and can improve plant adaptation with salt stress (Khedr *et al.*, 2003). The enhanced effect of potassium therapy in the blood can be due to physical fat. It has many

beneficial effects on the physical structure of soil and microbial propagation factors, as well as increasing the modification mechanisms used to stimulate plant growth, cell permeability, nutrient uptake and yield increase (Asik *et al*. 2009). Obtained findings are in conformity by those of Abd El-Samad *et al.* (2010), Faten *et al.* (2005), Abdel-Mawgoud *et al.* (2007), Helmy (2013), Khan *et al.* (2013) and Taha and Osman (2018).

Table 6. Chemical analysis of green broad bean seeds at harvesting time (from the fourth picking) as affected by spraying with PH and proline levels during 2016 and 2017 seasons.

Characters	N (%) in seeds		P (%) in seeds		K (%) in seeds		Total carbohy-drates (%)		Crude protein (%)	
Treatments	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Without (control)	2.51	2.54	0.338	0.342	1.45	1.50	44.21	43.43	15.32	14.69
PH (1 L/fad)	2.53	2.58	0.341	0.345	1.49	1.55	46.32	44.56	16.45	15.41
PH (2 L/fad)	2.61	2.64	0.345	0.352	1.54	1.61	48.62	46.43	18.53	16.91
Proline (50 mg/L)	2.57	2.62	0.342	0.349	1.51	1.58	47.76	45.53	17.62	16.52
Proline (100 mg/L)	2.63	2.67	0.349	0.355	1.57	1.64	49.54	47.36	19.37	17.46
PH (1 L/fad) + Proline (50 mg/L)	2.68	2.72	0.353	0.356	1.63	1.68	51.29	49.72	20.24	18.36
PH (2 L/fad) + Proline (50 mg/L)	2.75	2.79	0.361	0.362	1.67	1.72	52.17	50.54	21.54	20.23
PH (1 L/fad) + Proline (100 mg/L)	2.81	2.83	0.358	0.361	1.65	1.70	51.47	50.13	21.16	19.74
PH (2 L/fad) + Proline (100 mg/L)	2.90	3.00	0.365	0.369	1.73	1.75	52.53	51.35	22.46	21.37
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5%	1.220	0.750	0.590	1.120	0.310	0.650	0.670	0.750	0.245	0.212

D- Economic feasibility:

The economic feasibility of broad bean plants as affected by spraying with PH and proline are presented in Table 7. The results show that the highest net return 5801 LE/fed over both seasons was obtained from spraying broad bean plants with PH (2 L/fad) and proline (100 mg/L), such treatment returns the highest benefit cost ratio (2.133) in comparison with the other treatments. Therefore, this treatment considered to be economical for broad bean production under soil salinity and the environmental condition of Sahl El-Husseiniya, Sharkia Governorate.

Table 7. Economic feasibility of broad bean plants production as affected by spraying with PH and proline levels over both seasons.

Characters / Treatments	Total yield (t/fed)(1)	Gross return (LE/fed)(2)	Treatment cost (LE/fed)(3)	Total variable cost (LE/fed)(4)	Net return (LE/fed)(5)	Benefit cost ratio(6)	Order
Without (control)	2.100	5250	-	4516	734	1.162	9
PH (1 L/fad)	2.471	6177.5	180	4696	1481.5	1.315	8
PH (2 L/fad)	2.997	7492.5	360	4876	2616.5	1.536	6
Proline (50 mg/L)	2.677	6692.5	120	4636	2056.5	1.443	7
Proline (100 mg/L)	3.077	7692.5	240	4756	2936.5	1.617	5
PH (1 L/fad) + Proline (50 mg/L)	3.473	8682.5	300	4816	3866.5	1.802	4
PH (2 L/fad) + Proline (50 mg/L)	3.927	9817.5	480	4996	4821.5	1.964	2
PH (1 L/fad) + Proline (100 mg/L)	3.716	9290	420	4936	4354	1.882	3
PH (2 L/fad) + Proline (100 mg/L)	4.367	10917.5	600	5116	5801.5	2.133	1

1. Broad bean total yield as average over both seasons. 2. Gross return as total yield (t/fad) x 2500 LE ton.

3. Treatment cost was calculated according to the following prices; PH = 60 LE/L and proline = 40 LE/ 200 L.

4. Total variable cost (LE/fad) include; treatment cost plus land leasehold, N, P and K Fertilizers, microelements, pesticides, labors and other cultural practices, which equal nearly 4516 LE/fad. 5. = (2) – (4). (6) = (2) / (4).

CONCLUSION

From obtained results of this study, it could be recommended that foliar spraying broad bean plants grown under salinity soil with 2L/fad of PH with using using 100 mg/L of Proline to enhance growth, yields and its components and chemical constituents of broad bean under the environmental conditions of this research.

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تأثير البرولين وهيومات البوتاسيوم على نمو ومحصول وجودة الفول الرومى تحت ظروف الأرض الملحية

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أجريت هذه الدراسة خلال موسمي ٢٠١٦ و ٢٠١٧ في مزرعة خاصة بقرية الرواد بسهل الحسينية ، محافظة الشرقية بهدف دراسة تأثير الرش الورقي بالبرولين وهيومات البوتاسيوم وهى؛ بدون رش ورقى (معاملة المقارنة) ، الرش الورقى بهيومات البوتاسيوم بمعدل ١ و ٢ لتر/للفدان ، الرش الورقى بالبرولين بمعدل ٥٠ و١٠٠ ملليجرام/لتر ، الرش الورقي بخليط من هيومات البوتاسيوم بمعدل ١ لتر/للفدان + البرولين بمعدل ٥٠ ملليجرام/لتر ،الرش الورقي بخليط من هيومات البوتاسيوم بمعدل ٢ لتر/للفدان + البرولين بمعدل ٥٠ ملليجرام/لتر ، الرش الورقي بخليط من هيومات البوتاسيوم بمعدل ١ لتر/للفدان + البرولين بمعدل ١٠٠ ملليجرام /لتر والرش الورقى بخليط من هيومات البوتاسيوم بمعدل ٢ لتر/ للفدان +البرولين بمعدل ١٠٠ ملليجرام/لترعلى نمو ومحصول وجودة الفول الرومى تحت ظروف الأرض الملحية. استخدم فى هذه التجربة تصميم القطاعات كاملة العشوائية في ثلاثة مكررات. أدى الرش الورقى لنباتات الفول الرومى بهيومات البوتاسيوم بمعدل ١ لتر/فدان وبمعدل ٢ لتر/فدان الى زيادة معنوية والحصول على أعلى القيم لجميع صفات النمو والمحصول ومكوناته والمكونات الكيميائية في الأوراق والثمار بالمقارنة بمعاملة الكنترول في كلا الموسمين و كانت أحسن معاملة هي الرش الورقى بهيومات البوتاسيوم بمعدل ٢ لتر/للفدان. أدى الرش الورقى لنباتات الفول الرومى بالبرولين بمعدل ٥٠ ملليجرام/لتر وبمعدل ١٠٠ ملليجرام/ لتر لزيادة معنوية والحصول على أعلى القيم لجميع صفات النمو والمحصول ومكوناته والمكونات الكيميائية في الأوراق والثمار بالمقارنة بمعاملة الكنترول في كلا الموسمين و كانت احسن معاملة هى الرش الورقى بالبرولين بمعدل ١٠٠ ملليجرام/لتر. أدى الرش الورقى لنباتات الفول الرومى بخليط من هيومات البوتاسيوم والبرولين الى زيادة معنوية والحصول على أعلى القيم لجميع صفات النمو والمحصول ومكوناته والمكونات الكيميائية في الأوراق والثمار بالمقارنة بمعاملة الكنترول في كلا الموسمين و كانت أحسن معاملة هى الرش الورقي بخليط من هيومات البوتاسيوم بمعدل ٢ لتر/ للفدان + البرولين بمعدل ١٠٠ ملليجرام/لترفي كلا الموسمين. من ناحية أخرى، كانت أقل القيم لجميع الصفات تحت الدراسة من معاملة المقارنة (بدون رش ورقى) في كلا الموسمين. وبصفة عامة، يمكن التوصية بالرش الورقى لنباتات الفول الرومى بهيومات البوتاسيوم بمعدل ٢ لتر/للفدان مع الرش الورقى بالبرولين بمعدل ١٠٠ ملليجرام للحصول على أقصى نمو وإنتاجية وجودة للقرون الخضراء تحت الظروف البيئية لهذا البحث.