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RESPONSE OF POTATO GROWTH AND YIELD TO SOME STIMULATING COMPOUNDS.

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ABSTRACT

Two field experiments were carried out at the private Farm in Basandela Village, Belqas, Dakahlia Governorate during the two successive summer seasons of 2012 and 2013 to study the response of potato (c.v. Valor) growth and yield to some stimulating compounds i.e, Thiamine($V.B_1$)100 ppm, Riboflaphine($V.B_2$)100 ppm, Ascorbic acid (V.C)100 ppm, Decenyl succinic acid (DSA) 400 ppm, Arginine acid 400 ppm, Proline acid 400 ppm and Micronutrients (Fe, Zn and Mn) each 75 ppm .

Results indicated that plant height and number of leaves/plant were significantly increased with application of Decenyl saccinic acid (DSA) compared with other treatments in both seasons of study. Number of branches/ plant and number of stoolens /plant were significantly increased with application of proline acid compared with the control. Leaf area was significantly increased with foliar application of Ascorbic acid in both seasons of study.

Total yield (tones / fed.), average tuber weight and marketable yield of tubers were increased significantly with application of Ascorbic acid (100 ppm) followed by the Arginine acid compared with other treatments. The foliar application of Arginine acid increased the content of tuber from N%,P% and K% in both seasons of study compared with the other treatments. On the other hand, all treatments significantly decreased the content of $No_3^=$ and $No_2^=$ in the tubers at harvest compared with the control treatment while, the lowest values of $No_3^=$ and $No_2^=$ had been obtained after the foliar application of Arginine acid in both seasons. Therefore, this treatment could be recommended for raising potato production and quality under similar conditions to this work.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important food crops all over the world including Egypt. In world tonnage the potato ranks after wheat, rice and maize as the fourth most important crop for human consumption (Ewing 1997).

Vitamins compounds act as co-enzyme in a number of enzyme system and thus take part in the regulation of metabolism. Vitamin B_1 (Thiamine) is an important co – enzyme which involved in the formation of acetyl co–enzyme A an important intermediate in cell respiration. Vitamin B_1 is found in plant tissues (Robert, 1976). He studies the role of B_1- vitamin in plant and found that Vitamin is necessary for nutrient uptake, respiration, photosynthesis, chlorophyll and prolin content depend more of less on the availability of B_1- vitamin (Samiullah and Afridi, 1988). Foliar application of Vitamin B_1 gave rise to an increase the growth, total dry weight, total yield, nitrogen, phosphorus and total prolin of many plants (Midan, 1986 on tomato, El- Ghamriny *et al.,* 1999 on tomato and Arisha, 2000 a on pea).

Foliar application of vitamin C induced many stimulation effects on growth of different plants and activate some physiological processes such as

respiration and cell division (Oertli, 1987). Treatment of potato with vitamin C increased number of stem and leaves / plant, total dry weight / plant, number of tubers / plant, yield / plant, weight of small, medium and large tubers / fed, total yield / fed, DM % and starch content. On the other hand, specific gravity and T.S.S % were not significantly affected by application of Vitamin C (El-Sayed, 1991 and Arisha, 2000a).

Shehata *et al.,* (1990) indicated that treating potato plants with the mixture of micronutrients (Fe + Zn and Mn) increased number of stems, fresh and dry weight of plant foliage, number of tubers and tuber yield/ fed.

Abd EL- Razik and Gaber, (1994) indicated that foliar spray of Zinc significantly increased the total tubers yield, tuber dry matter and tuber content of Zinc and protein. El-Sayed *et al.,* (2007) observed that foliar spraying with micro- nutrients (Fe + Zn and Mn) led to increase vegetative growth characters, total tuber yield and starch content. Moreover, Saif El-Deen, (2005) pointed out that dry matter, total carbohydrates, were increased by foliar spray of micro- nutrients.

Shawky *et al.,* (1983) found that Decenyl succinic acid (DSA) unsaturated fatty acid) was effective in reducing injury banana plants, as increasing cold hardness due to increasing total sugars and reduced free water and increased bound water significantly. Kamar, and.Omar (1987) indicated that early and total yield average number of fruits per plant of cucumber as well as total yield of the two potato cultivars (Alpha and King Edward) were significantly increased as a result of spraying with amino acids solution. El- Shabasi *et al.,* (2005) indicated that foliar spraying of garlic plants with mixture of glaycine, alanin, cysteine and arginine (each at 100 ppm) gave the highest values of plant height, leaf blade area, nech and bulb diameter, fresh weight of leaves and markedly produced higher total yield as well as crude protein. Reda *et al.,* (1999) found that vegetative growth criteria of *Hyoscyomus muticusl* were significantly increased with the treatments of amino acids omithine, proline or cysteine as foliar spraying. Shaheen *et al.* (2013) found that foliar spraying by amino mix compound caused on enhancement in onion plant growth characters, i.e. length of plant, leaves number, fresh and dry weight of whole plant and its organs. Also, total bulb yield and TSS value recorded their highest values when amino mix sprayed at level within 2 – 3 cm/L. On the contrary the percentage of un-marketable and splitting bulbs decreased with using amino mix, and the lowest values were when used the highest amino mix level. Moreover, it is known that, every plant like any organism needs certain components for growth over or above soil. The basic component of living cells is protein, which are formed by sequence of amino acids. The requirement of amino acids in essential quantities is well known as a means to increase yield and overall quality of crops (Awad *et al*., 2007and Faten *et al*., 2010)

The main object of this study was to investigate the effect of foliar spray on potato plants (cv. Valor) with Vit B_1, B_2, C, Proline, Arginine, Decenyl succinic acid (DSA) and Micro – elements (Fe + Zn and Mn) on vegetative growth parameters, yield and its components as well as chemical composition.

MATERIALS AND METHODS

Tow field experiments were carried out in summer seasons of 2012 and 2013 at the privte farm in Basandela village, Belqas,Dakahlia Governorate, to study the effect of foliar application on potao plants cv. Valor with vitamins B_1 (thiamin), B_2 (Riboflaphine), V.C (ascorbic acids), Proline, Argnine, Decenyl succinic acids (DSA) and micro – elements (Fe + Zn and Mn), on vegetative growth parameters, yield and its components and chemical composition of potato. Potato seeds were planted on 15th and 20th of January in the first and second seasons, respectively. Each plot area was 10.5 m^2 which included 5 rows 3 m in length and70cm width. Potato seed tubers were planted in rows at 25 cm spacing between plants and the tubers were harvested after 125 days from planting in both seasons.

The used experimental design was a randomize complete block design. Soil samples were collected from experimental site prior to planting at 0 – 30 cm depth and their properties were shown in Table (1).

Table (1) Physical and chemical analysis of experimental soil during 2012 and 2013.

Soil prosperities	2012	2013
A : Physical analysis		
Clay %	46.60	45.53
Silt %	24.31	25.31
Fine sand %	23.4	23.22
Coarse sand %	1.23	1.38
Ca CO_3	2.63	2.85
Organic matter	1.83	1.72
B: Chemical analysis		
Ph(1:2.5soil water suspension	7.83	7.71
Ecdsm^{-1}(in saturated extract)	1.75	1.81
Total N ppm	0.91	0.83
Available P ppm	9.82	10.31
Avialable K ppm	258.00	263.00
Total Soluble Solids %	0.52	0.41

The source of vitamines vitamins B_1 (thiamin), B_2 (Riboflaphine), V.C (ascorbic acid), Proline, Arginine, Decenyl succinic acids (DSA) and micro – elements (Fe + Zn and Mn) were obtained from El- Gomhouria Chemicals Company. The treatments were as follow :

Foliar application on potato plants with :

1- Control Tap water .
2- 100ppm V.B_1 (Thiamin).
3- 100ppm V.B_2 (Riboflaphine).
4- Micro-nutrients each at 75 ppm (Fe + Zn and Mn).

5- Decenyl saccinic acid 400 ppm.
6- Arginine acid 400 ppm.
7- Ascorbic acid (V. C) 100 ppm.
8- Proline acid 400 ppm

All the treatments were fertilized with the recommendation rates of NPK as follow : 180 Kg N/ fed ammonium nitrate, 33.5 % N) and was added at three equal doses after 28, 39 and 52 days after planting , 75 Kg P_2O_5/ fed as superphosphate (15.5 % P_2O_5) was added once during soil preparation and 96 Kg K_2O/ fed. potassium sulphate (48 % K_2O) was added once after 52 days after planting. All other culture practices were applied according to recommendation of the ministry of Agriculture, Egypt.

Data recorded :

1- Plant growth parameters study:

A random sample of 5 potato plants were taken from each plot after 90 days of planting to record the vegetative growth parameters, plant height (cm), number of leaves / plant , fresh and dry weight / plant, number of branches/plant, number of tuber/plant and number of stoolens/plant and leaf area (cm^2) were described by (Koller, 1972).

2-Yield and its components :

At harvest time 5 plants were taken randomly from each plot and the following data recorded. number of tubers / plant, average tuber weight, total yield (tones / fed.). Tuber classified into two categories marketable tubers and non-marketable tubers (small size), then weighted to determine the total yield per feddan (tones).

3-Tuber quality and chemical contents:

A representative sample of 10 healthy tubers from each plot was selected to obtain quality data:

1- Dry matter percent in tuber: It was determined by allowing 100 g of fresh tuber to dry at 105^0C till constant weight.

2- Total soluble solids (TSS %) The percentage of TSS in tuber was estimated by hand Refractometer according to Cox and Pearson, (1962).

3- Nitrogen, phosphorus and potassium were determined in dried tuber at 105^0C as the following:

Nitrogen (%) was assayed according to the method described by Adams, (1965). Phosphorus (%) was determined according to (John, 1970). Potassium was determined using falme photomter according to(Pipper, 1950). Nitrate and nitrite determination were measured as described by (Singh, 1988).

RESULTS AND DISCUSSION

1-Vegetative growth characters :

Data presented in Table (2) show that plant height (cm) , number of leaves / plant were significantly increased by the foliar application of Decenyl Saccinic Acid (DSA) compared to control (untreated one) in both seasons of study.

Fresh and dry weight per plant was increased significantly with application of Arginine acid compared with other treatments in both seasons of this study, on the other hand the lowest data was recorded with the control (sprayed water tap). These increments may be due to the increase in productivity of the photosynthetic areas. Bidwall, (1980) stated that amino acids are known as building blocks proteins in plants beside number of additional functions in the regulating of metabolism, i.e., transport and storage of nitrogen, as well as protein synthesis was necessary during the development growth. The same data was reported by El- Shabasi *et al*., (2005) who found that all vegetative growth parameters on garlic was increased with the application of amixture of Glycine, Alanine, Cysteine and Argnine acids at 100 ppm in both seasons of study, Faten et al.,(2010) and Shaheen *et al.* (2013) on onion.

Table (2) Plant height (cm), number of leaves / plant, fresh weight / plant (g) and dry weight/ plant (g) as affected by some stimulating compounds on potato plants during the two summer seasons of 2012 (S1) and 2013(S2).

Traits / Treatments	Plant height (cm)		Number of leaves / plant		Fresh weight / plant (g)		Dry weight/ plant (g)	
	S1	S2	S1	S2	S1	S2	S1	S2
Control water tap	48.40	50.20	48.80	47.90	108.80	109.80	17.80	20.20
Thiamine(V.B1)	54.11	53.20	49.90	49.80	135.50	148.30	24.30	20.80
Riboflaphine(V.B2)	58.00	56.50	52.40	51.22	226.20	156.80	27.90	21.71
Mixed Micro (Fe + Zn and Mn)	59.00	58.00	52.33	51.50	154.30	150.00	26.00	21.10
Decenyl Saccinic acid	59.10	58.80	54.66	52.50	226.80	158.80	28.80	22.60
Argenine acid	58.33	56.20	52.33	51.11	243.20	160.80	30.20	22.80
Ascorbic acid(V.C)	58.33	56.00	52.80	52.80	226.50	156.90	28.00	21.80
proline acid	54.30	52.90	50.10	50.81	222.00	153.80	28.60	21.30
L.S.D 0.05	3.65	5.23	3.75	3.36	12.57	12.57	3.03	3.02

Data in Table (3) show that the number of branches/plant , number of stoolens/plant and leaf area was significantly increased with all treatments compared to control in both seasons of study. The highest value was recorded with foliar application of proline acid and ascorbic acids (V.C) and the lowest value was recorded with control in both seasons of study. These results were in agreement with El –Shabasi *et al.,* (2005) on garlic and El-Sayed (1991) mentioned that V. C (Ascorbic acid) increased number of leaves / plant of potato.

Table (3)Number of branches/ plant, number of Stoolens/plant and leaf area/plant (cm^2) as affected by some stimulating compounds by foliar spraying on potato plants during the two summer seasons of 2012 (S1) and 2013(S2).

Traits / Treatments	Number of branches/ plant		Number of Stoolens/plant		Leaf area/plant (cm^2)	
	S1	S2	S1	S2	S1	S2
Control water tap	2.66	3.16	6.00	5.33	1676.98	1565.60
Thiamine(V.B1)	2.33	2.66	6.83	5.83	1698.19	1581.00
Riboflaphine(V.B2)	3.83	3.00	6.00	6.16	2331.05	2184.46
Mixed Micro (Fe + Zn and Mn)	4.33	4.33	6.66	6.83	2035.66	1919.50
Decenyl Saccinic acid	2.83	4.16	6.50	6.00	1812.69	1726.27
Argenine acid	3.83	3.66b	6.16	5.83	2381.40	2231.36
Ascorbic acid(V.C)	4.40	4.50	6.83	5.83	2396.67	2243.53
proline acid	4.50	4.50	6.83	6.90	2261.20	2108.03
L.S.D 0.05	0.93	0.72	1.18	0.81	150.27	142.47

2-Yield and its components :

The results in Table (4) indicated that the tuber number of / plant was increased with the foliar application of mixed micronutrients (Fe + Zn and Mn) in both seasons compared with the other treatments and the lowest value recorded with the control in both season of study. The improving effect of Zn, Mn and Fe on yield and its components might be attributed to their positive role on enhancing photosynthesis, biosynthesis of proteins and carbohydrate assimilation diverted to the tuber roots (Marschner, 1995). These results were in agreement with El- Morsy *et al.,* (2006).

In Table (4) total yield ton / fed. and weight of marketable tubers were increased significantly with the foliar application of ascorbic acid (V.C) and arginine acid compared with other treatments in both seasons of study and the lowest value was recorded with the control treatment. These results were in agreement with (Sarg, Sawsan, 2005), Faten *et al.,(*2010) and Shaheen *et al.* (2013) on onion.

Amino acids are starting materials for the synthesis of alkaloid, and various products of secondary metabolisms (Stroev, 1986). These results were in agreement with those of El- Sabashi *et al.*, 2005 on garlic and Kamar and Omar 1987 on cucumber and potato.

The results in Table (5) reported that the foliar application of ascorbic acids increased significantly average tuber weight in both seasons of study compared to other treatments and the lowest value was recorded with application of control. The same data was reported by (Sarg, Sawsan, 2005) who reported that average tuber weight was significantly increased for plant sprayed with 200 ppm or 300 ppm of V. C .

In Table (5) the dry matter and TSS% of tuber was increased significantly with foliar application of Decenyl saccinic acid in both seasons of study and the lowest value was recorded with control. The same data was reported by (Shawky *et al*., 1983). These was accompanied by significant increase in glucose and as light increase in source control.

Table(4)Tuber number / plant, un marketable yield (tones /fed), Marketable yield (tones /fed) and Total yield (tones / fed.) as affected by some stimulating compounds on potato plants yield during the two summer seasons of 2012 (S1) and 2013(S2).

Traits / Treatments	Tuber number / plant		Un marketable yield (tones /fed)		Marketable yield (tones /fed)		Total yield (tones / fed.)	
	S1	S2	S1	S2	S1	S2	S1	S2
Control water tap	3.16	2.66	1.16	1.16	11.16	11.02	12.23	12.18
Thiamine(V.B1)	3.66	2.66	0.91	0.94	13.88	13.75	14.79	14.69
Riboflaphine(V.B2)	4.16	2.83	1.09	1.13	18.40	18.90	19.49	20.03
Mixed Micro (Fe + Zn and Mn)	4.16	3.00	0.94	0.97	18.96	18.83	19.96	19.80
Decenyl Saccinic acid	3.50	2.83	0.81	0.85	14.20	14.08	15.01	14.94
Argenine acid	4.16	2.66	0.78	0.82	19.85	20.48	20.64	21.30
Ascorbic acid(V.C)	3.83	2.50	0.81	0.88	20.15	20.35	20.96	21.83
proline acid	3.33	2.83	0.65	0.69	18.76	18.45	19.45	19.14
L.S.D 0.05	0.93	1.17	0.07	0.09	0.733	1.047	0.821	0.985

Table(5)tuber weight (g), Dry matter of tuber % and T.S.S % as affected by some stimulating compounds on potato tuber quality at harvest during the two summer seasons of 2012 (S1) and 2013(S2).

Traits / Treatments	tuber weight (g)		Dry matter of tuber %		T.S.S %	
	S1	S2	S1	S2	S1	S2
Control water tap	105.60	105.13	16.90	20.97	6.33	6.00
Thiamine(V.B1)	106.30	108.70	20.16	21.97	6.00	7.00
Riboflaphine(V.B2)	134.40	135.00	18.46	22.52	6.30	6.16
Mixed Micro (Fe + Zn and Mn)	134.50	133.00	20.07	21.20	5.33	6.16
Decenyl Saccinic acid	108.90	105.13	22.80	22.60	7.66	7.16
Arginine acid	140.90	140.90	20.64	22.73	4.66	6.50
Ascorbic acid(V.C)	143.80	148.20	21.06	22.73	6.00	6.30
proline acid	129.50	126.50	21.70	21.86	8.00	6.67
L.S.D 0.05	2.58	4.37	1.27	1.08	1.26	1.33

3-Chemical composition:

Data in Table (6) indicated that N%,P% and K% contents in the tubers at harvest were significantly increased with foliar application of arginine acid trearment compared with untreated one (control) in both seasons of study. The highest values of N%, P% and K% were recorded with

foliar application of arginine acid, these results are in line with those obtained by El- Sabashi *et al.*, (2005) on garlic and Shaheen *et al.* (2013) on onion.

In Table (6) $No_3^=$ ppm and $No_2^=$ppm contents in tubers were decreased significantly with all treatments compared with control and the lowest values of $No_3^=$ and $No_2^=$ were recorded with foliar application of arginine acid in both seasons of study.

Table(6)N%, P%, K%, $No_3^=$ and $No_2^=$ as affected by some stimulating compounds on of potato tubers during the two summer seasons of 2012 (S1) and 2013(S2).

Traits / Treatments	N %		P%		K%		$No_3^=$ppm		$No_2^=$ppm	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Control water tap	1.31	1.39	0.21	0.22	2.37	2.34	49.1	46.30	0.95	0.91
Thiamine(V.B1)	1.46	1.62	0.24	0.24	2.70	2.49	39.70	41.20	0.81	0.84
Riboflaphine(V.B2)	1.37	1.49	0.22	0.23	2.56	2.33	44.30	43.90	0.88	0.88
Mixed Micro (Fe + Zn and Mn)	1.53	1.71	0.24	0.25	2.73	2.54	37.10	39.80	0.75	0.79
Decenyl Saccinic acid	1.30	1.42	0.22	0.23	2.44	2.27	46.70	45.30	0.90	0.89
Arginine acid	1.67	1.83	0.26	0.28	2.89	2.74	34.30	37.20	0.66	0.72
Ascorbic acid(V.C)	1.58	1.73	0.26	0.27	2.82	2.62	35.80	38.50	0.72	0.77
proline acid	1.38	1.57	0.23	0.24	2.61	2.43	41.20	42.60	0.88	0.87
L.S.D 0.05	0.063	0.084	0.0066	0.0059	0.063	0.063	1.075	1.012	0.064	0.031

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استجابة نمو ومحصول البطاطس لبعض المركبات المحفزة للنمو.

أنـــور الدســـوقى علـــى اســـماعيل جودة،محمـــود نبيـــة محمـــد علـــى جحـــوش و احمد السيد عبد القادر.

أقسام بحوث الخضر - معهد بحوث البساتين - مركز البحوث الزراعية – الجيزة – مصر .

نفذت تجربتان حقليتان فى مزرعة خاصة بقرية بسنديلة – مركز بلقاس – محافظة الدقهلية خلال عامى ٢٠١٢ – ٢٠١٣ وذلك لدراسة تأثير رش بعض المواد المحفزة للنمو فيتامين ب ١، فيتامين ب٢، فيتامين ج، حامض دهنى غيرمشبع (ديسينيل سكسينيك أسيد) ، حامض الأرجينين ، حامض البرولين وخليط من العناصر الصغرى(حديد ، زنك ومنجنيز) على النموالمحصول والجودة فى البطاطس (صنف فالور).

أوضحت النتائج ما يلى :

طول النبات وعدد الاوراق زادت معنويا باضافة الديسينيل سكسينك اسيد مقارنة بباقى المعاملات والوزن الجاف والطازج زادت باضافة حامض الارجنين فى كلا موسمى الزراعة.

- عدد السيقان الارضية و الهوائية زادت باضافة حامض البرولين فى حين أن زيادة عدد الدرنات للنبات تأثر معنويا بواسطة العناصر الصغرى (حديد – زنك – منجنيز) فى حين أن الاسكوربيك أسيد أثر معنويا على المساحة الورقية.
- بالنسبة للمحصول الكلى ومتوسط وزن الدرنات فقد تاثرت معنويا باضافة (١٠٠ جزء فى المليون) من الاسكوربيك اسيد يليها المعاملة بحامض الارجنين.
- محتوى الدرنات من النيتروحين والفوسفور والبوتاسيوم تأثر معنويا باضافة حامض الارجنين فى حين ان محتوى الدرنات من النترات والنيتريت انخفض انخفاضاً معنوياً مع كل المعاملات مقارنة بالكنترول .

على ذلك يمكن التوصية باضافة الاسكوربيك اسيد والارجنين رشاً على البطاطس للحصول على محصول عالى من الدرنات ذوجودة عالية و ذو محتوى قليل من النترات والنتريت تحت ظروف اراضى محافظة الدقهلية.