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THE INFLUENCE OF FOLIAR SPRAYING WITH NUTRINTS ON GROWTH, YIELD AND STORABILITY OF POTATO TUBERS

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ABSTRACT

The field trial was conducted during the two spring plantation seasons of 2007/2008 on potato cv. Spunta at Abou Awad villiage, Aga, Dakahlia Governorate. The current study aimed to study the effect of foliar spraying with nutrients on growth, yield and storability of potato tubers. The treatments were phosphoric acid (2.5 ml/l), potassium sulphate (1%), calcium chloride (0.25%), iron (75 ppm), manganese (Mn 75 ppm), zinc (Zn 75 ppm), boric acid (50 ppm) and mixture of Fe, Zn and Mn each at 75 ppm as well as check.

Results showed that the vegetative growth parameters, i.e., plant height, number of main stems/plant, chlorophyll content, foliage fresh and dry weight/plant, at 80 days after planting, likewise, total yield, tuber number and tuber dry weight per plant at harvest time gave the highest values with foliar application the micronutrient mixture of Fe, Zn and Mn as well as potassium sulphate in the two seasons of study.

Potato tubers of all the treatments were stored at 8 – 10°C and 85% relative humidity to evaluate their behavior during the storage. The results revealed that foliar spraying with potassium, mixture of Fe, Zn and Mn or calcium had positive effects on reducing weight loss and sprouting percentage during the storage period. Dry matter and starch content were significantly higher in tuber of plants treated with Fe, Zn and Mn or Mn than in the control treatment. Meanwhile, specific gravity was not affected by foliar spraying with the tested nutrient elements.

Significant increase in weight loss and sprouting due to extending period were evident. Dry matter and starch content increased up till 30 days of storage then declined afterward, specific gravity was not significantly changed during storage.

INTRODUCTION

Potato is a major source of inexpensive energy. It contains high levels of carbohydrate and significant amounts of vitamins B and C as well as minerals. Moreover, potato is used in many industries, such as French fries, chips and starch (Abdel-Aal *et al.*, 1977). Foliar application of K can improve yield and tuber quality (Marchand and Bourrie, 1999). Singh *et al.* (1996) found that potato tuber can be stored for 14 weeks, and storage losses and sprouting percentage were the lowest when 180 kg K_2O/ha was applied. Potatoes supplied with K_2SO_4 either in split or split combined with foliar application had significantly higher percent of canopy cover, tuber DW, and total plant DW than those supplied with K fertilizer in single application (Gunadi, 2009). Application of water soluble forms of Ca during the tuber development period was effective in raising Ca level of the nonperiderm tissue and fastly improves tuber quality (Kleinhenz *et al.*, 1999). Ozgen *et al.* (2003) reported that by improving tuber Ca level, we can reduce tuber internal defects and improve of its storability. Karamaker *et al.* (1988) show that foliar spray of Agromin (chelated mixture of Zn, Fe, Cu, Mg, B and Mo) gave the highest average yields (20.63-21.57t/ha) compared with without trace elements (16.15t/ha). Dwivedi (1991) showed that ZnSO4 applications can increase potato yield by 37%, spraying and inoculating tubers with Zn increased also potato yield. Abdel- Razik and Gaber (1994) indicated that vegetative growth parameters, total tuber yield, tuber dry matter, specific gravity and starch content in tubers were generally increased as a result of foliar spray of Zn. Lozek and Fecenko (1996) indicated that yield was increased by 11.7- 15.7% with Mn and/or B. Nofal (1998) and Nofal *et al.* (1998) noticed that foliar application with chelated micronutrients (2.8 % Fe, 2.8 % Zn, and 2.8 % Mn at 800 g/fed.) gave the highest tuber yield. Utilization of Zn and Mn in potato production caused an increase in number of potato tubers, mean tuber weight and finally high performance and by applying ascorbic acid, Zn, Mn and other micronutrients, and quality of potato tubers was increased (Iqbal *et al.,* 1995; Mohamadi, 2000). Radwan and Tawfik (2004) reported that vegetative growth parameters, tuber yield, starch content and specific gravity were increased significantly by foliar addition with Mn or Zn at 100 ppm. Seif-El-Deen (2005) pointed out that dry matter, total carbohydrates, reducing sugars; non-reducing sugars were increased by foliar spray of micronutrients. El-Sayed *et al.* (2007) observed that foliar spraying with micronutrients (Fe, Zn and Mn) led to increase vegetative growth characters, total tuber yield and starch content, on the other hand, gave the lowest weight loss and sprouting percentage during the storage period. The quality of potato tubers can be maintained for up to 12 weeks by storing at 8-10°C (Burton, 1989). Cold storage is used to minimize weight losses caused by respiration and shrinkage. Respiration losses are usually minimal near 7.5°C (Stark and Love, 2003). On the other hand, application of foliar P had no effect on number of tubers or the yield (Allison *et al.*, 2001).

The objective of this study was to find out the effect of foliar spraying with nutrients on growth, yield and storability of potato tubers.

MATERIALS AND METHODS

This research was conducted during the two spring plantation seasons of 2007 and 2008 on potatoes (*Solanium tuberosum* L.) cv. Spunta at Abou Awad Village, Aga, Dakhalia Governorate, Egypt. Potato seed tubers were planted in rows 75 cm apart at 25 cm spacing between plants. Each plot area was 18 m^2, which included four rows 6 m in length. Planting dates were 12th and 17th of January 2007 and 2008, respectively and the tubers were harvested after 110 days from planting in both seasons.

Soil samples were collected from experimental site prior to planting at 0 – 30 cm depth and their properties are shown in Table (1).

Table 1: Some physical and chemical properties at the experimental soil

Sand	Silt	Clay	Texture	O.M.	$CaCO_3$	pH	Available nutrients (ppm)					
							N	P	K	Fe	Zn	Mn
16.0	29.1	53.6	Clayey	1.3	3.0	8.0	43.2	23.0	132	3.12	2.5	2.2

Phosphoric acid (40% P_2O_5), calcium chloride (36%Ca), boric acid (17% B) and potassium sulphate (48% K_2O) were obtained from El-Gomhoura for Chemical Company, while, Fe- EDTA (6%), Mn-EDTA (13%) and Zn- EDTA (13%) were obtained from Agrimatico for Chemical Company.

The experimental design

The treatments were arranged in a randomized complete block design with three replicates, treatments were based as follows:

1. Phosphoric acid at 2.5 ml/l.
2. Potassium sulphate at 1%.
3. Calcium chloride at 0.25%.
4. Iron at 75 ppm.
5. Manganese at 75 ppm.
6. Zinc at 75 ppm.
7. Mixture of Fe, Zn and Mn each at 75 ppm.
8. Boric acid at 50 ppm.
9. Check untreated.

Nutrient treatments were applied to plant as foliar spraying three times at 46, 60 and 74 days after planting date.

Ammonium nitrate (33.5 % N) as a source of nitrogen was applied at three equal portions after 3, 5 and 7 weeks from planting date, while potassium sulphate (48.0 % K_2O) was added once with third portion of nitrogen. Normal superphosphate (15.5% P_2O_5) was added once during the soil preparation. Chemical fertilizers at 180 kg N, 75 kg P_2O_5 and 96 kg K_2O/fedden were used.

Studied characters

1. Vegetative growth characters

At 80 days after planting, a random sample of six plants from each plot was taken to measuring plant height, number of main stems/plant, foliage fresh and dry weight per plant. Chlorophyll reading was recorded by a Minolta SPAD 502 unit chlorophyll meter (Yadaua, 1986), on the fifth leaf from the plant apex.

2. Yield and its components

Total tuber yield, tuber number/plant, tuber weight/plant, were determined at harvesting time (110 days from planting).

3. Storage

The potatoes were harvested on 2nd and 7th of May (110 days after planting dates) in 2007 and 2008 seasons, respectively. The harvested tubers were kept in heaps on the field for a 15day curing period. Healthy and undamaged tubers with uniform size (35-55mm) were chosen and were placed in plastic boxes (45×35×25 cm). For storage experiment, sixty randomly collected tubers from each treatment were placed in each box and transported to Postharvest and Handling of Vegetable Crop, Department, Horticulture Research Institute, ARC at Giza. Each sample was divided into three replications each of 20 seed tubers to study the quality attributes, then stored at 8 – 10°C and 85% relative humidity. Samples were evaluated at 30-days intervals for the following properties.

1. Weight loss, sprouting and dry matter percentage.
2. Starch content was calculated by the formula:
   Starch % = 17.55 + 0.981 (dry matter % - 24.182) (Burton, 1989).
3. Specific gravity was determined using the weight in air and weight in water method (Smith, 1975).

Experiment was conducted as completely randomized design with three replicates (9 foliar application treatments × 5 storage periods × 3 replicates).

Statistical analysis

The data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the randomized complete block design according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Vegetative growth characters

Data in Table (2) revealed that foliar application micronutrients mixture of (Fe, Zn and Mn) at 75 ppm gave the highest values of plant height, number of main stems per plant and chlorophyll reading, While the highest values of foliage fresh and dry weight were recorded with potassium sulphate at 1% in the two seasons. The effect of micronutrient mixture (Fe, Zn and Mn) on plant vegetative growth parameters might be due to their essential roles in many important metabolic functions such as transport of carbohydrates, regulation of meristematic activity, photosynthesis, respiration, energy production and protein metabolism. These results are in agreement with those obtained by Abdel- Razik and Gaber (1994), Radwan and Tawfik (2004) and El-Sayed *et al.* (2007). On the other hand, potassium plays an important role in functions of enzymes needed for the vital processes and growth. Potassium is considered as one of the most essential elements for growth and development of plant. Many studies proved that K plays a major role in many physiological and biochemical processes such as cell division and elongation, enzyme activation, stabilization of the native conformation of enzymes and possibly turgor, metabolism of carbohydrates and protein compounds. The obtained results are supported by those of Gunadi (2009).

Yield and its components

Data presented in Table (3) show that total tuber yield, tuber number and tuber weight per plant were significantly affected by foliar application of nutrients. Whereas, total tuber yield the plants which were foliar sprayed with potassium sulphate at 1% gave the highest values of total yield and its components followed by micronutrient mixture Fe, Zn and Mn each at 75 ppm in both seasons of study. These results might be due to the increase in vegetative growth characters (Table 2). The obtained results are in accordance with those recorded by Gunadi (2009) and El-Sayed *et al.* (2007). The role of K in an increasing the yield and its components might be attributed to its function in plants which include energy metabolism and enzyme activation on exchange rate and nitrogen activity as well as enhanced carbohydrates movement from shoot to storage organs (Marschner, 1995; Mengal 1997).

Table 2: Vegetative growth characters as affected by foliar spraying with nutrients in the two spring seasons 2007 and 2008.

Treatments	Growth characters / plant									
	2007 Season					2008 Season				
	Plant height (cm)	No. of main stem, plant	Chlorophyll reading (SPAD)	Foliage fresh weight (g/plant)	Foliage dry weight (g/plant)	Plant height (cm)	No. of main stem, plant	Chlorophyll reading (SPAD)	Foliage fresh weight (g/plant)	Foliage dry weight (g/plant)
Phosphoric acid at 2.5 ml/l	52.53	2.44	50.82	305.13	43.30	52.60	2.28	49.50	305.33	41.73
Potassium sulphate at 1%	53.95	2.20	52.78	336.90	55.08	53.82	2.15	51.03	336.27	54.50
Calcium chloride at 0.25%	52.62	2.08	51.27	302.67	42.08	52.72	2.12	51.83	301.58	42.24
Iron at 75 ppm	53.77	2.16	53.80	312.17	42.92	53.26	2.11	52.68	303.93	43.28
Zinc at 75 ppm	58.25	2.32	51.25	317.90	44.80	57.23	2.25	51.67	314.00	45.35
Manganese at 75 ppm	54.13	2.25	52.08	310.40	43.50	53.85	2.16	51.92	310.37	43.64
Iron+ Zinc+ Mn at 75 ppm	61.28	2.55	55.37	331.73	53.30	61.95	2.25	54.73	329.57	53.17
Boron at 50 ppm	52.32	2.11	50.13	305.03	44.21	50.07	2.06	50.42	310.23	42.93
Check	49.08	1.93	48.70	291.73	40.51	47.85	1.93	48.90	299.43	40.47
L.S.D at 5%	2.37	0.18	1.71	12.08	1.47	1.99	0.17	1.39	5.43	1.49

Table 3: Total tuber yield and its components as affected by foliar spraying with nutrients in the two spring seasons 2007 and 2008.

Treatments	2007 season			2008 season		
	Total tuber yield (t/fed)	Tuber No./plant	Tuber weight/ plant(g)	Total tuber yield (t/fed)	Tuber No./plant	Tuber weight/ plant(g)
Phosphoric acid at 2.5 ml/l	10.450	4.28	491.76	10.075	4.22	496.70
Potassium sulphate at 1%	14.773	4.97	650.13	14.862	5.29	664.80
Calcium chloride at 0.25%	11.510	4.08	496.93	11.500	4.16	494.37
Iron at 75 ppm	12.185	4.19	523.00	12.240	4.28	534.53
Zinc at 75 ppm	12.627	4.19	531.72	12.593	4.22	538.82
Manganese at 75 ppm	12.790	4.12	543.57	12.733	4.18	544.10
Iron+ Zinc+ Mn at 75 ppm	14.533	4.97	620.30	14.547	5.11	628.39
Boron at 50 ppm	13.047	4.43	555.37	13.050	4.38	562.47
Check	9.913	4.05	450.10	9.942	3.95	455.95
L.S.D at 5%	0.90	0.23	18.65	0.62	0.19	18.97

Storage behavior

Weight loss and sprouting percentage

Data in Table (4) reveal that the lowest weight loss percentage was recorded with foliar application of potassium, combination among Fe, Zn and Mn as well as calcium treatments while untreated plants demonstrated the highest values. These results might be due to the role of K in reducing transpiration (Kumar *et al.*, 2007), which not only depends on the osmotic potential of the mesophyll cells but is also controlled to a large extent by the opening and closing of stomata. Singh *et al.* (1996) found that tuber weight loss percentage was the lowest when plants were applied with 180 kg K_2O/ha. Calcium is also involved in controlling respiration (Bangerth *et al.*, 1972). Moreover Ca plays a pivotal role in membrane stabilization and in regulation of enzyme synthesis, e.g. protein- kinase or phosphates (Schmitz-Eilberger *et al.*, 2002). In addition, combination of Fe, Zn and Mn may reduce weight loss by developing flesh with more combined water which restricts water loss during the early storage periods (Iqbal *et al.*, 1995; Mohamadi, 2000). Similar results were reported by Seif El-Dein (2005) on sweet potato.

It is obvious from the data in Table (4) that weight loss percentage increased considerably and consistently with the prolongation of the storage period. The increased in weight loss percentage during storage might be attributed to the loss in moisture through transpiration and loss in dry matter through respiration (El-Sayed *et al.*, 2007).

As for sprouting, data in Table (5) show that addition of potassium, mixture of Fe, Zn and Mn, followed by calcium gave the lowest sprouting percentages compared with other treatments. Similar results were found by Singh *et al.* (1996), Moinuddin and Umar (2004) and El-Sayed *et al.* (2007).

Sprouting was noticed after 90 and 60 days of storage in the first and second season, respectively (Table 5). Extending the period of storage resulted in sustainable increase in sprouting percentage, where it reached 56.52 and 65.8% in the first and second season, respectively after 120 days of cold storage. Similar results were obtained by Moon *et al.* (2003) and Nourian *et al.* (2003).

The interaction between foliar application with nutrient elements and storage period on weight loss (Table 4) and sprouting percentages (Table 5) appeared significantly in the two seasons. The potato plants sprayed with potassium, mixture of Fe, Zn and Mn as well as calcium showed the lowest values of weight loss and sprouting percentages after 120 days of cold storage.

Table 4: Effect of interaction between foliar application with nutrient elements and storage period on weight loss percentage of potato tubers during storage at 8-10ºC

Treatments	2007 season						2008 season					
	Days in storage											
	Start	30	60	90	120	Mean	Start	30	60	90	120	Mean
Iran at 75 ppm	0	0.512	0.875	1.371	1.698	0.891	0	0.318	0.59	1.130	1.585	0.724
Fe + Zn + Mn at 75 ppm	0	0.397	0.799	1.181	1.478	0.771	0	0.293	0.55	1.070	1.662	0.713
Potassium sulpate at 1%	0	0.303	0.729	1.107	1.391	0.706	0	0.225	0.48	1.010	1.509	0.645
Boron at 50 ppm	0	0.392	0.848	1.267	1.639	0.829	0	0.341	0.6	1.180	1.458	0.715
Manganese at 75 ppm	0	0.374	0.856	1.299	1.672	0.840	0	0.261	0.54	1.120	1.674	0.718
Phosphoric acid at 2.5 ml/l	0	0.423	0.825	1.224	1.559	0.806	0	0.124	0.48	1.300	1.793	0.739
Zinc at 75 ppm	0	0.529	0.918	1.306	1.711	0.893	0	0.310	0.56	1.150	1.788	0.763
Calcium chloride at 0.25 %	0	0.369	0.758	1.033	1.473	0.727	0	0.256	0.52	0.990	1.769	0.706
Control	0	0.544	1.007	1.361	1.740	0.930	0	0.223	0.56	1.100	1.976	0.772
Mean	0	0.427	0.846	1.239	1.595		0	0.261	0.54	1.120	1.691	

	2007 season	2008 season
LSD at 5 % level : for Treatment (A)	0.088	N.S
Storage period (B)	0.066	0.090
(A) × (B)	0.199	0.280

Table 5: Effect of interaction between foliar application with nutrient elements and storage Period on sprouting percentage of potato tubers during storage at 8-10ºC.

Treatments	2007 season						2008 season					
	Days in storage											
	Start	30	60	90.00	120	Mean	Start	30	60	90	120	Mean
Iron at 75 ppm	0	0	0	44.00	55.01	19.80	0	0	20.30	45.20	67.53	26.61
Fe + Zn + Mn at 75 ppm	0	0	0	35.98	48.97	16.99	0	0	0	48.30	65.53	22.76
Potassium sulphate at 1%	0	0	0	34.00	50.61	16.92	0	0	0	41.70	58.67	20.08
Boron at 50 ppm	0	0	0	42.00	56.8	19.76	0	0	0	46.50	68.70	23.04
Manganese at 75 ppm	0	0	0	35.00	63.02	19.68	0	0	18.5	44	59.20	24.35
Phosphoric acid at 2.5 ml/l	0	0	0	40.59	54.67	19.05	0	0	0	49.80	65.10	22.97
Zinc at 75 ppm	0	0	0	44.00	59.3	20.66	0	0	21.40	47.50	64.80	26.75
Calcium chloride at 0.25%	0	0	0	38.00	53.17	18.23	0	0	0	46.40	63.33	21.94
Control	0	0	0	47.09	67.15	22.85	0	0	32.30	58.50	79.63	34.09
Mean	0	0	0	40.07	56.52		0	0	10.3	47.50	65.83	

	2007 season	2008 season
LSD at 5 % level : for Treatment (A)	2.46	2.76
Storage period (B)	1.83	2.06
(A) × (B)	5.5	6.17

Dry matter and starch percentage

Results on Tables (6 and 7) demonstrated clearly that dry matter slight higher values of dry matter and starch percentages in tubers were obtained by spraying the plant with mixture of Fe, Zn and Mn and Mn compared with other treatments. These results may be attributed to combined effect of micronutrients Fe, Zn and Mn or Mn on the more important biological functions such as photosynthesis, electron transport system protein synthesis and IAA oxidase.

These results are in agreement with those of Abdel- Razik and Gaber (1994), Radwan and Twfik (2004), Mousavi *et al.* (2007) and El-Sayed *et al.* (2007). They found that foliar application of micronutrients Fe, Zn and Mn increased dry matter and starch content in potato tubers.

As for period of storage, the obtained results showed that dry matter and starch content were increased during the first 30 days in storage, and then gradual significant reductions were evident along with elapsed time in both seasons. The potato tubers use part of their dry matter (mainly starch) for necessary energy supply (sprouting) resulting in dry matter loss (Mehta, 2004).

Significant interaction between foliar application with nutrient elements and period of storage was detected in both seasons. Potato plants sprayed with manganese or mixture of Fe, Zn and Mn resulted in slightly higher dry matter and starch content of potato tubers after 120 days in storage, while untreated plants (control) gave the lowest values.

Specific gravity

Data in Table (8) Cleary indicate that foliar application of nutrients, storage period and the interaction effects among the studied factors did not significantly affect specific gravity. Also, Wong Yen Cheong and Grovinden (1998) noticed that specific gravity of potato tuber remained unchanged during storage at 8 - 10 °C.

Table 6: Effect of interaction between foliar application with nutrient elements and storage period on dry matter percentage of potato tubers during storage at 8 - 10°C.

Treatments	2007 season						2008 season					
	Days in storage											
	Start	30	60	90	120	Mean	Start	30	60	90	120	Mean
Iron at 75 ppm	20.20	20.39	20.02	19.74	19.28	19.93	20.21	20.35	20.10	19.70	19.13	19.91
Fe + Zn + Mn at 75 ppm	22.43	22.53	22.40	22.04	21.82	22.24	21.43	21.53	21.40	21.20	21.01	21.31
Potassium sulphate at 1%	21.92	22.08	21.84	21.63	21.03	21.70	20.65	20.72	20.5	20.10	19.62	20.29
Boron at 50 ppm	22.35	22.48	22.36	22.00	21.64	22.17	20.92	21.06	20.8	20.50	20.31	20.73
Manganese at 75 ppm	22.50	22.64	22.43	22.10	21.99	22.33	21.99	22.07	22	21.80	21.68	21.90
Phosphoric acid at 2.5 ml/l	22.24	22.29	21.85	21.22	21.04	21.73	20.69	20.86	20.6	20.30	19.95	20.48
Zinc at 75 ppm	22.14	22.27	22.00	21.40	20.93	21.75	20.60	20.73	20.48	20.10	19.65	20.32
Calcium chloride at 0.25	20.42	20.54	20.21	20.08	19.46	20.14	20.37	20.50	20.2	20.80	19.22	20.01
Control	19.95	20.13	19.84	19.18	18.31	19.48	19.61	19.78	19.5	20.90	18.12	19.18
Mean	21.57	21.70	21.44	21.04	20.61		20.71	20.85	20.6	20.30	19.86	

LSD at 5 % level : for	2007 season	2008 season
Treatment (A)	0.55	0.53
Storage period (B)	0.41	0.39
(A) × (B)	1.24	1.18

Table 7: Effect of interaction between foliar application with nutrient elements and storage period on starch (9 / 100g dry weight) of potato tubers during storage at 8-10°C.

Treatments	2007 season						2008 season					
	Days in storage											
	Start	30	60	90	120	Mean	Start	30	60	90	120	Mean
Iron at 75 ppm	14.01	14.17	13.84	13.59	13.18	13.76	14.01	14.13	13.91	13.60	13.06	13.74
Fe + Zn + Mn at 75 ppm	15.99	16.09	15.97	15.68	15.45	15.83	15.18	15.19	15.08	14.90	14.72	15.01
Potassiun sulphate at 75 ppm	15.53	15.68	15.46	15.27	14.74	15.34	14.32	14.47	14.22	13.90	13.48	14.08
Boron at 50 ppm	15.92	16.03	15.93	15.61	15.28	15.75	15.10	14.77	14.57	14.30	14.11	14.57
Manganese at 75 ppm	16.06	16.20	15.98	15.69	15.60	15.91	15.60	15.67	15.57	15.40	15.32	15.52
Phosphoric acid at 2.5 ml/l	15.82	15.86	15.47	14.91	14.75	15.36	14.64	14.59	14.37	14.10	13.78	14.30
Zinc at 75 ppm	15.73	15.84	15.61	15.07	14.65	15.38	14.37	14.48	14.12	13.90	13.51	14.08
Calcium chloride at 0.25%	14.20	14.30	14.01	13.90	13.34	13.95	14.15	14.27	13.98	13.60	13.11	13.83
Control	13.78	13.93	13.68	13.09	12.32	13.36	13.48	13.63	13.33	12.90	12.15	13.09
Mean	15.23	15.35	15.11	14.76	14.37		14.54	14.58	14.35	14.10	13.69	

LSD at 5 % level : for	2007 season	2008 season
Treatment (A)	0.49	0.47
Storage period (B)	0.37	0.35
(A) × (B)	1.1	1.06

Table 8: Effect of interaction between foliar application with nutrient elements and storage period on specific gravity of potato tubers during storage at 8-10°C.

Treatments	2007 season						2008 season					
	Days in storage											
	Start	30	60	90	120	Mean	Start	30	60	90	120	Mean
Iron at 75 ppm	1.080	1.081	1.079	1.078	1.076	1.079	1.080	1.081	1.08	1.080	1.075	1.079
Fe + Zn + Mn at 75 ppm	1.090	1.091	1.090	1.089	1.088	1.090	1.086	1.086	1.09	1.090	1.084	1.085
Potassium sulphate at 1%	1.088	1.089	1.088	1.087	1.084	1.087	1.082	1.082	1.08	1.080	1.077	1.080
Boron at 50 ppm	1.090	1.091	1.090	1.089	1.087	1.089	1.083	1.084	1.08	1.080	1.081	1.082
Manganese at 75 ppm	1.091	1.091	1.090	1.089	1.088	1.090	1.088	1.089	1.09	1.090	1.087	1.088
Phosphoric acid at 2.5 ml/l	1.090	1.090	1.088	1.085	1.084	1.087	1.082	1.083	1.08	1.080	1.079	1.081
Zinc at 75 ppm	1.089	1.090	1.088	1.086	1.083	1.087	1.082	1.082	1.08	1.080	1.077	1.081
Calcium chloride at 0.25%	1.081	1.081	1.080	1.079	1.076	1.080	1.081	1.081	1.08	1.080	1.075	1.079
Control	1.079	1.080	1.078	1.075	1.071	1.077	1.077	1.078	1.08	1.070	1.070	1.075
Mean	1.086	1.087	1.086	1.084	1.082		1.082	1.083	1.08	1.080	1.078	

LSD at 5 % level :	2007 season	2008 season
for Treatment (A)	NS	N.S
Storage period (B)	N.S	N.S
(A) × (B)	NS	NS

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تأثير الرش الورقى بالمغذيات على النمو و المحصول والقابلية لتخـزين درنـات البطاطس

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تم إجراء تجربتان حقليتان خلال موسمي ٢٠٠٧و ٢٠٠٨ علـى محـصول البطـاطس صنف سبونتا بقرية أبو عوض– أجا– بمحافظة الدقهلية ، لدراسة تأثير الرش الورقى بالمغـذيات. المعاملات هى ٥و ml/l١٢ حمـض الفوسـفوريك، ١% سـلفات البوتاسـيوم ، ٢٥و %كلوريـد الكالسيوم ، ٧٥ ppm الحديد ، ٧٥ ppm الزنك ، ٧٥ ppm المنجنيز ،وخليط مـن العناصـر الثلاثة (٧٥ ppm الحديد، ٧٥ ppm الزنك ، ٧٥ ppm المنجنيز)، ٥٠ ppm حمض البوريـك بالإضافة إلى الكنترول على النمو و المحصول والقابلية لتخزين درنات البطاطس.

وتشير النتائج أن القياسات الخضرية طول النبات ،عدد السيقان الرئسية/نبات، محتـوى الكلورفيل ، والوزن الطازج والجاف /نبات عند ٨٠ يوم من الزراعة وكذللك المحصول الكلـى ، عدد الدرنات ووزن الدرنات /نبات عند حصاد المحصول أعطت أعلى قيم مع الرش الورقى بخليط من العناصر الصغرى (الحديد، الزنك و المنجنيز عند ٧٥ ppm) ، ١% سلفات البوتاسيوم فـى موسمى الزراعة.

خزنت جميع المعاملات على درجة حرارة ٨ – ١٠°م ورطوبة جوية نسبية ٨٥% لتقييم التغيرات في صفات الجودة أثناء التخزين ، وأوضحت النتائج أن الرش الورقي بالبوتاسيوم وخليط من العناصر الصغرى (حديد + زنك + منجنيز) والكالسيوم كان لها تأثير على تقليل فقـد الـوزن ونسبة التزريع للدرنات أثناء التخزين ، كما أن المادة الجافة ونسبة النشا كانـت أعلـى للنباتـات المعاملة بخليط العناصر (حديد + زنك + منجنيز) أو المنجنيز – في نفس الوقـت فـإن الكثافـة النوعية للدرنات لم تتأثر بالرش الورقي بالمغذيات.

هناك زيادة معنوية في الفقد في الوزن والتزريع للدرنات بإطالـة الفتـرة التخزينيـة. المحتوى من المادة الجافة والنشا زاد حتى ٣٠ يوم من التخزين ثم قل بعد ذلك. الكثافة النوعية لم تتغير معنويا أثناء التخزين.

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