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Response of Two Potato Cultivars to Organic Fertilization and Potassium Foliar Application

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ABSTRACT

Potato cultivation is quite demanding and adequate fertilization is a key factor for maximizing yield and producing tubers of high quality. So, two variety of potato (Sponta and Lady Rosita) were used to evaluate its response to foliar application of two sources of potassium under organic fertilization during the two successive winter seasons of 2020/2021 and 2021/2022 at privet farm at Nabarouh city, El-Dakahlia Governorate under open field conditions. For this purpose, the experiment was laid out in split-split plot design with three replications having two variety of potato were arranged as main plot, two type of compost (plant and animal) were assigned at random in sub-plot, whereas three sources of potassium foliar application (without, potassium silicate and mono potassium phosphate were allocated in the sub-sub–plots.According to the results, Spunta cultivar showed a significant superiority in all vegetative growth, chemical content, and yield as well as tuber quality. Addition of animal organic fertilization achieved the highest value of mentioned parameters. As for the effect of foliar application, potassium silicate results the highest value with the most parameters except P%, K%, and dry matter % during both seasons as well as specific gravity in the second season, which recorded the highest values with foliar application with mono potassium phosphate. This study demonstrated that utilization of animal organic with foliar application with potassium silicate was effective with Spunta cultivar.

Keywords: Animal, plant organic, potassium sources and potato cultivars

INTRODUCTION

Recently, potato (*Solanum tuberosum* L.) has become a worldwide elementary staple food. The key reason for this process is the high nutritional value of potato as a carbohydrate source, storability, and ease and divergent uses (Witold *et al.* 2017). Potato considered the most important fourth crop in the world after maize, wheat and rice with as a versatile vegetable with an overall production of almost 368 million tons (FAOSTAT, 2018). Potato is an important source of natural food consisting of about water (77%), sugar (0.9%), starch (16.3%), protein (4.4%), fiber (0.59%), crude fat (0.14%), minerals (0.9%) and a considerable source of vitamins B, A and C, and many minerals like magnesium, potassium and iron (Ezekiel *et al.* 2013; Zaheer and Akhtar, 2016). However, potato requires substantial supplement from nutrients to keep up with its productivity and to produce quality tubers. To guarantee the amount and quality of potato tubers, judicious utilization of mineral fertilization appears to be important (Navarre and Pavek, 2014).

Potassium is a fundamental considered as a fundamental nutrient for all plants and majorly affects development and yield as well as the general health and vigor of the crop (Hemeid, 2017). Potassium is needed in enormous quantities for optimum plant growth and productivity, since it is fundamental for finishing of different physiological and metabolic functions in plants.As an osmoticum, K keeps up with cell development and turgor pressure (Anschütz *et al.* 2014). Potassium effectsly affects digestion of nucleic acids, proteins, nutrients and growth substances (Ewais *et al.* 2020), expansion of leaf, elongation of root (Song *et al.* 2018), transport of photo assimilates among source and sink organs and regulation of stomatal guard cells. Additionally, K assumes a key part in photosynthesis by facilitating carbon dioxide diffusion through the leaf mesophyll, (Jákli *et al.* 2017; Tränkner *et al.* 2018)

Feeding of nutrients by foliar application has turned into an established procedure in crop production to increase yield and quality of crop products and it also minimizes pollution of environmental and improves nutrient usage through decreasing the amounts of fertilizers added to the soil (Abou-El-nour, 2002). Also, K foliar applications can improve yield and tuber quality, especially in heavy clay or in sandy soils where K is not readily available for the plants.Different sources of K salts are utilized for plants nutrition such as mono potassium phosphate and potassium silicate ($K_2O.4SiO_2$) which caused very good results to improve the growth and yield of plants under saline conditions (Salim *et al.* 2013).

The excessive utilization of mineral fertilization is likewise unsafe for soil health. The microbial activities are upset, infiltration and productivity are decreased. The utilization of mineral fertilization can increment of tubers yet it negative affects tuber quality, environmental pollution, public health and economic losses; contents of starch and sugar are decreased in tubers (Bhujel *et al.* 2021). Organic fertilizer can improve the physical, chemical and microbial attributes of the soil. Compost must use in agriculture fields for sustainable agriculture. Organic fertilization has helpful impacts including hydraulic conductivity, improves water holding capacity, regulates soil pH, enhances soil

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aggregation and reduces incidence of diseases (Rós *et a*l., 2014 and Khan *et al.* 2017). Combination between inorganic and organic fertilizer showed huge impact especially on yield traits of potato (Suh *et al.*, 2015). Integrated nutrient management is fundamental for sustainable production of potato. Incorporating compost is vital for expanding potato yield and maintaining soil health. It additionally diminishes the production expense, as acquisition of mineral manures are sensibly costly in markets sectors for poor farmers (Bhujel *et al*. 2021).

Our main research goal was to assess combination of the interactions between differentiated fertilization management as organic fertilization and different sources of potassium in foliar way with two variety of potato plants in aspects of its influence on the potato yield production and its quality.

MATERIALS AND METHODS

Two variety of potato (Sponta and Lady Rosita) were used as a test crop to evaluate its response to foliar application of two sources of potassium under organic fertilization during the two successive winter seasons of 2020/2021 and 2021/2022 at privet farm at Nabarouh city, El-Dakahlia Governorate under open field conditions. Selected physical and chemical properties are summarized in Table (1). Mechanical analysis determined according to the methods of Haluschak (2006), while chemical analysis were determined according to Reeuwijk (2002)

Table 1. Some physical and chemical soil properties from 0 to 30 cm from the surface (average of two seasons).

Soil properties	Season 2020 and 2021
Mechanical Analysis:	
Clay (%)	40.22
Silt (%)	31.61
Sand (%)	28.17
Textural class	Clay loam
Chemical analysis:	
pH	8.11
EC at 25° C (dS/m)	1.25
OM %	1.13
Available N (mg/kg soil)	38.46
Available P (mg/kg soil)	7.38
Available K (mg/kg soil)	216.17

The experiment was laid out in split-split plot design with three replications having two variety of potato (Spunta and Lady Rosita) were arranged as main plot, two type of compost (plant and animal) were assigned at random in sub-plot, whereas three sources of potassium foliar application (without, potassium silicate and mono potassium phosphate were allocated in the sub-sub–plots.

Animal and plant compost were brought from commercial farm and applied before ploughing with soil preparing at the rate of 15 m^3/fed. Some chemical and physical properties of organic fertilization in Table (2).

Tuber potato of Spunta and Lady Rosita cv. were planted at the 1st week of October during both seasons, the experimental plot area was 10.5 m^2 contains 5 rows, each row was (3 X 0.7 m), and the distance between plants was 25 cm on one side of row. All plots were fertilized with N fertilizer as ammonium sulphate (21.5%N) at the rate 150 kg N /fed was added in three equal doses, after 4, 6 and 8 weeks from planting. Phosphorus as calcium superphosphate (15%P2O5) at the rate of 75 kg P2O5/ fed was also applied to all plots during the soil preparation. Potassium was added as foliar application in two forms potassium silicate and mono potassium phosphate at 2000 ppm three times after 20, 40 and 60 days from planting.

Table 2. Some physical and chemical properties of organic properties used during the experiments (average of two seasons).

Organic manures properties	Plant compost	Animal compost
pH 1:5	6.63	6.14
EC (1:10)(dSm^{-1})	3.94	3.72
Organic matter (%)	33.12	34.58
Organic carbon (%)	19.18	20.60
Total nitrogen (%)	1.26	1.44
C/N ratio	15.22	14.30
Total Phosphorus (%)	0.45	0.53
Total Potassium (%)	0.68	0.92
Iron	53.87	62.32
Manganese	18.47	26.40
Zinc	18.49	20.66

Vegetative growth parameters were randomly taken from 3 plants in each treatment after 70 days from planting, which included plant length, shoot fresh weight (g), shoot dry weight and total chlorophyll reading. Chlorophyll reading was recorded by Minolta Chlorophyll Meter SPAD – 502. The Samples were oven dried at 70 °C tell constant weight was reached. Then, Chemical constituents of leaves expressed as N was obtained using the Kjeldahl method. P and K were measured using spectrophotometers and flame photometer, respectively as descripted by Rukun (1999)

Yield was harvested after 120 days from sowing. Tubers were collected from each plot the weighted and counted. Total tuber yield (ton/h) was calculated.

Tuber quality as dry matter% and specific gravity were measured according to the method as mentioned by Ewais (2020), total carbohydrates% and total sugar % in fresh tubers according to Sadasivam and Manickam, (1996). Vitamin C mg/100g was determined according to the method described by Mazumdar and Majumder (2003) using titrimetric estimation.

All data from the two seasons were statistically analyzed according to the technique of analysis variance (ANOVA). The differences between data were compared against Least Significant Differences test LSD and Duncan's at 5% and the data were outright using analysis of variance technique of CoSTATE Computer Software.

RESULTS AND DISCUSSION

Vegetative growth parameters:

Vegetative growth parameters i.e. plant height, fresh and dry weight of plant for two cultivars of potato under organic and potassium fertilization are present in Table (3). Data indicated that Spunta cultivar showed a significant superiority in all vegetative growth characteristics comparing with the Lady Rosita cultivar during two seasons, this may be related to the genetic factors or the different response of two cultivars to day length and temperature average of day and night (Zelelew *et al*. 2016; Salem, 2019).

The results in the same Table demonstrated that both sources of organic fertilization significantly affected in vegetative growth parameters. The recorded results indicated that the highest average values were obtained due to the application of animal compost over the plant compost during both seasons. The increase due to the animal compost may be attributed to its role in improving chemical, physical and microbial properties of the soil that increases absorption of water and utilization of nutrients and thus vegetative growth parameters if potato, also, animal compost may give balance micro and macronutrients just as upgraded accessibility of plant nutrients, which would assist with upgrading the metabolic activity of microorganisms and improvement of plant growth. This results are in agreement with the findings of other researchers who observed that animal compost increased growth of potato (Ahmed *et al.* 2019; Alemayehu *et al.* 2020; Abou El-Goud *et al.* 2021).

Data presented in Table (3) indicated the effect of potassium sources on vegetative growth parameters, the results revealed that plant height, fresh and dry weight of plant were significantly increased by the foliar application of different sources of potassium as compared with the untreated plants. Generally, the highest mean values of growth parameters were scored with potassium silicate at the rate of 2000 ppm comparing to mono potassium phosphate and control during the both seasons of the study. The increase in growth due to the potassium sources may be related to the part of potassium on plants nutrition as improving the translocation of absorbs and protein synthesis and advancement of proteins enzymes. In this connection, Sangakkara *et al.* (2000) indicated that increment in the growth of potato plants could be attributed to the job of K in biochemical pathways in plants and it increases the photosynthetic rates, CO2 assimilation and facilitates carbon movements. Moreover, Potassium is a significant element for physiological functions and plant meristematic growth, including protein union, regulation of gas and water trade in plants, compound actuation, starch movement and photosynthesis in plants. Besides, K is additionally fundamental for the translocation of photo assimilates in root growth (Romheld and Kirkby, 2010).

The interaction effect between treatments under investigation in the same Table revealed that Spunta cultivars fertilized with animal compost and foliar application of potassium silicate observed the highest mean values of growth parameters during both seasons.

Table 3. Vegetative growth parameters of two cultivars as affected by organic, potassium fertilization and their interactions during 2020 and 2021.

Treatments			Plant height cm		Fresh weigh g		Dry weight g	
			2020	2021	2020	2021	2020	2021
Potato variety								
Spunta			57.81a	59.88a	251.42a	253.87a	14.39a	14.69a
Lady Rosita			54.60b	56.52b	225.77b	228.01b	13.62b	13.92b
LSD at 5%			0.02	0.16	0.29	3.47	0.04	0.46
Organic fertilization								
Animal compost			56.63a	58.56a	242.18a	244.70a	14.11a	14.42a
Plant compost			55.78b	57.84b	235.02b	237.18b	13.89b	14.18b
LSD at 5%			0.13	0.13	0.65	2.06	0.04	0.12
Potassium fertilization								
Control			55.14c	57.20c	230.13c	232.80b	13.73c	14.04b
K silicate			56.99a	58.94a	245.05a	246.60a	14.21a	14.49a
Mono K phosphate			56.48b	58.45b	240.61b	243.42a	14.06b	14.38a
LSD at 5%			0.21	0.24	0.93	3.88	0.06	0.18
Interaction								
Spunta	Animal compost	Control	56.98e	59.04c	244.83e	248.24cd	14.21d	14.48cd
		K silicate	59.08a	61.14a	262.12a	266.06a	14.68a	15.11a
		Mono K phosphate	58.57b	60.40b	257.62b	260.06ab	14.56b	14.92ab
	Plant compost	Control	56.51f	58.74c	241.11f	244.14de	14.06e	14.39cde
		K silicate	58.13c	59.97b	253.78c	252.08c	14.49b	14.63bc
		Mono K phosphate	57.56d	59.98b	249.08d	252.66bc	14.33c	14.62bc
Lady Rosita	Animal compost	Control	53.81k	55.76g	219.62k	220.69ij	13.41i	13.74gh
		K silicate	55.88g	57.84d	236.86g	238.80ef	13.97e	14.16def
		Mono K phosphate	55.45h	57.17e	232.03h	234.37fg	13.83f	14.12def
	Plant compost	Control	53.27l	55.25h	214.98l	218.13j	13.25j	13.57h
		K silicate	54.88i	56.81e	227.43i	229.47gh	13.69g	14.04efg
		Mono K phosphate	54.33j	56.26f	223.73j	226.58hi	13.54h	13.86fgh
LSD at 5%			0.42	0.47	1.86	7.76	0.11	0.36

Leaf chemical content:

Data in Table (4) showed the effect of organic fertilization and potassium sources on chemical content of leaves of two cultivars of potato plant during 2020 and 2021. It is clear an increased trend for N, P, K and chlorophyll content in Spunta cultivars over Lady Rosita cultivars in two successful seasons. These results may be correlated with the gene action of the studied cultivars (Zelelew *et al*., 2016; Salem, 2019).

On the other hand, in case of the effect of organic fertilization on leaves chemical content of N, P, K and chlorophyll in Table (4). It was found that addition of animal compost increased significantly the nutation values in comparing with plant compost. The consistent release of the nutrients from animal compost may have resulted that, they have been taken up mainly for the most part of available forms which probably caused accumulations of nutrients in the plants tissues (Abou El Goud, 2020 and Djaman *et al.* 2021).

Data in Table (4) indicated the effect of potassium sources on nutrition values of potato leaves during both seasons of the experiments. Foliar application of different sources of potassium gave the highest values for leaf biochemical content comparing to the control treatment in the two seasons. Foliar application of potassium silicate recorded the highest mean values of N% and chlorophyll content during both seasons as mentioned by (Barker and Pilbeam, 2007) observed that K^+ is necessary for stimulating the ATPase plasmalemma that produces the necessary conditions for the metabolites, such as amino acids and sucrose. utilization of potassium silicate affect the absorption and translocation of a lot of macronutrients (Das *et al.* 2017), may positively influence the osmotic adjustment, antioxidant enzyme (CAT and/or SOD) activities, and decreased H_2O_2 concentration in leaves as well as photosynthetic apparatus maintenance (Pilon *et al.* 2014). Potassium is one of the most important nutrient needed for plant growth. It plays fundamental part in many physiological processes such as translocation of photosynthesis, photosynthesis, regulation of plant stomata and transpiration, control of ionic balance, activation of plant enzymes and several other processes (Thompson, 2010). While content of phosphorus and potassium content in the both seasons were higher with mono potassium phosphate, this result agreement with this obtained by (Salim *et al.* 2014) resulted that K and P concentration were increased due to the foliar application of mono potassium phosphate. Mon potassium Phosphate is a cost effective and promptly accessible fertilizer. Among the phosphate and potassium fertilizers utilized in foliar applications, Mon potassium Phosphate is the formulation with the least salt index and in this way the foliar fertilizer of choice for many crops (Ewais *et al.* 2020). Foliar feeding with different nutrients promotes root absorption of the same elements or nutrients through the spray by improving root growth and movement of nutrients from leaves to roots and vice versa (El-Fouly and El-Sayed, 1997).

The interactions between organic fertilization, foliar application of potassium treatments and cultivars have significant effect on N, P, K and chlorophyll content of potato leaves. The highest mean values recorded with Spunta cultivars with animal organic and foliar application with potassium silicate in N% and chlorophyll content during both seasons. While, the concentration of phosphorus and K% in two seasons were scored with the same treatment but foliar application with mono potassium phosphate.

Table 4. Leaf biochemical content of two cultivars as affected by organic, potassium fertilization and their interactions during 2020 and 2021.

Treatments			N%		P%		K%		Chlorophyll SPAD	
			2020	2021	2020	2021	2020	2021	2020	2021
Potato variety										
Spunta			3.57a	3.64a	0.407a	0.414a	3.22a	3.26a	42.75a	43.67a
Lady Rosita			3.23b	3.29b	0.364b	0.370b	2.98b	3.02b	41.83b	42.38b
LSD at 5%			0.01	0.01	0.003	0.004	0.01	0.01	0.20	0.14
Organic fertilization										
Animal compost			3.44a	3.51a	0.391a	0.398a	3.13a	3.16a	42.42a	43.31a
Plant compost			3.35b	3.42b	0.380b	0.386b	3.07b	3.11b	42.16b	42.74b
LSD at 5%			0.03	0.01	0.003	0.003	0.01	0.01	0.02	0.01
Potassium fertilization										
Control			3.27c	3.34c	0.372c	0.377c	3.02c	3.06c	41.99c	42.74c
K silicate			3.50a	3.57a	0.387b	0.395b	3.11b	3.15b	42.53a	43.32a
Mono K phosphate			3.42b	3.49b	0.396a	0.404a	3.17a	3.20a	42.35b	43.01b
LSD at 5%			0.04	0.45	0.006	0.005	0.04	0.04	0.11	0.10
Interaction										
Spunta	Animal compost	Control	3.47d	3.54d	0.395de	0.403cd	3.16cde	3.20cd	42.55cd	43.73c
		K silicate	3.71a	3.79a	0.417ab	0.425ab	3.28ab	3.33ab	43.13a	44.36a
		Mono K phosphate	3.65ab	3.73ab	0.425a	0.434a	3.32a	3.35a	42.97ab	43.95b
	Plant compost	Control	3.45de	3.52de	0.390ef	0.393de	3.14de	3.18cd	42.35de	43.12de
		K silicate	3.60bc	3.67bc	0.401cd	0.409c	3.20bcd	3.23c	42.86b	43.56c
		Mono K phosphate	3.53cd	3.60cd	0.411bc	0.421b	3.23bc	3.26bc	42.65c	43.28d
Lady Rosita	Animal compost	Control	3.17h	3.24h	0.356hi	0.363h	2.92hi	2.94g	41.63ij	42.29g
		K silicate	3.38ef	3.44ef	0.369g	0.376fg	3.02fg	3.04ef	42.21ef	43.01e
		Mono K phosphate	3.27g	3.33gh	0.381f	0.385ef	3.09ef	3.12de	42.02fg	42.54f
	Plant compost	Control	2.99i	3.04i	0.347i	0.350i	2.87i	2.92g	41.44j	41.83h
		K silicate	3.32fg	3.39fg	0.363gh	0.371gh	2.96gh	2.99fg	41.92gh	42.35fg
		Mono K phosphate	3.23gh	3.32gh	0.367gh	0.374gh	3.05f	3.09e	41.74hi	42.27g
LSD at 5%			0.09	0.09	0.011	0.010	0.08	0.08	0.21	0.20

Yield and its components:

Yield and its components as average fruit weight, number of fruit and total yield of each cultivars in relation to the organic fertilization and foliar application of potassium are presented in Table (5) during 2020/2021 and 2021/2022. There were statistically significant differences between the two cultivars for all traits except number of fruit had no significant effect. Spunta cultivar gives the higher values of average fruit weight and total yield than Lady Rosita cultivar and the differed among two cultivars depended on the time, place and length of stems formation on plant. These results are in harmony with previous findings of Vaezzadeh and Naderidarbaghshahi (2012) and Salem, (2019) they observed yield components of potato cultivars differences are mainly attributed to the genotype of each cultivar.

It is clear from data in Table (5) that the yield and its components gradually significantly affected by the addition of organic fertilization as animal and plant compost during both seasons. In this respect, addition of animal compost significantly recorded the higher values of average fruit weight and total yield than the plant compost, while number of fruit recorded no significant effect. These results are in concurrence with (Abou El Goud, 2020; Djaman *et al*., 2021) they observed that the organic fertilizers are valuable for plants because of their beneficial impact on the chemical, physical, and microbial traits of the soil, also they found that animal compost produced in root zone high amount of IAA which in turns, reciprocally growth and increase plant production. Besides that, they focused on the organic agricultural production in Egypt in order to avoid plant and environmental pollution with various elements and to diminish the utilization of chemical fertilizers (Shaheen *et al*. 2018; Djaman *et al.* 2021).

Table 5. Yield and its components of two cultivars as affected by organic, potassium fertilization and their interactions during 2020 and 2021.

Treatments			Average fruit weight g		Number of fruit/plant		Total yield ton/h	
			2020	2021	2020	2021	2020	2021
Potato variety								
Spunta			158.56a	161.00a	5.06a	5.33a	42.15a	45.15a
Lady Rosita			155.09b	157.62b	4.22a	4.50a	34.42b	37.29b
LSD at 5%			0.04	0.16	n.s	n.s	0.14	0.20
Organic fertilization								
Animal compost			157.20a	159.67a	4.72a	5.06a	39.07a	42.48a
Plant compost			156.46b	158.95b	4.56a	4.78a	37.50b	39.96b
LSD at 5%			0.37	0.46	n.s	n.s	0.26	0.23
Potassium fertilization								
Control			155.65c	157.99c	4.33a	4.58a	35.47c	38.09c
K silicate			157.80a	160.56a	4.92a	5.17a	40.81b	43.63b
Mono K phosphate			157.04b	159.38b	4.67a	5.00a	38.57a	41.94a
LSD at 5%			0.58	0.56	n.s	n.s	0.19	0.27
Interaction								
Spunta	Animal compost	Control	157.64cd	159.85de	4.67a	5.00a	38.66c	42.01c
		K silicate	159.98a	162.71a	5.33a	5.67a	44.85a	48.46a
		Mono K phosphate	159.48ab	162.07ab	5.33a	5.67a	44.70a	48.26a
	Plant compost	Control	157.10d	159.23e	4.67a	5.00a	38.53c	41.87c
		K silicate	158.84ab	161.49bc	5.33a	5.33a	44.51a	45.26b
		Mono K phosphate	158.35bc	160.67cd	5.00a	5.33a	41.60b	45.04b
Lady Rosita	Animal compost	Control	154.16g	156.64fg	4.00a	4.33a	32.39e	35.66e
		K silicate	156.48de	159.14e	4.67a	5.00a	38.39c	41.83c
		Mono K phosphate	155.46ef	157.62f	4.33a	4.67a	35.40d	38.65d
	Plant compost	Control	153.70g	156.25g	4.00a	4.00a	32.30e	32.83f
		K silicate	155.89ef	158.90e	4.33a	4.67a	35.49d	38.97d
		Mono K phosphate	154.86fg	157.16fg	4.00a	4.33a	32.56e	35.80e
LSD at 5%			1.16	1.14	n.s	n.s	0.38	0.55

As presented in Table (5), in the most cases of the foliar applications exhibited high significant increases of yield components included average fruit weight and total yield, while number of fruit had no significant effect in the two tested seasons compared to control treatment. Foliar application of potassium silicate at the rate of 2000 ppm gave the highest values of mentioned traits in the two seasons. The increase in growth parameters and significant yield of potato plants as response to various sources of K was reported previously. Potato production requires large amounts of potassium, which has prompted the idea that high doses of the element are required for potato production (Salim *et al*., 2014). Potassium is a monovalent cation and its capture is profoundly particular; is coupled with metabolic activity. It is characterized by high versatility in plants at all levels; is the most plentiful cation in the cytoplasm and along with its accompanying anions makes a high commitment to the osmotic capability of cells and tissues. Moreover, this component plays a significant part in water relations of the plant, besides K isn't metabolized and forms easily interchangeable weak complexes (Marschner, 2012).

The combined effect of organic manures, foliar application of potassium sources and potato cultivars were found to be significant in case of average fruit weight and total yield in two seasons. But number of fruit had no significant effect. The maximum values were recorded with the animal manure and foliar application with potassium silicate in Spunta cultivar.

Tuber quality:

Data presented in Table (6) showed the effect of organic fertilization and foliar application of potassium on tuber quality as (dry matter, specific gravity, total carbohydrates, vitamin C and total sugar) of two cultivars during both seasons of the experiments.

Spunta cultivar gave the highest mean values in most tuber quality over the Lady Rosita cultivar. This results in the differences between two cultivars in some parameters of tuber quality may be related to genetic factors as mentioned by Vaezzadeh and Naderidarbaghshahi (2012) and Zelelew *et al*. (2016).

As for the effect of organic fertilization, data in the same Table revealed that both forms of organic fertilization significantly affected on tuber quality during both seasons. On the other hand, animal compost recorded the highest mean values of tuber quality in the two seasons

Regarding the effect of potassium fertilization on tuber quality, the obtained results in Table (6) revealed that dry matter and specific gravity recorded the highest significant mean values with foliar application of mono potassium phosphate, with no significant effect for specific gravity in the 1st season. Specific gravity is the main widely accepted trait of potato quality, which is an expression of density and related to the dry matter contents was positively affected by K fertilization, also potato variety may be responsible for specific gravity and dry matter of potato (Ewais *et al.* 2020). Nonetheless, potatoes with extremely high specific gravity may not be reasonable for French fries production since they become hard or biscuit like. So motivation of growing potato should be kept in mind. Dry matter content changes impressively among varieties and is a firmly inherited characteristic. Independent of cultural conditions that can influence dry matter certain varieties are reliably high in dry matter, while others are reliably low. The dry matter was higher in potato treated with foliar application of potassium sources than those of untreated one. A huge increase in tuber observed with foliar application of mono potassium phosphate. Potassium is considered as major osmotically active cation of plant cell where it improves uptake of water and permeability of root and acts as guard cell controller, also its part in increasing use efficiency of water (Thompson, (2010). Additionally, the vital significance of potassium in formation of quality is related to its part in promoting synthesis of photosynthates in potato leaves and their transport to the tubers and to enhance their change into vitamins, protein and starch, hence overall tuber bulking and tuber composition depend on K nutrition (Bansal and Trehan 2011). Also, data showed a significant increase due to foliar application with potassium silicate for total carbohydrate, vitamin C and total sugar, this may be due to that potassium activates number of enzymes involved in carbohydrate metabolism, proteins synthesis especially the production of proteins and sugars as well as photosynthesis and assists in the translocation of carbohydrates from leaves to tubers and its accumulation in storage tubers as mentioned by (Ewais *et al.* 2020) recorded that Sugar contents of potato tubers were also affected with potassium sources application sugar content was relatively higher in tubers treated with potassium sources as compared to control treatment.

Table 6. Tuber quality of two cultivars as affected by organic, potassium fertilization and their interactions during 2020 and 2021.

Treatments			Dry matter %		Specific gravity %		Total carbohydrates %		Vitamin C $mg.100g^{-1}$		Total sugars %	
			2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Potato variety												
Spunta			21.54a	22.30a	1.070a	1.078a	27.57	28.16a	22.81a	23.29a	5.52a	5.62a
Lady Rosita			20.06b	20.77b	1.051b	1.058b	26.22	26.61b	21.24b	21.46b	5.15b	5.23b
LSD at 5%			0.07	0.25	0.010	0.004	0.17	0.21	0.10	0.01	0.01	0.01
Organic fertilization												
Animal compost			20.96a	21.67a	1.063a	1.070a	27.04a	27.59a	22.23a	22.61a	5.39a	5.49a
Plant compost			20.64b	21.40b	1.058a	1.067b	26.75b	27.19b	21.82b	22.15b	5.28b	5.36b
LSD at 5%			0.05	0.13	n.s	0.002	0.02	0.21	0.10	0.07	0.02	0.01
Potassium fertilization												
Control			20.29c	21.04c	1.053a	1.062c	26.44c	26.93c	21.58c	21.96c	5.22c	5.30b
K silicate			20.87b	21.57b	1.061a	1.068b	27.30a	27.82a	22.41a	22.74a	5.42a	5.52a
Mono K phosphate			21.25a	22.00a	1.068a	1.074a	26.94b	27.42b	22.07b	22.43b	5.36b	5.45a
LSD at 5%			0.08	0.26	n.s	0.004	0.11	0.38	0.11	0.09	0.02	0.07
Interaction												
Spunta	Animal compost	Control	21.14e	21.87c	1.064abc	1.069de	27.24cd	27.82bcd	22.40cd	22.96d	5.43d	5.52cde
		K silicate	21.92b	22.67a	1.076ab	1.079bc	28.12a	28.80a	23.45a	23.97a	5.66a	5.81a
		Mono K phosphate	22.17a	22.86a	1.081a	1.090a	27.88b	28.52ab	23.19b	23.72b	5.60b	5.73ab
	Plant compost	Control	20.92f	21.73cd	1.061abc	1.071cd	27.05d	27.62cd	22.23d	22.76e	5.36e	5.45de
		K silicate	21.41d	22.09bc	1.066abc	1.075cd	27.71b	28.29abc	23.00b	23.32c	5.56b	5.65bc
		Mono K phosphate	21.69c	22.59ab	1.074ab	1.084ab	27.43c	27.93bcd	22.57c	23.01d	5.49c	5.57cd
Lady Rosita	Animal compost	Control	19.69k	20.41fg	1.046bc	1.057fg	25.86i	26.28fg	20.99g	21.09i	5.11i	5.21g
		K silicate	20.19i	20.87ef	1.053abc	1.062ef	26.82e	27.30de	21.98e	22.22f	5.31f	5.40ef
		Mono K phosphate	20.67g	21.33de	1.059abc	1.062ef	26.33g	26.80ef	21.37f	21.67g	5.21g	5.28fg
	Plant compost	Control	19.41l	20.13g	1.041c	1.052g	25.63j	26.00g	20.70h	21.01i	4.98j	5.03h
		K silicate	19.96j	20.65fg	1.049bc	1.056fg	26.55f	26.86ef	21.22f	21.45h	5.17gh	5.22g
		Mono K phosphate	20.46h	21.20e	1.056abc	1.061f	26.10h	26.44g	21.16fg	21.31h	5.15hi	5.22g
LSD at 5%			0.16	0.52	n.s	0.008	0.21	0.76	0.21	0.17	0.04	0.15

The interaction between organic fertilization and foliar application of potassium sources on two cultivars increased tuber quality in the two seasons (Table 6). The Spunta cultivar recorded the most great tuber quality when fertilized with animal organic fertilizer and sprayed with mono potassium phosphate especially with specific gravity and dry matter, while foliar application with potassium silicate with the same cultivar and animal organic recorded the highest values of carbohydrate, vitamin C and total sugar during both seasons of the experiments.

CONCLUSION

Based on the results of the present study, it can be concluded that the form of the fertilizers applied and the variety can significantly affect the yield and the tuber quality of potato crop. Addition of both organic fertilization affected in potato yield but animal organic fertilization was the most suitable. Foliar application enhance all parameters but potassium silicate gave the highest value in most parameters. Finally, it can be concluded that foliar application with potassium silicate under animal organic fertilization was the most effective treatment on the most parameters especially with the Spunta cultivars.

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استجابة صنفين من البطاطس للتسميد العضوي والرش الورقي بالبوتاسيوم

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تتطلب زراعة البطاطس الكثير من المتطلبات اذ أن التسميد المناسب هو عامل رئيسي لزيادة المحصول وإنتاجية درنات عالية الجودة. لذلك تم دراسة صنفين من البطاطس (Sponta and Lady Rosita) لتقييم الاستجابة للرش الورقي لمصدرين من البوتاسيوم تحت التسميد العضوي خلال موسمي شتاء متتاليين ٢٠٢٠ و٢٠٢١ في مزرعة خاصة في مدينة نبروه، محافظة الدقهلية تحت ظروف الحقل المفتوح. لهذا الغرض، تم تنفيذ التجربة في تصميم القطع المنشقة مع ثلاثة مكررات فمثل صنفي البطاطس القطع الرئيسية، بينما السماد العضوي (نباتي وحيواني) مثل القطع المنشقة الاولي. كذلك كانت معاملات الرش الورقي للبوتاسيوم (بكنترول, سيليكات البوتاسيوم وفوسفات البوتاسيوم أحادي البوتاسيوم) في القطع المنشقة الثانية . ووفقًا للنتائج، أظهرت صنف Spunta تفوقًا معنويًا في كل من النمو الخضري والمحتوى الكيميائي والمحصول. بالإضافة إلى جودة الدرنات. حققت إضافة التسميد العضوي (الكومبوست الحيواني) أعلى قيمة للصفات المذكورة. أما بالنسبة لتأثير الرش الورقي، فإن ن سيليكات البوتاسيوم حققت أعلى القيم مع معظم الصفات باستثناء تركيز الفسفور والبوتاسيوم، ونسبة المادة الجافة خلال كلا الموسمين. بالإضافة إلى الكثافة النوعية للدرنات في الموسم الثاني والذي سجل أعلى القيم مع الرش الورقي بفوسفات البوتاسيوم الأحادي، وقد أوضحت هذه الدراسة أن استخدام الكومبوست الحيواني مع الرش الورقي لسلكات البوتاسيوم كان فعالاً مع الصنف.Spunta