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Impact of Foliar Application with Salicylic Acid on Growth and Yield of Potato (*Solanum tuberosum* L.) under Different Irrigation Water Quantity

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ABSTRACT

Two field experiments were carried out in the Experimental Station, Faculty of Agriculture, Mansoura University in the two summer seasons of 2014 and 2015 to study the effect irrigation water quantity and foliar application with salicylic acid on growth and yield of potato cv. Spunta grown under clay loamy soil conditions using drip irrigation system. The experiment layout was split plot in based on complete randomized block design with three replications. Quantity of irrigation water (700, 1000 and 1300 m^3/ fed.) were present in the main plots, while foliar application with salicylic acid (0.0, 0.1, 0.2 and 0.3 g /litter.) were assigned in the sub plots. The results indicated that increasing water quantity up to1300 m^3/ fed. led to a significant increase of vegetative growth parameters (Plant height, leaves number, leaves area, number of main stem and foliage fresh weight per plant), leaves chemical composition (N, P, K, chlorophyll a, chlorophyll b and carotenoids), Tubers yield and its physical quality (tubers weight and number per plant, marketable and total yield), Tubers chemical quality (Vit. C, TSS, N, P and K) and plant water relations (Relative water content). On contrary, foliage dry matter percentage, tuber dry matter percentage, hardness, density, electrolyte leakage and water use efficiency were decreased. With respect to the effect of foliar application of salicylic acid, the data exhibited that, the mentioned characters were increased compared to untreated plants except electrolyte leakage. The interaction between irrigation water quantity and spraying salicylic acid showed that the combination which consist of 1300 m^3/ fed. and 0.2 g/l salicylic acid gave the highest values for most effective previous parameters.

Keywords: potato, irrigation water quantity, salicylic acid, relative water content, electrolyte leakage, water use efficiency and tubers yield.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the Solanaceae family plants. It is the fourth crop after maize, rice and wheat in the world. Potato is one of the main crops in Egypt. Also, it is considered as the second vegetable crop after tomato and one of the most important exported crops. Among top potato producer countries in the world Egypt is number eleventh and it is the first among African countries (FAO, 2012).

The yield and quality of potato tubers are affected with several factors such as variety, cultural practices, environmental conditions, water deficit and foliar application such as salicylic acid (Mohammad *et al*., 2014; Nasrabadi *et al*., 2015).

It has been detected that the lack of water for human life, especially in arid and semi-arid areas and in developing countries is a real threat. Population growth and rising standards of living lead to increase water consumption since the quantity of water used in agriculture is significant, saving water used in this respect, as well as possible solutions to eliminate the problem of water deficit, is the needed (Keyvan and Irandoost, 2015).Early investigations have reported that water is the most important factor for the potato production. Well-scheduled irrigation programs throughout the growing season is possible to increase potato yield (Erdem *et al*., 2006; Abou El-Khair *et al*., 2011; Abd El-Latif *et al*., 2011; Alaa *et al*., 2013).

Potato is sensitive to water deficit at some growth stages since irrigation has become critical component for production. Many irrigation studies have proved that potato is sensitive to water deficit due to its weak root system and 85% of roots is concentrated in the top 30 cm of soil, water stress causes weaker plant growth and minimize biomass production which led to yield reduction. Potato evaporates approximately 3–5 mm water every day during growth stage under optimal soil moisture level. Also, potato yield are responded linearly to amount of irrigation water (Shock and Feibert, 2002).

The probability of supply the plants with nutritious elements are very little or absent during water deficiency. Also, water deficit leads to reducing photosynthesis with 10-30%, thus inner changes happen in plants, cells formation and accumulation of osmotic active substances promote. Also, water stress influences on plant respiration (Lahlou *et al*., 2003). Irrigation regime of 80% of water requirement was the most water use efficiency. The drought stress led to the oxidative damage inevitably, producing more of reactive oxygen species (ROS), which are the result of incomplete oxygen reduction (Cruz de Carvalho, 2008). Also, Abd El-Latif *et al*. (2011) reported that repeated irrigation at 80 % from available soil moisture content recorded that the maximum values of the protein content, TSS, tuber yield and water use efficiency of potato. While at 40 % from available water soil moisture content gave the lowest values.

On potato, Abou El-Khair *et al.* (2011) reported that plant height, number of leaves per plant, shoot dry weight, total and free water in leaf tissues, N, P and K % and their uptake by shoot significantly increased with increasing quantity of irrigation water up to the highest level (1750 m^3/ fed.). 1250 or 1750 m^3/ fed. recorded the highest values of tuber yield/ plant and total yield/ fed., N, P, starch, carbohydrates and dry matter % in tuber. Cell sap, bound water, osmotic pressure, proline content in leaf tissues and water use efficiency (WUE) were increased by decreasing irrigation water quantity up to the lowest level (750 m^3/ fed.).

Salicylic acid (SA) a ubiquitous plant phenolic compound, which regulate many of processes in plants (Hayat *et al*., 2008). Also, it is improve plant growth parameters under water deficit conditions and other stresses (Senaratna *et al*., 2000). Exogenous SA increase the activities of antioxidant enzymes and plant tolerance to abiotic stress by decreasing generation of reactive oxygen species (ROS). SA has different effects on stress and damage of plants that depend on plant species, concentration, method and time of addition. Also, salicylic acid application probably activate the consumption of soluble carbohydrates to form young cell constituents which led to promote plant growth (Metwally *et al*., 2003).

SA acts as cofactors for some specific enzymes, *i.e.*, dismutases, peroxidases and catalases, those catalyzed breakdown of the toxic radicals (H_2O_2), (OH), (O-2). SA also plays an important role in the regulation of many physiological processes in plants such as effects on growth development, ion uptake, transport and membrane permeability (Simaei *et al*., 2012). Also, is introduced as an important messenger molecule in responses of plant to the different abiotic and biotic stresses and can ameliorate the impairing effects of water stress in different species (Arfan *et al*., 2007). Siamak and Kazemi-Arbat (2014) found that the application of salicylic acid increased the plant biomass and protein content of leaves in complete drought stress condition of chickpea compared with control plants significantly. On contrary, the 1-aminocyclopropane-1-carboxylic acid (ACC) synthase activity was decreases by using SA which led to producing of ethylene in the plant (Li *et al*., 1992). Ethylene will cause the loss of chlorophyll pigments in plants (Arfan *et al*., 2007). Also, SA inhibit ascorbate peroxidase activity which can disturb the H_2O_2 pathway and led to excessive accumulation of this substance in cell (Durner and Klessig, 1995).Hayat *et al*., (2008) found that SA increased relative water content (RWC), proline content, total chlorophyll content SPAD and decreased electrolyte leakage on tomato under drought condition. Jamali *et al*. (2011) mentioned that fresh weight of (shoot and root) and yield of strawberry were increased by using SA. Also, fruit weight per plant, yield and fruit ripening duration were decreased by increasing water deficit. On the contrast, proline and TSS content increased. SA increased total chlorophyll content (SPAD), fruit ripening duration and TSS compared the control treatment. The combination of water deficit and salicylic acid application rates treatments had in significant effects on fruit number per plant (Nasrabadi *et al*., 2015).

The objective of this study was to evaluate the effect of salicylic acid on growth, yield quality and water use efficiency of potato under different irrigation water quantity.

MATERIALS AND METHODS

Two field experiments were carried out in the Experimental Station, Faculty of Agriculture, Mansoura University in summer seasons of 2014 and 2015, to study the effect irrigation water quantity and foliar application with salicylic acid on growth and yield of potato cv. Spunta grown under clay loamy soil conditions using drip irrigation system. The experiment layout was split plot in based on randomized complete block design with three replications. Quantity of irrigation water (700, 1000 and 1300 m^3/ fed.) were present in the main plots, while foliar application with salicylic acid (0.0, 0.1, 0.2 and 0.3 g per litter.) were randomly assigned in the sub plots. Soil samples from the top layer (0-30 cm depth) were randomly collected before planting for physical and chemical analysis (Table 1)

Table 1. Physical and chemical parameters during the two seasons of 2014 and 2015.

Seasons	Silt %	Clay %	Sand %	Texture soil	F.C %	W.P %	AW %	PH	E.C (dSm-1)	O.M %	$CaCO_3$ %	N ppm	P ppm	K ppm
2014	40.5	37.2	22.3	Clay loamy	35.7	18.9	16.8	8.22	1.51	1.8	3.39	51.9	5.7	288
2015	41.1	36.9	22.0	Clay loamy	35.2	18.4	16.8	8.13	1.78	2.o	3.45	54.1	6.2	294

F.C : Field Capacity; W.P.: Welting point; AW: Available water; OM: Organic matter

Individual tuber seed (pieces of tuber about 20 – 25 g) was transplanted manually at a depth of 12-15 cm and 25 cm apart on 5th and 8th of January in the 1st and 2nd summer seasons, respectively. The plot area was 10.5 m^2. It consists of five dripper lines with 3 m length for each and 0.7 m distance between the two dripper lines. 0.25 m was the distance between the dripper and the other in the same line. Two lines were used to measure the morphological and physiological characters and the other three lines were used for yield and its components determinations. In addition, one row was left between each two plots as guard area to avoid the overlapping on irrigation water infiltration.

Irrigation water quantities treatments were 700, 1000 and 1300 m^3 water/fed. All experimental units received equal amounts of water during germination (240 m^3 water/fed.) as furrow irrigation through water counter. The remainder amounts of irrigation water quantities (m^3/fed.) were added by using water counter at 1.5 bar, water flow through the drippers (4 liter/h.). Irrigation numbers were 30 for each treatment. The irrigation water quantity were added (depending on growth stage) two days intervals to each treatment began at 5th and 8th Feb. (month after planting) and ended 13 and 18 April (10 and 12 days before harvesting) in the 1st and 2nd seasons, respectively.

Salicylic acid at (0.0, 0.1, 0.2 and 0.3 g per litter.) were add twice as foliar application at 40 and 55 day after planting its volume was 300 and 400 litter per fed. in the 1st and 2nd foliar application, respectively.

All treatments received 120 kg N, 125 kg P_2O_5 and 100 kg K_2O kg/ fed. as ammonium nitrate (33.5 %), phosphoric acid (85 % P_2O_5) and potassium sulfate (50 % K_2O), respectively. as fertigation at 2 days interval beginning one month after planting. Also, Farmyard manure (FYM) at 20 m^3/ fed. was applied during soil preparation.

Experimental design:

Treatments were arranged in split plots in complete randomized blocks design with three replicates. Irrigation water quantities were assigned in the main plots, while foliar applications with salicylic acid were allocated in the sub plots.

Measurements:

Five plants were taken at random from each plot at 85 days after planting to evaluate the following criteria for the two seasons.

1- Vegetative growth characters:

Plant height (cm), leaves number / plant, leaves area (cm^2) / plant, number of main stem /plant, foliage fresh weight (g)/plant, foliage dry matter percentage.

2 - Leaves chemical composition:

N, P and K percent, chlorophyll a, b, carotenoids content were analyses according to AOAC (1990).

3- Tubers yield and its physical quality:

At the harvesting time (110 day after planting), tubers weight (g) per plant and tubers number per plant were represented by taking the average of 5 hills, dry matter percentage, hardness as kg cm^{-2} (average measuring without cortex at the top plus the bottom tuber), density (tubers weight (g) per plant / tubers volume (cm^3) per plant), marketable tubers yield (ton / fed.) as healthy tuber with a weight more than or equal to 50 g without (growth cracks, abnormally curved shape, rotten, bottleneck shape, diseased, insect attacked, deformed tuber, those having a weight less than 50 g and two or more knobs) and total tubers yield (ton/fed.) was (total fresh weight of tubers per plot / plot area) x 4200.

4-Tubers chemical quality:

Vit. C, TSS and (N, P and K %). All chemical quality parameters were determined according to A.O.A.C (1990).

5- Plant water relations:

Relative water content and Electrolyte Leakage were determined according to (Korkmaz *et al*., 2010), Water use efficiency was estimated according to (El-Banna *et al*., 2011).

Statistical analysis:

Data were statistically analyzed using the analysis of variance according to Snedecor and Cochran (1980). Least significance difference (LSD) was used to differentiate means at the at 5 % level of probability.

RESULTS AND DISCUSSION

1- Vegetative growth characters:

Data presented in Table 2 show that plant height, leaves number per plant, leaves area per plant, number of main stem per plant and foliage fresh weight per plant, significantly increased with increasing irrigation water quantity up to the highest level at 1300 m^3/ fed. On the other hand, foliage dry matter percentage was decreased by increasing irrigation water quantity in both seasons. These increases can be due to that available more water enhances nutrient availability which improves macro- and micro-elements absorption, on contrary, the decreasing due to the reduction of cells growth and development in different plant parts especial in stem and leaves. So that, the effects of water deficit can be detected in smaller leaves or plant height, decreasing in leaf area, light absorption decreased and made reduction in total capacity of photosynthesis and growth. (Hasani, 2006; Ayas, 2013 and Abubaker *et al*., 2014).

Concerning the effect of spraying salicylic acid the data in Table 2 revealed that the mentioned characters were increased compared to untreated plants. The maximum values of these parameters were recorded by using 0.2 g/l of salicylic acid in the two seasons, followed by 0.3 g/l. This improvement in vegetative growth parameters could be attributed to the water stress long, the plant will face the oxidative damage inevitably, and can be resulted in producing reactive oxygen species (ROS) which are the result of incomplete reduction of oxygen (Cruz de Carvalho, 2008). Salicylic acid is one of the antioxidants which prevent the high activity of ROS and is introduced as an important messenger molecule in plant responses to the different biotic and abiotic stresses, Also, the increase of plant growth by improving cell division and elongation of root cells, activate the consumption of soluble carbohydrates to form young cell constituents, regulates some physiological processes in plants such as effects on growth and development, ion uptake and membrane permeability (Simaei *et al*., 2012).Salicylic acid application increases, spermidine, spermine and putrescine polyamines in the plant which results in membrane keeping and integrity in drought stress, Also, led to increasing in gibberellins and cytokinins. On the other hand, endogenous auxins and abscisic acid were decreased. Which led to more vegetative and reproductive growth. In addition, increasing endogenous cytokinin level on auxin enhanced formation of branches and increasing photosynthetic pigments content in tomato plants (Mady, 2009).

The interaction between irrigation water quantity and spraying salicylic acid showed that the combination which consist of 1300 m^3/ fed. and 0.2 g/l salicylic acid gave the highest values of plant height, leaves number per plant, leaves area per plant, number of main stem per plant and foliage fresh weight per plant, the lowest values were noticed with 700 m^3/ fed. and 0.0 g/l salicylic acid. On contrast, the maximum foliage dry matter percentage was noticed by application of 700 m^3/fed. and 0.2 g/l salicylic acid. But, the minimum values were recorded with 1300 m^3/ fed. and 0.0 g/l salicylic acid. These results agree with those reported by Erdem *et al*. (2006); Shahram *et al*. (2011); Ayas (2013); Abubaker *et al*. (2014) and Keyvan and Irandoost (2015); on potato; Tahereh *et al*. (2014) on mungbean and Nasrabadi *et al*. (2015) on melons.

2- Leaves chemical composition parameters:

Data listed in Table 3 show that increasing irrigation water quantity caused significant increases in N, P, K, chlorophyll a, chlorophyll b and carotenoids in leaves tissue. These results may be due to that water deficit was causes retarding of nutrients uptake, the roots failed to absorb the accumulative valuable nutrient elements. Also, water deficit caused reducing in leaf miner content due to a reduction roots formation (Abou El-Khair *et al*., 2011). These results exhibit positive correlation between water stress and chlorophyll a, chlorophyll b and carotenoids content. This increment in previous pigments may be attributed to increase macronutrients uptake, especially N and Mg nutrient by increasing water quantity, whereas N and Mg nutrient are necessary for chlorophyll pigments synthesis (Lahlou *et al*., 2003).

Data in Table 3 indicated that parameters of N, P, K, chlorophyll b and carotenoids in leaves of potato plants were significantly increased in the two seasons with spraying salicylic acid up to 0.2 g/l then decline at 0.3 g/l. This may be attributed to (ROS) has destructive effect for chlorophyll pigments under water deficit. SA decreases the damaging influences of (ROS) on chlorophyll by promoting antioxidant systems, and the increase of plant growth through the activating of cell division and elongation of root cells, enhancement the consumption of soluble carbohydrates to form young cell constituents as a means to improved plant growth, ion uptake and membrane permeability (Simaei *et al.*, 2012). Also, Nasrabdi *et al.* (2015) reported that SA probably inhibits chlorophyll oxidase enzymes therefore it will be prevents chlorophyll breakdown, so that photosynthesis was increased.

In the same Table, the interaction results shows that the N, P, K, chlorophyll a, chlorophyll b and carotenoids were significantly affected by irrigation water quantity and spraying salicylic acid, the highest values were obtained by 1300 m^3 and 0.2 g/l. On contrast, the lowest values were recorded at 700 m^3 as irrigation water quantity and 0.0 g/l of foliar application of salicylic acid. The above mentioned results are in harmony with those obtained by Abou El-Khair *et al.* (2011); Maralian *et al.* (2014); Abd El-Latif *et al.* (2011) on potato.

Table 2. Impact of foliar application with salicylic acid on vegetative growth characters of potato at 85 DAP under different irrigation water quantity during the two seasons of 2014 and 2015.

Treatments		Plant Height (cm).		Leaves No / plant		Leaves area (cm^2) / plant		Number of main stem /plant		Foliage FW g / plant		Foliage DM %	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Water quantity m^3/fed.													
700		65.9	67.7	38.7	39.4	1519	1556	2.7	3.0	214	217	6.77	6.88
1000		70.5	72.3	40.6	41.3	1638	1677	3.0	3.2	267	271	6.30	6.40
1300		72.8	74.6	41.8	42.5	1741	1783	3.6	3.7	330	355	6.02	6.03
LSD 5%		1.9	2.1	0.9	0.8	29	30	0.5	0.5	32	29	0.50	0.36
salicylic acid g/l													
0.0		68.3	69.6	38.8	39.8	1463	1487	2.6	2.8	245	249	5.92	5.98
0.1		69.2	70.8	39.9	40.6	1558	1591	3.0	3.1	264	266	6.22	6.31
0.2		71.3	73.4	41.8	42.3	1870	1920	3.5	3.7	292	297	6.86	6.99
0.3		69.9	72.3	41.0	41.4	1640	1689	3.3	3.4	281	285	6.45	6.58
LSD 5%		2.1	2.2	0.9	0.9	50	52	0.4	0.5	26	28	0.36	0.37
Interaction													
700	0.0	63.7	65.0	37.4	38.4	1381	1403	2.4	2.6	197	201	6.32	6.38
	0.1	65.5	67.0	38.4	39.2	1449	1479	2.6	2.8	202	204	6.62	6.72
	0.2	67.7	69.6	39.6	40.0	1761	1808	3.0	3.4	237	242	7.32	7.46
	0.3	66.5	69.2	39.4	39.8	1486	1531	2.8	3.0	217	221	6.82	6.96
1000	0.0	69.7	71.1	39.0	40.0	1480	1503	2.6	2.8	251	256	5.82	5.88
	0.1	70.3	71.9	40.4	41.2	1578	1611	2.8	3.0	261	265	6.12	6.21
	0.2	71.2	73.2	42.0	42.6	1876	1927	3.4	3.4	283	288	6.82	6.95
	0.3	70.8	72.9	41.0	41.4	1619	1667	3.2	3.4	270	274	6.42	6.55
1300	0.0	71.3	72.7	40.0	41.0	1529	1553	2.8	3.0	285	291	5.62	5.67
	0.1	71.9	73.6	40.8	41.6	1648	1683	3.6	3.6	326	329	5.92	6.01
	0.2	75.1	77.3	43.8	44.4	1973	2026	4.0	4.2	355	361	6.42	6.54
	0.3	72.6	74.8	42.6	43.0	1816	1870	3.8	3.8	354	359	6.12	6.24
LSD 5%		3.6	3.7	1.6	1.5	88	90	0.7	0.8	45	49	0.62	0.65

Table 3. Impact of foliar application with salicylic acid on N, P, K percentage and pigments in leaves of potato under different irrigation water quantity during the two seasons of 2014 and 2015.

Treatments		N %		P %		K %		Chl. a mg/100 FW		Chl.b mg/100 FW		Carotenoids mg/100g FW	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Water quantity m^3/fed.													
700		2.88	2.97	0.374	0.386	3.31	3.39	31.8	32.2	15.3	15.7	11.4	11.7
1000		3.50	3.61	0.465	0.481	3.48	3.56	32.6	33.4	16.9	17.3	13.3	13.5
1300		3.98	4.11	0.507	0.524	3.98	4.08	35.9	36.9	20.2	20.5	13.9	14.3
LSD 5%		0.27	0.28	0.018	0.018	0.08	0.16	3.0	3.1	0.6	0.9	0.5	0.6
salicylic acid g/l													
0.0		2.86	2.92	0.411	0.421	3.48	3.53	31.9	32.3	16.3	16.5	12.4	12.6
0.1		3.32	3.42	0.431	0.444	3.51	3.58	32.5	33.3	17.1	17.5	12.8	13.1
0.2		3.98	4.12	0.487	0.504	3.80	3.90	34.7	35.9	18.7	19.1	13.3	13.7
0.3		3.64	3.79	0.465	0.484	3.57	3.68	34.0	35.4	17.9	18.3	12.9	13.4
LSD 5%		0.36	0.37	0.012	0.012	0.10	0.14	2.2	2.3	1.1	1.6	0.6	0.7
Interaction													
700	0.0	2.31	2.35	0.299	0.305	3.25	3.230	30.0	30.4	14.7	14.9	10.9	11.1
	0.1	2.71	2.80	0.345	0.355	3.31	3.37	30.3	31.1	14.9	15.4	11.3	11.5
	0.2	3.35	3.47	0.441	0.456	3.37	3.46	32.6	33.8	16.2	16.6	11.9	12.2
	0.3	3.15	3.28	0.411	0.427	3.32	3.42	32.5	33.7	15.7	15.9	11.4	11.8
1000	0.0	2.87	2.92	0.451	0.464	3.42	3.47	31.3	31.6	15.9	16.2	12.4	12.5
	0.1	3.35	3.45	0.463	0.477	3.44	3.51	31.9	32.7	16.9	17.4	13.3	13.6
	0.2	4.19	4.33	0.478	0.495	3.55	3.64	34.1	35.5	17.8	18.3	13.8	14.2
	0.3	3.59	3.73	0.468	0.487	3.53	3.63	33.0	34.3	17.2	17.6	13.4	13.8
1300	0.0	3.42	3.49	0.482	0.495	3.78	3.84	34.4	34.8	16.2	18.5	13.8	14.0
	0.1	3.90	4.01	0.487	0.501	3.80	3.88	35.3	36.2	19.4	19.7	13.9	14.2
	0.2	4.41	4.56	0.543	0.561	4.48	4.61	37.6	38.9	22.1	22.5	14.3	14.5
	0.3	4.20	4.37	0.517	0.538	3.87	3.98	36.6	38.0	20.8	21.3	13.9	14.4
LSD 5%		0.63	0.65	0.020	0.021	0.18	0.23	3.8	3.9	1.9	2.8	1.2	1.1

3- Tubers yield and its physical quality:

Obtained data of Table 4 indicate that tubers weight and number per plant, dry matter percentage, hardness, density, marketable tubers yield and total tubers yield were affected significantly, by irrigation water quantity. Tubers weight and number per plant, marketable and total tubers yield per fed. were significantly higher under high irrigation water quantity 1300 m^3 per fed. On contrast, tuber dry matter percentage, hardness, density were higher under low irrigation water quantity 700 m3 per fed. These results could be attributed to water deficit led to increasing reactive oxygen species (ROS), Ethylene, abscisic acid and decreasing Intensity of photosynthesis at 10-30%, nutritious elements, gibberellins and cytokinins will cause the reduction of chlorophyll pigments in plants could also be of great influence upon different vegetative and reproductive growth and lower amount of biomass produced which led to yield reduction. (Lahlou *et al*., 2003).

With respect to the effect of foliar application of salicylic acid, the data exhibited that, the mentioned characters were increased compared to untreated plants. This improvement in the yield and its component could be the role of SA which acts as cofactors for some specific enzymes, *i.e.*, dismutases, catalases, peroxidases, which results in breakdown of the toxic (H_2O_2), (OH), (O-2) radicals, Also, SA decreasing generation of ROS (Metwally *et al*., 2003), inhibits of auxin oxidation (Fariduddin *et al*. 2003). Also, SA probably promote the consumption of soluble carbohydrates to form young cell constituents as a mechanism to enhancement plant growth an important signal molecule for modifying plant responses to environmental stressors (Arfan *et al*., 2007), Also, increasing ion uptake, membrane permeability and increase in protein content of leaves (Simaei *et al*., 2012)

SA decreases the synthase activity of 1-aminocyclopropane-1-carboxylic acid (ACC) which enhancement the production of ethylene in the plant (Li *et al*., 1992). Ethylene will led to the reduction of chlorophyll pigments in plants (Arfan, 2007). Also, Durner and Klessig (1995) reported that SA inhibit ascorbate peroxidase activity which can disturb the H_2O_2 pathway and cause increasing accumulation of this product in cells.

Results in Table 4 clarify that, the interaction was significant in the two seasons, the maximum values of that tubers weight and number, marketable and total tubers yield per fed. were recorded with combination which consist of 1300 m^3/ fed. and 0.2 g/l salicylic acid, on the other hand, the lowest values were achieved by application of 700 m^3/ fed. and 0.0 g/l salicylic acid. On contrast, the highest tuber dry matter percentage and hardness were noticed by application of 700 m^3/ fed. and 0.2 g/l salicylic acid. But the lowest values were achieved at 1300 m^3/ fed. and 0.0 g/l salicylic acid. Also, the highest density was recorded with 700 m^3/ fed. and 0.0 g/l salicylic acid, but 1300 m^3/ fed. and 0.3 g/l salicylic acid gave the lowest values of density character. Similar results were reported by Shahram *et al*. (2011); Ayas (2013); Aksic *et al*.(2014); Abubaker *et al*. (2014); Keyvan and Irandoost (2015) on potato, Nasrabadi *et al*. (2015) on melons; Tahereh *et al*. (2014) and Akram *et al*. (2016) on mungbean.

4- Tubers chemical quality:

Tabulated data in Table 5 revealed that, Vit. C, TSS, N, P and K of potato tuber were gradually increased by increasing irrigation water quantity in the two seasons. These increases can be due to the fact that available more water enhances nutrient availability which improves macro- and micro- elements absorption, Also, water deficit led to increasing ethylene, abscisic acid, ROS and decreasing nutritious elements, cytokinins, gibberellins, Intensity of photosynthesis at 10-30%, which led to decreasing of chlorophyll vegetative and reproductive growth and lower amount of biomass produced which led to Vitamin C, TSS, N, P and K reduction. (Lahlou *et al*., 2003).

Regarding foliar application of salicylic acid, it was noticed that, TSS, N, P and K of potato tuber in Table 5 were significantly increased in the two seasons with spraying salicylic acid up to 0.2 g/l then decline at 0.3 g/l, while Vit. C was gradually increased by increasing salicylic acid rate as foliar application. The maximum values were recorded with 0.3 g/l, but the minimum values were noticed at 0.0 g/l of salicylic acid in both seasons. This improvement in Vit. C, TSS, N, P and K could be the role of salicylic acid which increasing dismutases, catalases, peroxidases, those catalyzed led to breakdown of the toxic (H_2O_2), (OH), (O-2) radicals, Also, decreasing generation of ROS (Metwally *et al*., 2003), decreasing the production of ethylene (Li *et al*., 1992). inhibit of auxin oxidation (Fariduddin *et al*. 2003), increasing soluble carbohydrates and protein which promote plant growth and increasing ion uptake and membrane permeability (Simaei *et al*., 2012).

As for the interaction between irrigation water quantity and spraying salicylic acid, the mentioned parameters in Table 5 were significantly affected in both seasons, the highest Vit. C values were recorded with combination consists of 1300 m^3/ fed. and 0.3 g/l salicylic acid. But the lowest values were achieved at 700 m^3/ fed. and 0.0 g/l salicylic acid. Also, the maximum values of TSS, N, P and K of potato tuber were recorded at irrigation water quantity as 1300 m^3/ fed. and spraying salicylic acid as 0.2 g/l. on contrast, the minimum values were produced by application 700 m3/ fed. and 0.0 g/l salicylic acid. These results are in accordance with those reported by Abou El-Khair *et al*. (2011); Abd El-Latif *et al*. (2011); Alaa *et al*. (2013) on potato; Nasrabadi *et al*. (2015) on melon.

Table 4. Impact of foliar application with salicylic acid on tubers yield and its physical quality of potato under different irrigation water quantity during the two seasons of 2014 and 2015.

Treatments		Tubers weight (g) per plant		Tubers No./ plant		Tuber dry matter %		Hardness kg cm^{-2}		Density (g/ cm^3)		Market Yield (ton/ fed.)		Total Yield (ton/ fed.)	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Water quantity m^3/fed.															
700		663	678	4.4	4.7	19.72	19.99	6.9	7.1	1.098	1.124	14.41	14.95	15.36	16.02
1000		880	900	5.2	5.6	18.96	19.23	6.5	6.6	1.035	1.060	19.34	19.71	20.37	20.84
1300		1011	1034	5.9	6.2	18.73	18.99	5.8	5.9	1.020	1.045	22.63	23.06	23.40	23.93
LSD 5%		98	100	0.8	0.5	0.57	0.58	0.4	0.8	0.068	0.070	2.14	1.95	2.25	2.04
salicylic acid g/l															
0.0		768	791	4.8	5.0	18.38	18.75	6.1	6.1	0.994	1.009	17.30	17.56	18.06	18.59
0.1		826	838	5.7	6.0	19.23	19.51	6.4	6.6	1.056	1.077	17.85	18.47	18.82	19.53
0.2		953	977	5.4	5.8	19.87	20.09	6.8	7.0	1.092	1.122	21.17	21.70	22.18	22.73
0.3		859	876	4.6	5.0	19.08	19.27	6.3	6.6	1.063	1.099	18.85	19.22	19.79	20.18
LSD 5%		159	162	0.9	0.7	0.82	0.83	0.6	0.9	0.074	0.076	3.51	3.49	3.66	3.63
Interaction															
700	0.0	602	621	4.0	4.2	18.62	19.00	6.5	6.6	1.063	1.079	13.36	13.57	14.17	14.56
	0.1	629	638	5.2	5.4	20.30	20.59	6.9	7.1	1.076	1.098	13.37	14.61	14.34	15.82
	0.2	791	811	4.4	4.8	20.62	20.85	7.3	7.5	1.168	1.200	17.31	17.74	18.42	18.88
	0.3	630	642	4.0	4.4	19.34	19.54	7.1	7.3	1.084	1.121	13.59	13.87	14.51	14.80
1000	0.0	791	815	5.0	5.4	18.49	18.87	6.3	6.3	0.989	1.004	17.77	18.04	18.61	19.17
	0.1	835	848	6.0	6.4	18.74	19.00	6.5	6.6	1.054	1.075	17.99	18.26	19.04	19.32
	0.2	967	991	5.6	6.0	19.63	19.85	6.7	6.7	1.042	1.070	21.39	21.93	22.52	23.08
	0.3	926	945	4.2	4.6	19.01	19.21	6.4	6.6	1.057	1.093	20.20	20.61	21.33	21.76
1300	0.0	910	938	5.4	5.6	18.02	18.39	5.5	5.6	0.930	0.944	20.77	21.08	21.40	22.05
	0.1	1013	1028	6.0	6.4	18.67	18.93	5.9	6.0	1.038	1.059	22.21	22.54	23.08	23.43
	0.2	1100	1127	6.4	6.8	19.36	19.57	6.3	6.5	1.066	1.094	24.81	25.43	25.60	26.24
	0.3	1021	1042	5.8	6.0	18.89	19.08	5.6	5.7	1.048	1.083	22.73	23.19	23.52	24.00
LSD 5%		275	281	1.5	1.3	1.42	1.44	1.0	1.2	0.129	0.132	6.08	6.05	6.34	6.30

Table 5. Impact of foliar application with salicylic acid on some tubers chemical quality parameters of potato under different irrigation water quantity during the two seasons of 2014 and 2015.

Treatments		Vit. C mg/100 g FW		TSS %		N %		P %		K %	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Water quantity m^3/fed.											
700		13.3	13.7	4.6	4.7	1.47	1.83	0.348	0.357	3.53	3.58
1000		16.1	16.5	5.1	5.2	1.80	1.92	0.408	0.420	3.74	3.80
1300		19.6	20.2	5.5	5.7	1.89	2.00	0.424	0.436	3.98	4.05
LSD 5%		2.6	2.7	0.4	0.4	0.12	0.33	0.008	0.004	0.07	0.11
salicylic acid g/l											
0.0		13.5	14.0	4.4	4.5	1.54	1.76	0.355	0.363	3.62	3.65
0.1		14.7	15.2	5.1	5.2	1.63	1.86	0.387	0.397	3.69	3.76
0.2		17.4	17.9	5.7	5.9	1.91	2.08	0.426	0.438	3.94	4.01
0.3		19.8	20.2	5.2	5.4	1.79	1.98	0.405	0.419	3.75	3.81
LSD 5%		2.9	3.0	0.3	0.4	0.12	0.16	0.002	0.004	0.12	0.16
Interaction											
700	0.0	10.8	11.2	4.0	4.0	1.26	1.62	0.330	0.337	3.39	3.43
	0.1	12.0	12.4	4.7	4.8	1.33	1.77	0.340	0.349	3.45	3.50
	0.2	14.3	14.7	5.2	5.3	1.75	1.99	0.368	0.379	3.76	3.82
	0.3	16.3	16.6	4.8	4.9	1.54	1.93	0.353	0.365	3.52	3.57
1000	0.0	12.1	12.6	4.4	4.4	1.61	1.77	0.364	0.372	3.64	3.67
	0.1	13.6	14.1	5.0	5.2	1.75	1.84	0.405	0.416	3.70	3.77
	0.2	18.6	19.2	5.6	5.8	1.96	2.07	0.443	0.456	3.88	3.95
	0.3	19.9	20.3	5.3	5.4	1.89	2.00	0.421	0.435	3.76	3.81
1300	0.0	17.6	18.2	4.8	4.9	1.75	1.87	0.372	0.379	3.82	3.85
	0.1	18.4	19.0	5.5	5.7	1.82	1.96	0.417	0.427	3.94	4.02
	0.2	19.2	19.8	6.2	6.5	2.03	2.18	0.466	0.480	4.18	4.25
	0.3	23.2	23.7	5.5	5.7	1.96	2.01	0.443	0.458	4.00	4.06
LSD 5%		5.1	5.2	0.6	0.7	0.20	0.29	0.005	0.007	0.21	0.28

5- Plant water relations

Data presented in Table 6 show that relative water content % significantly increased with increasing irrigation water quantity up to the highest level 1300 m^3/ fed. On the other hand, electrolyte leakage % and water use efficiency (kg per m3 water) was decreased by increasing irrigation water quantity in both seasons Relative water content is considered a measure of plant water status, reflecting the metabolic activity in tissues and used as a most meaningful index for dehydration tolerance. These results could be attributed to water deficit led to increasing ethylene, abscisic acid and decreasing water and nutritious elements uptake, gibberellins and cytokinins production which led to low roots formation, the stomata should be closed to avoid more water loss, the waste of chlorophyll in plants could also be of great influence upon different vegetative and reproductive growth and lower amount of biomass produced which led to yield reduction. (Lahlou *et al*., 2003). On the other hand, higher water quantity applied to plants led to keep higher water content in plant tissues. Water deficit stress results in the membrane injury and liberation of ions from the cell to extra cellular space and lipid peroxidation (Scandadalius, 1993).

Electrolyte leakage % is an index, which can quantify determined the damage conceived by plant cell membrane. Its relative conductivity can be used to measure the damage on structure and cell membranes function under stresses. Under normal conditions, the total amount of reactive oxygen species (ROS) formed in the plants is measured by the balance between the production of ROS and the ability of the enzymatic and non-enzymatic mechanisms to breakdown with them under stress conditions, when ROS formation is higher than the ability of plants to remove it, this could result in oxidative damages, which led to increasing of electrolyte leakage (Laspina *et al*., 2005).

Regarding the effect of spraying salicylic acid the data in Table 6 revealed that relative water content % and water use efficiency (kg per m^3 water) were increased compared to the control treatment. The maximum values of these parameters were recorded by applications of 0.2 g/l of salicylic acid in both seasons followed by 0.3 g/l. On the contrast, electrolyte leakage % was decreased by increasing salicylic acid rate.

These results could be attributed to the role of salicylic acid which increasing dismutases, catalases, peroxidases, which led to breakdown of the toxic (OH), (H_2O_2), (O-2) radicals, decreasing generation of reactive oxygen species (ROS) (Metwally *et al*., 2003), decreasing the production of ethylene (Li *et al*., 1992). Inhabitation of auxin oxidation (Fariduddin *et al*., 2003), increasing soluble carbohydrates, protein and water content which promote plant growth and decreased electrolyte leakage. The increase in RWC may be related to the role of salicylic acid in accumulation of compatible osmolytes in plants tissues, which were subjected to water stress (Siamak and Kazemi-Arbat, 2014).

Table 6. Impact of foliar application with salicylic acid on some plant water relations parameters of potato under different irrigation water quantity during the two seasons of 2014 and 2015.

Treatments		Relative water content %		Electrolyte leakage %		Water use efficiency (kg per m^3 water)	
		S1	S2	S1	S2	S1	S2
Water quantity m^3/fed.							
700		69.7	70.8	84.3	85.6	21.94	22.88
1000		75.3	76.5	77.9	78.9	20.37	20.83
1300		79.5	80.7	66.3	67.3	18.00	18.40
LSD 5%		2.3	2.4	3.9	2.2	2.06	1.79
Salicylic acid g/l							
0.0		72.8	74.2	81.1	82.5	18.44	18.97
0.1		74.9	75.7	78.3	79.5	19.09	19.98
0.2		76.2	77.5	75.5	76.2	22.84	23.41
4		75.6	76.7	69.7	70.8	20.05	20.45
LSD 5%		2.1	2.2	6.5	6.6	3.38	3.23
Interaction							
700	0.0	68.3	69.6	90.3	91.9	20.25	20.80
	0.1	69.9	70.6	84.7	85.9	20.49	22.08
	0.2	70.5	71.8	82.1	82.8	26.31	26.97
	0.3	70.1	71.1	80.2	81.7	20.72	21.14
1000	0.0	71.6	72.9	80.1	81.6	18.61	19.17
	0.1	75.4	76.1	79.7	80.9	19.04	19.33
	0.2	77.5	78.9	76.3	77.0	22.52	23.08
	0.3	76.8	77.9	75.5	76.0	21.33	21.76
1300	0.0	78.6	80.1	72.7	74.0	16.47	16.96
	0.1	79.5	80.3	70.8	71.8	17.76	18.03
	0.2	80.2	81.7	68.1	68.7	19.69	20.19
	0.3	79.7	80.9	53.4	54.5	18.09	18.46
LSD 5%		3.7	3.8	11.3	11.5	5.85	5.59

The interaction between irrigation water quantity and spraying salicylic acid showed that 1300 m^3/ fed. and 0.2 g/l salicylic acid recorded the maximum values of Relative water content %. On contrary, the minimum values were recorded with 700 m^3/ fed. and 0.0 g/l salicylic acid. On contrast, the highest water use efficiency (kg per m^3 water) was noticed by application of 700 m^3/ fed. and 0.2 g/l salicylic acid, while the lowest values were recorded at 1300

m^3/ fed. of irrigation water quantity and 0.0 g/l salicylic acid. Also, electrolyte leakage %, 700 m^3/ fed. and 0.0 g/l salicylic acid gave the highest values, but the lowest values were recorded with 1300 m^3/ fed. and 0.3 g/l salicylic acidThese results coincide with those reported by Ayas and Korukcu (2010); Abou El-Khair *et al.* (2011); alaa *et al.* (2013); Maralian *et al*. (2014); Keyvan and Irandoost (2015) on potato; Akram *et al*. (2016) on mungbean.

CONCLUSION

The adverse effects of water deficit on the growth and productivity of potato can be mitigated by foliar application of SA. The results presented in this investigation clearly indicate that it is possible to ameliorate the impacts of water deficit by the exogenous application of salicylic acid (SA). The interaction between irrigation water quantity and spraying salicylic acid showed that the combination which consist of 1300 m^3/ fed. and 0.2 g/l salicylic was the best combination and it is recommended for potato cultivar Spunta grown under loamy soil conditions using drip irrigation system in order to get the maximum Tubers yield and its physical and chemical quality.

REFERENCES

Abd El-Latif, K. M.; E. A.M. Osman; R. Abdullah and N. Abd el Kader (2011) Response of potato plants to potassium fertilizer rates and soil moisture deficit. Adv. Appl. Sci. Res., 2 (2): 388-397.

Abou El-Khair, E.E.; Dalia A.S. Nawar and H.M.E. Ismail (2011) Effect of irrigation water quantity and farmyard manure on potato plant grown in sandy soil. Egypt. J. Agric. Res., 89 (1): 317-334.

Abubaker, B. M. A.; Y. Shuang-En; S. Guang-Cheng; M. alhadi and A. Elsiddi (2014) Effect of irrigation levels on the growth, yield and quality of potato. Bulgarian J. of Agric. Sci., 20 (2): 303-309.

Akram, S. M.; M. L. Ijaz and M. Hussain (2016) Mitigation of drought stress by foliar application of salicylic acid and potassium in mungbean (Vigna radiata L.). Legume Research, 39 (2): 208-214.

Aksic,M.; S. Gudzic; N. Deletic; N. Gudzic; S. Stojkovic and J. Knezevic (2014) Tuber yield and evapotranspiration of potato depending on soil matric potential. Bulgarian J.of Agric. Sci., 20 (1): 122-126.

Alaa, S. A.; F. Al-Sahaf; D. H. Wally and T. E. Thamer (2013) Effects of potassium humate fertilizers and irrigation rate on potato yield and consumptive use under drip irrigation method. J. of Agric. Science and Technology. A 3: 803-810.

AOAC (1990) Official Methods of Analysis.15th Ed. Association of Official Analytical Chemists, Inc., Virginia, USA.

Arfan M, H.R. Athar and M. Ashraf (2007) Does exogenous application of salicylic acid through the rooting medium modulate growth and photosynthetic capacity in two differently adapted spring wheat cultivars under salt stress. J. of Plant Physiology, 164 (6): 685-694.

Ayas, S. (2013) The effects of different regimes on Potato (Solanum Tuberosum L. Hermes) yield and quality characteristics under unheated greenhouse conditions. Bulgarian J. of Agric. Sci., 19 (1): 87-95.

Ayas, s. and A. Korukcu (2010) Water-Yield Relationships in Deficit Irrigated Potato. J. of Agric. Fac. of Uludag University. 2, 23-36

Cruz de Carvalho, M. H. (2008) Drought stress and reactive oxygen species. Plant signal. Behav. 3(3): 156-165.

Durner, J. and D.F. Klessig (1995) Inhibition of ascorbate peroxidase by salicylic acid and 2,6, -dichloroisonicotinic acid, two inducers of plant defense responses. Proc. National Academy of Science. USA, 92:11312-11316.

El-Banna, E.N.; A.H. Selim; H.Z. Abd El-Salam (2001) Effect of irrigation methods and water regimes on potato plant (Solanum tuberosum L.) under Delta soil conditions. J. Agric. Sci. Mansoura Univ. 26 (1), 1-11.

Erdem, T.; Y. Erdem; H. Orta and H. Okursoy (2006) water-yield relationships of potato under different irrigation methods and regimens. Sci. Agric. (Piracicaba, Braz.). 63 (3): 226-231.

FAO(2012)StatisticsDivision.http://faostat.fao.org/(2014/06/17).

Fariduddin, Q.; S. Hayat and A. Ahmad (2003) Salicylic acid influences net photosynthetic rate, carboxylation efficiency, nitrate reductase activity and seed yield in Brassica juncea. Photosynthetica 41: 281-284.

Hasani, A. (2006) Effect of water deficit stress on growth, yield and essential oil content of Dracocephalum moldavica. Iranian Journal of Medicinal and Aromatic Plants, 22(3): 256-261.

Hayat, S.; S.A. Hasan; Q. Fariduddin and A. Ahmad (2008) Growth of tomato (Lycopersicon esculentum, mill) in response to salicylic acid under water stress. J. Plant. Interact. 3(4):297-304.

Jamali, B.; S. Eshghi and E. Tafazoli (2011) Vegetative and reproductive growth of strawberry plants cv. pajaro affected salicylic acid and nickel. J. Agric. Sci. Technol. 13:895-904.

Keyvan, M. H. and M. Irandoost (2015) Effect of different irrigation levels on the yield of potatoes in bardsir city. Acta Biologica Indica. 4(2):149 - 157.

Korkmaz, A.; Y. Korkmaz and A.R. Demirkiran (2010) Enhancing chilling stress tolerance of pepper seedling by exogenous application of 5-aminolevolinic acid. Enviro. and Experimental Botany, 67 :495-501.

Lahlou,O., S. Ouattar, and J. F. Ledent (2003) The effect of drought and cultivar on growth parameters, yield and yield components of potato. Agronomie. 23(3):257-268.

Laspina, N.V.; M.D. Groppa; M.L. Tomaro and M.P. Benavides (2005) Nitric oxide protects sunflower leaves against Cd-induced oxidative stress. Plant Science 169: 323-330.

Li, N.; B.L. Parsons; D.R. Liu; A.K. Mattoo (1992) Accumulation of wound-inducible ACC synthase transcript in tomato fruit is inhibited by salicylic acid and polyamines. Plant Molecular Biology, 18: 477-487.

Mady, M. A. (2009) Effect of foliar application with salicylic acid and vitamin e on growth and productivity of tomato (Lycopersicon esculentum, mill.) plant. J. Agric. Sci. Mansoura Univ., 34 (6): 6735 – 6746.

Maralian, H.; S. Nasrollahzadeh; Y. Raiyi and D. Hassanpanah (2014) Responses of potato genotypes to limited irrigation. Inter. J. of Agro. and Agric. Res. 5(5): 13-19.

Metwally, A.; I. Finkemeier; M. Georgi and K.J. Dietz (2003) Salicylic acid alleviates the cadmium toxicity in barley seedlings. Plant Physiology, 132(1): 272-281.

Mohammad, L.; E. Sabbagh; K. Rigi and A. Keshtehgar (2014) Effect of salicylic acid on activities of antioxidant enzymes, flowering and fruit yield and the role on reduce of drought stress. Intl. J. Farming and Allied Sciences. 3 (9): 980-987.

Nasrabadi, H.N.; H. Nemati; M. Kafi and H. Arouei (2015) Effect of foliar application with salicylic acid on two Iranian melons (Cucumis melo L.) under water deficit. Afr. J. Agric. Res. 10(33): 3305 - 3309

Scandadalius, J.G. (1993) Oxygen stress and superoxide dismutase. Plant Physiology. 101: 7-12.

Senaratna, T.; D. Touchell; E. Bunn and K. Dixon (2000) Acetyl salicylic acid (aspirin) and salicylic acid induce multiple stress tolerance in bean and tomato plants. Plant Growth Regul. 30:157-161.

Shahram, S.; M. Deimehr; A. E. Jahromi (2011) Effect of irrigation regimes on growth and yield of two potato cultivars. Advances in Environmental Biology, 5(7): 1476-1479.

Shock, C.C. and E.B.G. Feibert (2002) Deficit irrigation on potato, pp: 47– 56. In Deficit irrigation practices, FAO, Rome.

Siamak, F. and H. Kazemi-Arbat (2014) Effects of salicylic and ascorbic acid applications on growth, yield, water use efficiency and some physiological traits of chickpea (Cicer arietinum L.) under reduced irrigation. Legume Research, 38 (1) 2015: 66-71.

Simaei, M., R.A. Khavari-Nejad and F. Bernard (2012) Exogenous application of salicylic acid and nitric oxide on the ionic contents and enzymatic activities in NaCl-stressed soybean plants. American Journal of Plant Sciences, 3: 1495-1503.

Snedecor, W.G. and G.W. Cochran (1980) Statistical Methods. 7th Ed., the Iowa State Univ. Press, Ames, Iowa, USA.

Tahereh, S. N.; H. R. Mobasser; M. Dahmardeh and M. karimian (2014) Effect of foliar application of salicylic acid and drought stress on quantitative yield of mungbean (Vigna radiata L.). J. Nov. Appl. Sci., 3 (5): 512-515.

تأثير الرش الورقى بحمض السلسيلك على النمو والمحصول فى البطاطس تحت كميات رى مختلفة

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اجريت تجربتان حقليتان متتاليتان بمحطة البحوث – كلية الزراعة جامعة المنصورة فى الموسم الصيفى من عامى 2014 و2015. لدراسة تاثيركميات مياه الرى والرش بحمض السلسيلك على النمو والمحصول فى البطاطس صنف اسبونتا والمنزعة فى ارض طميية طينية تحت نظام الرى بالتنقيط. نفذت التجربة فى تصميم قطاعات كاملة العشوائية منشقة مرة واحدة فى ثلاث مكرارات , وزعت كميات مياة الرى (700 – 1000 – 1300 متر مكعب للفدان) فى القطع الرئيسية, بينما وزع الرش بحمض السلسيلك (صفر – 0.1 – 0.2 – 0.3 جرام للتر) فى القطع المنشقة. اوضحت النتائج ان زيادة كميات مياة الرى ادت الى زيادة معنوية فى صفات النمو الخضرى (ارتفاع النبات – عدد الاوراق – المساحة الورقية للنبات عدد السيقان - الوزن الطازج للنمو الخضرى -). التركيب الكيماوى للاوراق (نسبة النتروجين والفسفور والبوتاسيوم – محتواها من كلورفيل أ – كلورفيل ب – الكاروتينيدات). ومحصول وجودة الدرنات الفزيقية (وزن و عدد الدرنات للنبات-المحصول التسويقة والكلى للدرنات). جودة الدرنات الكيمائية مثل (فيتامين س- المواد الصلبة الذائبة الكلية - النتروجين والفسفور والبوتاسيوم) محتوى المياة النسبى للاوراق. وعلى العكس نقص كل من (النسبة المئوية للمادة الجافة للنمو الخضرى والدرنات – الصلابة – الكثافة – التسرب الاكتروليتى – كفاءة استخدام المياة) بزيادة كميات الرى. اوضحت النتائج ان جميع الصفات السابقة زادت باستخدام الرش الورقى بحمض السلسيلك مقارنة بالنباتات الغير معاملة ماعدا صفة التسرب الاكتروليتى . ولقد اوضح التفاعل بين كميات مياة الرى و استخدام الرش الورقى بحمض السلسيلك الى ان معاملة 1300 متر مكعب للفدان والرش بحمض السلسيلك ب 0.2 جرام للتر حققت أعلى القيم لمعظم الصفات.