Plant Archives Volume 20 No. 2, 2020pp. 9291-9300 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

APPLICATION OF BANANA COMPOST AS A SOURCE OF POTASSIUM IN COMBINATION WITH FOLIAR SPRAYING WITH POTASSIUM HUMATE ON GROWTH AND PRODUCTIVITY OF RED BEET *(BETA VULGARIS L.)*

Yassen, [1] A. A., Abou El-Nour[2] E. A. A., Abou Seeda,[1] M. A and Sahar M. Zaghloul[1]

1Plant Nutrition Department, National Research Centre. 33 El- Bohouth St. P.C. 12622. Dokki, Cairo, Egypt

2Fertilization Technology Department, National Research Centre. 33 El- Bohouth St. P.C. 12622. Dokki, Cairo, Egypt

Abstract

Red beet (*Beta vulgaris L.*), is consider as an important vegetable crop grown all over the world, it's a good source of minerals, carbohydrates, fiber, protein, and vitamin B1. Field experiment was carried out during successive season of 2018/2019 at the Experimental Station of the National Research Centre, Beheira Governorate, Egypt. The Study was targeted to determine the effect of organic fertilizer prepared from banana wastes, using as a source of potassium (6.92% K) in combination with potassium humate foliar spraying on growth and productivity of red beet (Beta vulgaris L). Experimental treatments were, BC2 + water foliar spray, BC1 + 2g /L K H foliar spray,BC2 + 2g /L K H foliar spray, BC1 + 4g /L K H foliar spray.BC1 + 4g /L K H foliar spray. Results noticed that foliar feeding of potassium humate had significant positive effects on plant height; root length; root fresh and dry. Foliar application with 2g potassium humate (KH) gave the highest increments for the aforementioned parameters as compared with control treatment (water foliar spray).It is also clear that no significant difference was deducted between foliar spray of 2 g.and 4g KH/L. foliar application was more pronounced effect as compared to soil treated with Banana organic compost. The interaction effects between BC and KH were statistically insignificant for root P, K, Ca and Mg concentrations, root N concentration showed significant interaction, where, BC2 in combination with foliar spray with 2gKH/L showed the highest N concentration, while the lowest value was recorded BC1 and water foliar spray treatment. It is also noticed that significant interaction effect was recorded for root P, K and Ca uptake, where, BC2 with 2gKH/L showed the highest uptake values. However, the lowest values were recorded on the combination between BC1 and Control (water foliar spray).

Keywords: Red beet, foliar spray- potassium humate- growth parameters- nutritional status.

Introduction

Red beet (Beta vulgaris L.), is consider as an important vegetable crop grown all over the world. Beta vulgaris L is in the fourth position in terms of production and consumption, after cabbage, carrot, and onion crops Deuter, and Grundy, (2004). Red beet (Beta vulgaris L) is consider as a good source of minerals, carbohydrates, fiber, protein, and vitamin B1 Rey et al., (2005); Bavec et al., (2010), Sediyama, et al., (2011), and Lacerda, (2014). Currently, juice of Beta vulgaris L is recommended as a stimulant for the immune system, as well as cancer preventative and consequences of radiation exposure. Red beet (Beta vulgaris L.), has also been considered materials beneficial for blood, heart and the digestive system. Beet root contained high iron, concentration and can be useful during pregnancy and menstruation Nottingham, (2004); Szura, et al., (2008); Zujko and Witkowska, (2009) Morgado, et al., (2016); Hamedi, and Honarvar, (2018) and Babarykin, et al., (2019), which can be stimulate, the liver's and help to detoxification processes Vali, et al., (2007). Several researchers Cai, et al.,(2003); Dias, et al., (2009) Carrillo et al., (2017), reported that red beet is the main source of pigment betacyanins, which comprise to the group of natural plant antioxidants. These pigments (betacyanins) are used in food industry as natural dyes for food production, Szalaty, (2008) and Chhikara, et al.,(2018).

Potassium is an essential element for all living organisms. In agricultural practice, the nutritional requirements especially potassium needs to be applied in sufficient amount to produce healthy and productive crop. It affects the quality of the root yield or tubers Zörb et al., (2014); Berisha et al., (2014) and Bernardes Cecílio Filho et al., 2017).

The produced sugars during photosynthesis process must be transported through the phloem to other parts of the plant for utilization and storage. Plant's transport system always needs energy in the form of ATP. If K is inadequate, less ATP is available, and the transport system breaks down. Potassium plays a foremost role in translocation of carbohydrates, photosynthesis, water relations, resistance against insects and diseases Amtmann, et al., (2008) and sustain balance between monovalent and divalent cationsPettigrew, et al., (2008); Lester, et al., (2010); Min Wang, et al., (2013); Oosterhuis, et al., (2014) and Zahoor,et al., (2017). However, in recent years, fertilizer consumption increased exponentially throughout the world, causes serious environmental problems. Fertilization may affect the accumulation of heavy metals in soil and plant system. Plants absorb the fertilizers through the soil; they can enter the food chain. Thus, fertilization leads to water, soil and air pollution. Alternative ways have been sought to meet these needs. Better management of all essential nutrients is required that delivers sustainable agriculture and maintains the necessary increases in food production while minimizing waste, economic loss and environmental impacts. More extensive production systems typified by 'organic farming' may prove to be sustainable. However, for most of the developed world, and in the developing world where an ever-growing population demands more food, it will be essential to increase the efficiency of nutrient use in conventional systems. Nutrient management on farms is under the control of the land manger, the most effective of whom will already use various decision supports for calculating rates of application to achieve various production targets. Increasingly, land managers will need to conform to good practice to achieve production targets and to conform to environmental targets as well. Organic agriculture is an integrated farming system, based on ecological principles, in which product quality is more important than its quantity. Organic agriculture system can be considered as an alternative to conventional systems and lead to the development of sustainable agriculture and environmental health Anjaiah, and Padmaja, (2006) and Ihsanullah Daur and Bakhashwain (2013).Humic acid is one of the most important organic fertilizers, which can positively affect plants growth and furthermore increase nitrogen, potassium, calcium, magnesium, and phosphorus absorption by the plant Sabzevari et al., (2009) and Eyheraguibel, et al., (2008). Foliar nutrition are rapidly absorbed by plants and are commonly used as nutritional supplements for plants and as alternative nutrition in conditions where plants have a high nutrient requirement or in cases of soil fertility deficiency Fernandez and Eichert (2009) and Petrov, 2014). Potassium humate is an organic potash fertilizer combined with humic acid can be also used as an inexpensive source for potassium. Felipe, et al., (2015) stated that foliarK-fertilization did not affect the characteristics of production; moreover, it tends to increase potassium content in both shoots and roots, besides increasing total sugar content. Potassium humate gradually increases photosynthesis, chlorophyll density. Hassanpanah, (2009); Amjad, et al., (2010); Patil, et al., (2011); Prakash, et al., (2011) and (2012) and Tripura, et al., (2017).

Material and Method

A field experiment was carried out during successive season of 2018/2019 at the Experimental Station of the National Research Centre, Behrira Governorate, Egypt. The Study was targeted to determine the effect of organic fertilizer prepared from banana wastes which used as a source of potassium (6.92% K) in combination with potassium humate foliar feeding on red beet (Beta vulgaris L) growth and productivity. Soil sample was taken from the soil surface (0-30 cm) of the experimental site, air-dried, sieved by 2 mm sieve and analyzed, some physical and chemical properties of soil and banana residues were determined according to Klute (1986) and Page et al., (1982) and presented in (tables1&2). The experimental design was split plot design with three replicates. Banana compost applications were allocated in the main plots and potassium humate (KH) foliar feeding treatments were allocated in the sub-plots.

Table 1: Some physical and chemical properties of the investigated soil.

Soil property	Value	Soil property	Value
Particle size distribution %		pH (1:2.5 soil suspension)	7.70
Sand	93.65	EC dS. m^{-1} (soil paste)	1.60
Silt	4.07	Soluble ion and cation (Mmol. L^{-1})	
Clay	2.28	Ca^{++}	8.02
Texture	Sandy	Mg^{++}	3.23
$CaCO_3$ %	2.60	Na^{+}	3.92
Saturation percent %	22.50	K^{+}	0.91
Organic matter%	0.10	CO_3^{--}	ND.
Available N (mg. kg^{-1})	22.8	HCO_3^{-}	2.20
Available P (mg. kg^{-1})	2.81	Cl^{-}	3.98
		SO_4^{--}	9.90
Available K (mg. kg^{-1})	56.6	CEC (Cmol. kg^{-1})	7.00

Table 2: Chemical analysis of Banana residues used in this study.

Content	pH (1:20)	EC dSm^{-1} (1:20)	OM %	O.C %	N %	P %	K %
Banana compost	8.72	3.38	76.16	44.18	1.55	0.59	6.92

Seeds of Red beet (Beta vulgaris L.) cv El- Masry were obtained from the Department of vegetable Crops, Agricultural Research Center, Ministry of Agriculture, Egypt. The size of each plot was 1/400 feddan (10.5 m2), 3.5 m long and 3.0 m wide. Three seeds were planted in each hole, at a depth of 2.5 cm with a distance of 30 cm between holes. Red beet seeds were sown on 18 September at rate 5 kg/fed. Plants were thinned after the first true leaf appeared. Nitrogen and phosphorus fertilizers were applied according to Ministry of Agriculture (MOA) recommendation. The applied Banana compost (BC) was mixed to the soil surface (0-20 cm). The experiment include six treatment as follows:

Two banana compost application: (BC1) 433 kg K/fed. in addition (BC2) 866 kg K/fed. Which equivalent to 30 kg K/fed. in addition,60 kg K/fed. respectively.

Three-potassium humate (11% K2O) as foliar feeding treatment. Potassium humate spray was applied twice .The first was after thinning, the second after 2 weeks.from the first one

Experimental treatments were as follows BC1 + water foliar spray

BC2 + water foliar spray

BC1 + 2g /L K H foliar spray

BC2 + 2g /L K H foliar spray

BC1 + 4g /L K H foliar spray

BC1 + 4g /L K H foliar spray

Data recorded:

Plant height (cm), root length (cm), root diameter (cm), root fresh matter/ plant, root dry matter/plant, leaves fresh matter/plant, leaves dry matter/plant, number of leaves/ plant, yield/ plot (kg) and yield ton/ fed.

Chemical constituents:

Prior to digestion the samples were dried in order to, remove possible moisture gained before the analysis.

-Total N, P and K, Ca and Mg in roots and leaves as well as some micronutrients (Fe, Zn, Mn), were determined using atomic absorption spectrophotometer, according to the method described by Cottenie et al. (1982).

-Total soluble solids (TSS %) in roots was measured in juice of fresh roots by using Hand refractometer and Juice purity percentage (%) was determined as a ratio between sucrose (%) and TSS (%) of roots A.O.A.C., (1995).

-Vitamin C was determined in root of red beet according to the method described by A.O.A.C, (2000).

- Betalain content was determined and quantified using the method described by Cardoso-Ugarte et al. (2014).

Statistical analysis:

The means of data recorded in the two successive seasons were subjected to the analysis of variance according to Snedecor and Cochran, (1980). The least significant differences (LSD) at P=0.05 level was used to verify the differences between among of the treatments.

Results and Discussion

Data presented in Table 3 A revealed that the high level of banana compost (BC2) significantly increased all studied parameters with an exception in case of root diameter, where the increment did not reach to the level of significance. The increment recorded in plant height; root length; root fresh and dry weights amounted by 18.4; 26.8; 28.5 and 47.2% over those received BC1. The obtained results are in harmony with the results of Ismail and Allam (2007), Nafei et al., (2010); Abou El-Nasr and Ibrahim (2011); Saud, et al (2013),they reported that application of high rate of potassium significantly affected root length root diameter, root fresh weight, root yield fresh weight / plant. Data also showed that foliar feeding of potassium humate had significant positive effects on plant height; root length; root fresh and dry matter.

Foliar application of 2g potassium humate (KH) gave the highest increments for the aforementioned parameters as compared with control treatment (water foliar spray). It is also clear that no significant difference was deducted between foliar spray of 2 g and 4g KH/L.Foliar application was more pronounced effect as compared to soil treated with Banana organic compost.These observations may be due to the effectiveness of foliar application with potassium humate comparing to soil application. Such effectiveness of foliar spraying due to faster enhancement that developed plant growth through physiological processes such as the synthesis of simple sugars, starch and the translocation of carbohydrates, as well as protein synthesis and antioxidant enzymes, similar results were observed by Chen et al., (2004); Salami and Sadat (2013) and Zahoor, et al., (2017).

Concerning the interaction between the two studied factors (BC and KH), data revealed significant positive effects for all studied parameters with an exception for root diameter. Banana compost (BC2) in combination with 2g KH/L foliar spray showed the highest increments for the studied parameters. However, the lowest values recorded because of combination between BC1 and control(spraying water).Aly, et al., (2014), they found that application of potassium in either soil or foliar treatment was significantly increased both diameter and fresh weight/plant. Positive significantly effects and benefits of applying k-humate as a new fertilizer used may attribute to its content in vitamins, hormones, enzymes. These results agreed with the findings of Hassanpanah, et al., 2007 and Asadi, 2010), they found that application of potassium humate in potato field experiment gradually increased the root system, tuber yield, tuber number per plant.

Table 3. Effect of different rates of banana compost in combination with foliar application ofpotassium humate on of growth parameter and yield of red beet

(A)

Treatments	**Plant height (cm)**			**Root length**			**Root diameter (cm)**			**Root Fresh weight (g)**			**Root dry weight (g)**		
	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean
0 KH /L	51.80	58.66	55.23	11.06	14.11	12.59	4.87	5.86	5.37	58.12	77.15	67.30	10.35	14.84	12.60
2g KH /L	52.90	70.23	61.57	12.36	17.45	14.91	5.23	6.44	5.84	64.64	95.45	80.05	11.00	18.46	14.73
4g KH /L	56.74	62.22	59.48	13.71	15.55	14.63	5.10	5.72	5.41	76.69	83.79	80.24	12.06	15.91	13.99
Mean	53.81	63.70		12.38	15.70		5.07	6.01		66.48	85.46		11.14	16.40	
LSD 5%															
BC			1.59			1.85			N.S.			2.11			3.83
KH			2.80			1.51			N.S.			3.18			1.08
BC x KH			3.96			N.S.			N.S.			4.49			1.53

(B)

Treatments	**Leaves fresh weight(g)**			**Leaves dry weight (g)**			**Leaves No. /plant**			**Yield/plot (kg)**			**Yield/fed. (ton)**		
	BC1	**BC2**	**Mean**	**BC1**	**BC2**	**Mean**	**BC1**	**BC2**	**Mean**	**BC1**	**BC2**	**Mean**	**BC1**	**BC2**	**Mean**
0 KH /L	48.88	54.69	51.79	5.96	6.00	5.98	8	11	9.5	40.48	45.00	42.74	10.10	12.61	11.36
2g KH /L	55.31	64.30	59.80	6.40	8.23	7.32	10	14	12.0	44.32	47.63	45.98	11.70	13.89	12.80
4g KH /L	52.58	58.20	55.39	6.11	7.09	6.60	11	12	11.5	45.60	50.40	48.00	12.51	15.00	13.76
Mean	52.25	59.06		6.16	7.11		9.7	12.3		43.47	47.68		11.44	13.83	
LSD 5%															
BC			1.47			N.S.			1.6			2.99			N.S.
KH			2.50			1.00			N.S.			3.18			1.26
BC x KH			N.S.			N.S.			N.S.			N.S.			N.S.

KH: potassium humate BC : Banana compostBC1 = 30 kg K/fed BC2 = 60kg K/fed

.

Data presented in Table (3 B) showed that, parameters of leaves fresh weight; leaves No/plant and root yield/pot were significantly increased by applying BC2 as compared with BC1application. These parameters recorded increments by 14.1, 26.8 and 9.7% over BC1 treatment.It is also clear that foliar application of potassium humate affected significantly leaves fresh and dry weights; root yields of pot as well as of feddan. While, spraying red beet plants with 2g KH/L showed the highest fresh and dry weights; 4g KH/L achieved the highest yields either /pot or per feddan. It is also quite clear that there were not significant differences between spraying plants with 2 or 4 g KH/L. That means it could be concluded that spraying the plants with 2 g KH/L is quite enough and recommended. The interaction between the two studied factors did not show any significant differences.

CHEMICAL COMPOSITION:

Table (4) showed the effect of banana compost (BC1 and BC2) addition and foliar feeding with potassium humate (KH) treatments as well as their interactions on macronutrients concentration and uptake of red beetroots. Results revealed that banana compost (BC) as a source of potassium had no marked effects on root N, K, Ca and Mg concentrations. Similar trends were noticed by Herak, et al., (2007 andGranjeiro, et al., (2007), they reported application of potassium (K) fertilizer was the most exported nutrient particularly the Red beet (Beta vulgaris L.).While, root P concentration showed significant increase by applying BC2 as compared to BC1. The increment amounted by 19%. However, results presented in Table (4) showed significant increments in root N, P, and K uptake due to applying BC2. The increments reached to 53.2, 78.2 and 56.9% respectively. Banana compost significantly did not affect both root Ca and Mg.Research Results of Ernani, et al.,(2007), observed that, mineralization rates of different organic matter were not similar; they also reported that, potassium in organic formsare mineralizedand become available to plants as well as potassium derived from mineral fertilizers. Application of organic matter not only enhanced the chemical content of plants but also improve the physical properties of the treated soil,reflecting on grown plants. Results showed that foliar treatments in combination with organic material added were much more effective than organic alone; potassium fertilization through foliar and soil treatment gradually increased the concentration of potassium in Red beet (Beta vulgaris L.).Concerning the effect of foliar feeding with potassium humate (KH) on root macronutrients concentration and uptake, it is quite clear that both concentration and uptake of root macronutrients were significantly affected by foliar feeding with potassium humate (KH). In spite of 4gKH/ L showed the highest values of measured nutrients, foliar feeding with 2g KH/L is recommended, since the values of 4 and 2g KH/L showed insignificant differences**.**In addition, Andry, et al., (2019) reported that organic matter added in combination with foliar treatments at two rates; stimulate phosphorus content in both leaves and roots. This could be attribute to phosphorus mineralized from the organic matter added since (P) has been found to be the life-limiting element in natural ecosystems due to its insoluble forms and furthermore unavailable for plant.

Phosphorus is an essential nutrient and an integral component of several important compounds in plant cells. These compounds include the sugar phosphates involved in respiration, photosynthesis and the phospholipids of plant membranes, the nucleotides used in plant energy metabolism and in molecules of DNA and RNA. It is also necessary for the biosynthesis of chlorophyll, where P as pyridoxal phosphate must be present for the biosynthesis of chlorophyll besides its essential for cell division and development of meristematic tissue**.**Several researchers Petek, et al., (2008) and Shahabifar, et al., (2019), they stated thatincreasing the available forms of phosphorusdue to the solubility effects of organic acid, created from organic matteradded particular banana residue, resulting in increasing phosphorusuptake by beet root**.**

The interaction effects between BC and KH were statistically insignificant for root P, K, Ca and Mg concentrations. Only root N concentration showed significant interaction effect, where, BC2 in combination with foliar spray with 2gKH/L showed the highest N concentration, while the lowest value was recorded by applying BC1 and water foliar spray. It is also noticed that significant interaction effect was recorded for root P, K and Ca uptake, where, BC2 with 2gKH/L showed the highest uptake values. While, the lowest values recorded as a result on combination between BC1 and Control (water foliar spray). Results noticed that Ca and Mg contents in leaves and roots resulted with potassium fertilizer added,application of high rates of potassium or ammonium fertilizers particularly in sandy soils, might cause Mg and Ca deficiencies. Ranade-Malvi (2011) and Madhava Rao, et al., (2006),they reported that increasing potassium supply might cause a nitrogen deficiency as well as Ca^{2+} and Mg^{2+}.Data presented in table (5) showed that only leaf nitrogen concentration significantly increased because of applying BC2. The increment reached to 18% over plants received BC1. However, only leaf N and Ca recorded significant increments in their uptake due to applying banana compost. Nitrogen uptake increased by 38.8% because of applying BC2, while applying BC1 resulted in increasing Ca by 4%.Potassium humate foliar spray significantly only increased leaf N and P concentrations and uptake, 2g KH/L showed the highest values as compared with the other KH treatments. Moreover, the aforementioned treatment significantly increased leaf K uptake. Cai,et al.,(2019) reported that importance of Potassium as a key factor which controlling crop productivity particularly under salt stressed plants are better benefited via potassium sulfate than the non-stressed Potassium, contributes for tolerance against salinity as it has competing nature to sodium for binding and maintaining plant water status.Concerning the effect of foliar spray with KH on root micronutrients concentration and uptake, it is clear that foliar feeding with 2g KH/L, markedly increased micronutrients concentration. The same previous treatment could be considered the best treatment for achieving the highest micronutrients uptake, since the differences between 2 and 4g KH/L did not reach to the level on significance.Table (6 B) showed that only leaf Zn and Mn concentration showed significant increases in their due to applying BC1; while, all micronutrients did not show any significant effects on their uptakes. Marko Petek, et al., (2017), on contrary, foliar feeding of potassium humate showed marked effects on both micronutrients concentration and uptake. Foliar feeding of 2g

KH resulted in the highest Fe and Mn concentration and uptake. While foliar application of 4g KH/L gave, the highest concentration and uptake of leaf Zn. Dada also showed that combination of BC1 and foliar spray at rate of 2 g KH/L gave the highest increase of Fe concentration; and Bc1 and 4 g KH/L showed the highest increase of Mn.

Table 4: Effect of different rates of potassium fertilizer and foliar application of potassium humate on N, P, k, Ca and Mg contents and uptake (mg/plant) % in roots of red beet plants.

Treatments	Root nutrient concentration (%)														
	Nitrogen			Phosphorus			Potassium			Calcium			Magnesium		
	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean
0 KH /L	1.20	1.40	1.30	0.19	0.23	0.21	2.00	2.20	2.10	0.29	0.27	0.28	0.35	0.33	0.34
2g KH /L	1.33	1.68	1.51	0.22	0.28	0.25	2.21	2.43	2.32	0.31	0.25	0.28	0.33	0.30	0.32
4g KH /L	1.55	1.48	1.52	0.22	0.25	0.24	2.35	2.66	2.50	0.31	0.25	0.28	0.32	0.30	0.31
Mean	1.36	1.52		0.21	0.25		2.00	2.43		0.30	0.26		0.33	0.31	
LSD 5%															
BC			N.S.			0.03			N.S.			N.S.			N.S.
KH			0.10			0.03			0.21			N.S.			N.S.
BC x KH			0.01			N.S.			N.S.			N.S.			N.S.

Table 5: Effect of different rates of potassium fertilizer and foliar application of potassium humate on N, P, k, Ca and Mg contents and uptake (mg/plant) % in roots nutrient uptake.

Treatments	Root nutrient uptake (mg/plant)														
	Nitrogen			Phosphorus			Potassium			Calcium			Magnesium		
	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean
0 KH /L	124.2	209.4	166.8	19.3	33.6	26.5	207	327	267	29.7	37.9	33.8	36.2	46.8	41.5
2g KH /L	146.4	259.4	202.9	24.1	51.6	37.9	243	450	347	34.0	45.3	39.7	37.6	51.5	44.6
4g KH /L	187.1	232.5	209.8	26.9	39.8	33.4	283	423	370	37.3	39.7	40.2	39.6	46.8	43.2
Mean	152.6	233.8		23.4	41.7		255	400		33.7	41.0		37.8	48.4	41.5
LSD 5%															
k)			40.8			6.0			48			N.S.			N.S.
(KH)			30.5			5.2			40			2.6			N.S.
K x KH			N.S.			7.36			57			3.7			N.S.

Table 6: Effect of different rates of potassium fertilizer with foliar application of potassium humate on Fe, Zn and Mn contents % in roots and leaves of red beet plants.

a)

Treatment	Root micronutrient																	
	Iron			Zinc			Manganese			Iron			Zinc			Manganese		
	%									Uptake (µg/plant)								
	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean
0 KH /L	136	129	132.5	14	12	13	15	16	16	1409	1910	1660	147	221	184	156	282	219
2g KH /L	168	157	162.5	19	16	18	20	21	21	1847	2909	2378	183	272	228	230	394	312
4g KH /L	189	166	177.5	25	18	19	20	21	21	2339	2643	2491	241	292	267	246	339	293
Mean	164	151		18	15		18	19		1865	2487		190	262		211	338	
LSD 5%																		
k)			8			N.S			N.S			433			43			70
(KH)			11			2			3			205			55			41
K x KH			N.S			N.S			N.S			290			N.S			NS

b)

Treatments	Leaves micronutrient																	
	Iron			Zinc			Manganese			Iron			Zinc			Manganese		
	%									Uptake (µg/plant)								
	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean
0 KH /L	121	205	163	20	19	20	42	37	40	724	1230	977	119	115	117	252	222	237
2g KH /L	273	226	250	25	21	23	57	44	51	1752	1859	1806	160	175	168	332	365	349
4g KH /L	256	236	246	29	24	27	62	48	50	1556	1676	1616	181	173	177	380	344	362
Mean	217	222		25	21		54	43		1344	1588		153	154		321	310	
LSD 5%																		
k)			N.S			3			2			N.S.			N.S.			N.S.
(KH)			14			2			3			235			24			44
K x KH			20			N.S			4			N.S.			N.S.			N.S.

Table 7: Effect of Banana compost as K source and foliar feeding with potassium silicate on root protein (%), total soluble solids (TSS), betalian (mg/g DW) and vitamin C(%).

Treatment	Protein (%)			Total soluble solids (%)			Betalain (mg/g DW)			Vitamin C (%)		
	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mean	BC1	BC2	Mea n
0 KH /L	7.50	8.75	8.13	8.00	8.25	8.13	20.10	22.40	21.3	4.10	4.58	4.34
2g KH /L	8.31	10.50	9.41	10.00	11.46	10.73	23.71	28.65	26.2	4.44	5.90	5.17
4g KH /L	9.69	9.25	9.47	10.87	12.46	11.67	25.30	28.00	26.7	5.63	5.60	5.62
Mean	8.5	9.5		9.62	10.72		23.0	26.4		4.72	5.36	

Data presented in Table (7) showed that application of BC2 increased all studied parameters. Application of BC2 as compared with BC1 gave increments amounted by 11.6; 11.4; 14.8 and 13.6% in root protein; TSS; betalain and vitamin C, respectively. Pavlov, et al., (2005); Sikora, et al., (2010); Hunter, et al., (2011) .and Rivoira, et al., (2017) reported that content of total soluble solids, vitamin C and betalain pigment in root of red beet is highly dependent on fertilization. Foliar spray of KH at rate of 4g/L increased all the aforementioned parameters. The increments reached to 16.5; 43.5; 25.4 and 29.5 over control treatment (water foliar spray). However, combination between BC2 and 2g KH/L gave the highest root protein; betalain and vitamin C, combination of BC2 and 4g KH/L showed the highest TSS. On the other hand, combination of BC1 and water foliar spray showed the lowest values.

References

A.O.A.C. (2000).Association of Official Analytical Chemists.17th ED. Of A.O.A.C. international Published by AOAC international Maryland, USA, 1250pp

Abou El-Nasr, M. E. and E. A. Ibrahim,(2011). Effect of different potassium fertilizer rates and foliar application with some sources of potassium on growth, yield and quality of carrot plants (Daucus carota L.). Plant Production, Mansoura Univ., 2 (4): 559-569.

Aly, E.F.A.; Eman, M.E. Abdel Fatah and Soha R.A. Khalil (2014). Response of some sugar beet varieties to the integrated soil and foliar application of potassium in saline soil. Fayoum J. Agric. Res. & Dev., 29 (2): 155-172.

Amjad, A.S.A., Y.M.A. Khanif, H.A. Aminuddin, O.A. Radziah and H.A. Osumanu, (2010). Impact of potassium humate on selected chemical properties of an acidic soil. 19 th World Congress of Soil Science, Soil Solutions for a Changing World 1- 6 August 2010, Brisbane, Australia

Amtmann, A.; Troufflard, S.; Armengaud, P. (2008) the effect of potassium nutrition on pest and disease resistance in plants. Physiol. Plantarum 133, 682–691.

Andry A, Tiphaine C, Dominique M, Herintsitohaina R, Tantely R. (2019) Land management modifies the temperature sensitivity of soil organic carbon, nitrogen and phosphorus dynamics in a Ferralsol. Appl Soil Ecol.; 138:112–122.

Anjaiah, T. and G. Padmaja (2006). Effect of potassium and farmyard manure on yield and quality of carrot. Journal of Research ANGRAU., 34 (2): 91-93.

AOAC, 1995. Association of Official Analytical Chemists. Official methods of analysis, 16th Edition, AOAC International, Washington, DC

Asadi, A. K.; M. J. Mirhadi; D. Hassanpaannah; B. delkhoushand L.Imanparast (2010). The effect of K-humate on the nitrate content and accumulation and some yield components in three potato cultivars. Res. J. of envir.sci. 4(5): 460-466.

Babarykin, D.; Smirnova, G.; Pundinsh, I.; Vasiljeva S.; Krumina, G. and Agejchenko, V.(2019) Red Beet (Beta vulgaris) Impact on Human Health .Journal of Biosciences and MedicinesVol.07 No.03,19.

Bavec, M., M. Turinek, S. Grobelnik Mlakar, A. Slantnar and F. Bavec (2010). Influence of industrial and alternative farming systems on contents of sugar, organic acids, total phenolic content and the antioxidant activity of red beet (BetavulgarisL. ssp. Vulgaris Rote Kugel). J. Agric. Food.Chem., 58: 825-831.

Berisha, D., E. Susaj, N. Bardhi, L. Susaj, V. Havolli, S. Aliu, I. Rusinovci, B. Neziraj and A. Osmanaj. (2014) Effect of potassium fertilization rate on several vegetative and yield characters of potato (Solanum tuberosum L.), grown under two different agro-climatic regions of Kosovo. Online International Interdisciplinary Research Journal4: 62-69.

Bernardes Cecílio Filho; Alexson Filgueiras Dutra and Gilson Silverio Da Silva (2017) Phosphate and potassium fertilization for radish grown in a latosol with a high content of these nutrients. RevistaCaatinga vol.30 no.2.

Cai A, Xu M, Wang B, Zhang W, Liang G, Hou E, (2019) Manure acts as a better fertilizer for increasing crop yields than synthetic fertilizer does by improving soil fertility. SoilTill Res.; 189:168–175.

Cai Y., Sun M., Corke H. (2003) Antioxidant activity of betalains from plants of the Amaranthaceae. J. Agri. Food Chem. 51: 2288-2294.

Cardoso-Ugarte, G.A., M.E. Sosa- Morales, T. Ballard, A. Liceaga, and M.F. San Mart_ın-Gonz_alez. 2014. Microwave-assisted extraction on betalains from red beet (Beta vulgaris). Lebensm. Wiss. Technol. 59:276–282

Carrillo, C., Rey, R., Hendrickx, M., Del Mar Cavia, M. and Alonso-Torre, S. (2017) Antioxidant Capacity of Beetroot: Traditional vs Novel Approaches. Plant Foods for Human Nutrition, 72, 266-273

Chen, Y., C. Clapp and H. Magen,(2004) Mechanism of plant growth stimulation by humic substances: The role of organo-iron complexes. Soil Sci. Plant Nutr. 50: 1089-1095.

Chhikara N, Kushwaha K, Sharma P, Gat Y, Panghal A.(2018) Bioactive compounds of beetroot and utilization in food processing industry: a critical review. Food Chem.; 272:192–200.

Cottenie, A., M. Verloo, L. Kiekens, G. Velghe and R. Camerlynck, (1982) Chemical Analysis of Plant and Soil. PP. 100 – 129. Laboratory of Analytical and Agrochemistry, State Univ. Ghent. Belgium.

Deuter, P. and Grundy, T. (2004). Beetroot Commercial Production and Processing. Agency for Food and Fibre Sciences. Holland Horticultural Limited Partnership. P. 1 – 4.

Dias, M.G., M.F.G.F.C. Camoes, and L. Oliveira. (2009) Carotenoids in traditional Portuguese fruits and vegetables. Food Chem. 113:808–815.

Ernani PR; Almeida JA, Santos FC. Potassium (2007) In: Novais RF (Org). Fertilidade do Solo (Soil Fertility). Sociedade Brasileira de Ciência do Solo

Eyheraguibel, B., J. Silvestre and P. Morard, (2008) Effects of humic substances derived from organic waste enhancement on the growth and mineral nutrition of maize. Biores. Technol., 99:4206-4212.

Felipe, O. M., G D Ewerton S, W Hiroshi S T, A I Cardoso, D M Fernandes, R M Evangelista,(2015) Organic compost and potassium top dressing fertilization on production and quality of beetroot. Australian Journal of Crop Science. 9 (10): 962- 967.

Fernandez, V., Eichert, T. (2009): Uptake of hydrophilic solutes through plant leaves: Current state of knowledge and perspectives of foliar fertilization. Critical Reviews in Plant Science 28: 36-68.

Hamedi, S. and Honarvar, M. (2018) Beta vulgaris—A Mini-Review of Traditional Uses in Iran. Phyto-Chemistry and Pharmacology Current Drug Discovery Technologies, 15, 1

Hassanpanah, D. (2009). Effect of water deficit and potassium humate on tuber yield and yield component of potato cultivars in Ardabil region, Iran. Res. J. Environ. Sci., 3: 351-356.

Hassanpanah, D. (2009). Effect of water deficit and potassium humate on tuber yield and yield component of potato cultivars in Ardabil region, Iran. Res. J. Environ. Sci., 3: 351-356.

Hunter D., Foster M., McArthur J. O., Ojha R., Petocz P., Samman S. 2011. Evaluation of the micronutrient composition of plant foods produced by or-ganic and conventional agricultural methods. Cr. Rev. Food Sci. Nutr. 51: 571-582

Ihsanullah Daur and Bakhashwain A.A(2013) Effect of humic acid on growth and quality of maize fodder production. Pakistan J. Bot. 45: 21-25.

Ismail, A.M.A. and S.M. Allam (2007). Yield and technological traits of sugar beet as affected by planting density, phosphorus and potassium fertilization. The 3rd Conf. Sustain. Agric. Develop., Fac. Agric., Fayoum Univ., 12-14 Nov., pp. 15-28.

Klute, A. (1986) Methods of Soil Analysis, Part 1, Physical and Mineralogical Methods 2nd edition. American Society of Agronomy, Madison, Wisconsin, USA.

Lester G.E., Jifon J.L., Makus D.J., (2010) Impact of Potassium Nutrition on Food Quality of Fruits and Vegetables: A Condensed and Concise Review of the Literature. Better Crops 94, 1,18–21.

Lester G.E., Jifon J.L., Makus D.J., (2010) Impact of Potassium Nutrition on Food Quality of Fruits and Vegetables: A Condensed and Concise Review of the Literature. Better Crops 94, 1,18–21.

Madhava Rao, K.V., Raghavendra, A.S., Janardhan Reddy, K., (2006) Physiology and Molecular Biology of Stress Tolerance in Plants. Springer, Printed in the Netherlands, 187-217

Mansour, E., M. I. Abdul-Hamid, M. T. Yasin, N. Qabil and A. Attia (2017). Identifying drought-tolerant genotypes of barley and their responses to various irrigation levels in a Mediterranean environment. Agric. Water Manag. 194: 58–67

Mansour H. A., Sameh K. Abd-Elmabod and B. A. Engel. 2019a. Adaptation of modeling to the drip irrigation system and water management for corn growth and yield. Plant Archives Vol. 19, Supplement 1, pp. 644-651.

Mansour H. A., Hu Jiandong, Ren Hongjuan, Abdalla N. O. Kheiry and Sameh K. Abd-Elmabod. 2019b. Influence of using automatic drip irrigation system and organic fertilizer treatments on faba bean water productivity, International Journal of GEOMATE, Oct., 2019 Vol.17, Issue 62, pp. 256 – 265.

Mansour Hani A, Osama A. Nofal, Maybelle S. Gaballah, Adel B. El-Nasharty 2019. Management of two irrigation systems and Algae Foliar application on wheat plant growth. AIMS Agriculture and Food, 4 (3): pp. 824-832. doi: 10.3934/agrfood. 3.824

Mansour, H. 2006. The response of grapes to the application of water and fertilizers under different local irrigation systems. Master: Thesis, Faculty of Agriculture, Ain Shams University, Egypt. s. 78-81.

Mansour, H. A., Abdel-Hady, M.,Eldardiry, E.I., Bralts, V.F., 2015a, Performance of automatic control different localized drip irrigation systems and lateral lengths for emitters clogging and maize (Zea mays L.) growth and yield. International Journal of GEOMATE, Vol. 9, No. 2 (Sl. No. 16), pp. 1545-1552.

Mansour, H. A., M. Abd El-Hady, V. F. Bralts, and B. A. Engel, 2016b. Performance Automation Controller of Drip Drip irrigation System and Saline Water for Maize Yield and Water Productivity in Egypt. Journal of Drip irrigation and Drainage Engineering, American Society of Civil Engineering (ASCE), J. Irrig. Drain Eng. 05016005, http://dx.doi.org/10.1061/(ASCE)IR, 1943-4774.0001042.

Mansour, H.; Osama, A.N.; Maybelle, S.G. and El-Nasharty, A.B. (2019). Management of two irrigation systems and Algae Foliar application on wheat plant growth, AIMS Agriculture and Food, 4(3): 824–832.

Mansour, H.A., Aljughaiman, A.S. 2012, Water and fertilizers use efficiency of corn crop under closed circuits of drip irrigation system. Journal of Applied Sciences Research, 6 (11), pp.546 5-5493.

Mansour, H.A., El-Hady, M.A., Eldardiry, E.I., Aziz, A.M. 2019.Wheat crop yield and water use as influenced by sprinkler irrigation uniformity. Plant Archives. Supplement 2, , pp. 2296-2303.

Mansour, H.A., Saad, A., Ibrahim, A.A.A., El-Hagarey, M.E., 2016c. Management of drip irrigation system: Quality performance of Egyptian maize (Book Chapter). Micro Drip irrigation Management: Technological Advances and Their Applications. pp. 279-293.

Mansour, H.A.; Abdallah, E.F.; Gaballah, M.S. and Gyuricza, C. (2015). Impact of bubbler discharge and irrigation water quantity on 1-hydraulic performance evaluation and maize biomass yield, int. J. of geomate, 9(2): 1538-1544.

Mansour, H.A.A. 2015. Design considerations for closed circuit design of drip irrigation system (Book Chapter). pp.61-133.

Mansour, H.A.A. and Aljughaiman, A.S. 2015.Water and fertilizer use efficiencies for drip irrigated corn: Kingdom of Saudi Arabia (book chapter) closed circuit trickle drip irrigation design: theory and applications, Apple Academic Press, Publisher: Taylor and Frances. pp. 233-249

Mansour, H.A.A. and El-Melhem, Y. 2015. Performance of drip irrigated yellow corn: Kingdom of Saudi Arabia (Book Chapter), closed circuit trickle drip irrigation design: theory and applications, Apple Academic Press, Publisher: Taylor and Frances. pp. 219-232

Mansour, H.A.A., Tayel, M.Y.,Lightfoot, D.A.,El-Gindy, A.M. 2015e. Energy and water savings in drip irrigation systems. Closed Circuit Trickle Drip irrigation Design: Theory and Applications, , pp.149-176 .

Mansour, H.A.A., El-Hady, M.A., Gyurciza, C.S. 2015. Water and fertilizer use efficiencies for drip irrigated maize (Book Chapter). Closed Circuit Trickle Drip irrigation Design: Theory and Applications.. pp. 207-216 .

Mansour, Hani. A., and Sameh K. Abd-Elmabod, AbdelGawad Saad. The impact of sub-surface drip irrigation and different water deficit treatments on the spatial distribution of soil moisture and salinity. Plant Archives. Supplement 2, 2019, pp. 384-392.

Mansour, E., M. I. Abdul-Hamid, M. T. Yasin, N. Qabil and A. Attia (2017). Identifying drought-tolerant genotypes of barley and their responses to various irrigation levels in a Mediterranean environment. Agric. Water Manag. 194: 58–67

Mansour H. A., Sameh K. Abd-Elmabod and B. A. Engel. 2019a. Adaptation of modeling to the drip irrigation system and water management for corn growth and yield. Plant Archives Vol. 19, Supplement 1, pp. 644-651.

Mansour H. A., Hu Jiandong, Ren Hongjuan, Abdalla N. O. Kheiry and Sameh K. Abd-Elmabod. 2019b. Influence of using automatic drip irrigation system and organic fertilizer treatments on faba bean water productivity, International Journal of GEOMATE, Oct., 2019 Vol.17, Issue 62, pp. 256 – 265.

Mansour Hani A, Osama A. Nofal, Maybelle S. Gaballah, Adel B. El-Nasharty 2019. Management of two irrigation systems and Algae Foliar application on wheat plant growth. AIMS Agriculture and Food, 4 (3): pp. 824-832. doi: 10.3934/agrfood. 3.824

Mansour, H. 2006. The response of grapes to the application of water and fertilizers under different local irrigation systems. Master: Thesis, Faculty of Agriculture, Ain Shams University, Egypt. s. 78-81.

Mansour, H. A., Abdel-Hady, M.,Eldardiry, E.I., Bralts, V.F., 2015a, Performance of automatic control different localized drip irrigation systems and lateral lengths for emitters clogging and maize (Zea mays L.) growth and yield. International Journal of GEOMATE, Vol. 9, No. 2 (Sl. No. 16), pp. 1545-1552.

Mansour, H. A., M. Abd El-Hady, V. F. Bralts, and B. A. Engel, 2016b. Performance Automation Controller of Drip Drip irrigation System and Saline Water for Maize Yield and Water Productivity in Egypt. Journal of Drip irrigation and Drainage Engineering, American Society of Civil Engineering (ASCE), J. Irrig. Drain Eng. 05016005, http://dx.doi.org/10.1061/(ASCE)IR, 1943-4774.0001042.

Mansour, H.; Osama, A.N.; Maybelle, S.G. and El-Nasharty, A.B. (2019). Management of two irrigation systems and Algae Foliar application on wheat plant growth, AIMS Agriculture and Food, 4(3): 824–832.

Mansour, H.A., Aljughaiman, A.S. 2012, Water and fertilizers use efficiency of corn crop under closed circuits of drip irrigation system. Journal of Applied Sciences Research, 6 (11), pp.546 5-5493.

Mansour, H.A., El-Hady, M.A., Eldardiry, E.I., Aziz, A.M. 2019.Wheat crop yield and water use as influenced by sprinkler irrigation uniformity. Plant Archives. Supplement 2, , pp. 2296-2303.

Mansour, H.A., Saad, A., Ibrahim, A.A.A., El-Hagarey, M.E., 2016c. Management of drip irrigation system: Quality performance of Egyptian maize (Book Chapter). Micro Drip irrigation Management: Technological Advances and Their Applications. pp. 279-293.

Mansour, H.A.; Abdallah, E.F.; Gaballah, M.S. and Gyuricza, C. (2015). Impact of bubbler discharge and irrigation water quantity on 1-hydraulic performance

evaluation and maize biomass yield, int. J. of geomate, 9(2): 1538-1544.

Mansour, H.A.A. 2015. Design considerations for closed circuit design of drip irrigation system (Book Chapter). pp.61-133.

Mansour, H.A.A. and Aljughaiman, A.S. 2015.Water and fertilizer use efficiencies for drip irrigated corn: Kingdom of Saudi Arabia (book chapter) closed circuit trickle drip irrigation design: theory and applications, Apple Academic Press, Publisher: Taylor and Frances. pp. 233-249

Mansour, H.A.A. and El-Melhem, Y. 2015. Performance of drip irrigated yellow corn: Kingdom of Saudi Arabia (Book Chapter), closed circuit trickle drip irrigation design: theory and applications, Apple Academic Press, Publisher: Taylor and Frances. pp. 219-232

Mansour, H.A.A., Tayel, M.Y.,Lightfoot, D.A.,El-Gindy, A.M. 2015e. Energy and water savings in drip irrigation systems. Closed Circuit Trickle Drip irrigation Design: Theory and Applications, , pp.149-176 .

Mansour, H.A.A., El-Hady, M.A., Gyurciza, C.S. 2015. Water and fertilizer use efficiencies for drip irrigated maize (Book Chapter). Closed Circuit Trickle Drip irrigation Design: Theory and Applications.. pp. 207-216 .

Mansour, Hani. A., and Sameh K. Abd-Elmabod, AbdelGawad Saad. The impact of sub-surface drip irrigation and different water deficit treatments on the spatial distribution of soil moisture and salinity. Plant Archives. Supplement 2, 2019, pp. 384-392.

Marko Petek; Nina Toth; MarijaPecina; Boris Lazarević; Igor Palčićand Mirjana Herak Ćustić1 (2017) Status of Fe, Mn and Zn in red beet due to fertilization and environment. Journal of Central European Agriculture, 2017, 18(3), p.554-570

Min Wang, Qingsong Zheng, Qirong Shen and ShiweiGuo (2013) the Critical Role of Potassium in Plant Stress Response Int. J. Mol. Sci. 2013, 14, 7370-7390.

Morgado, M., de Oliveira, G.V., Vasconcellos, J., Monteiro, M.L., Conte-Junior, C., Pierucci, A.P. and Alvares, T.S. (2016) Development of a Beetroot-Based Nutritional Gel Containing High Content of Bioaccessible Dietary Nitrate and Antioxidants. Journal of Food and Nutrition Sciences, 67, 153-160.

Nafei. A.I.; A.M.H. Osman and Maha M. El.Zeny (2010) effect of Plant Densities and potassium fertilization rates on yield and quality of Sugar Beet Crop In Sandy Reclaimed Soils. (BetaVulgarisL.).J. of Plant Production, Vol. 1 (2): 229 – 237.

Nottingham, S., 2004. The characteristic colour of beetroot. Eur. Food. Res. Tech. 214:505-510

Oosterhuis, DM; DA Loka, and EM Kawakami (2014) The physiology of potassium in crop production. Advances in Agronomy, Newark, v. 126, n. 1, p. 203-233.

Page, A.I.; Miler, R.H. and Keeny, D.R. (1982) Methods of Soil Analysis part II. Chemical and Microbiological Methods. Amer. Soc. Agron., Madison, Wisconsin, USA,

Patil, R.B., A.S. Kadam and S.S. Wadje. (2011) Role of potassium humate on growth and yield of soybean and black gram. International Journal of Pharma and Bio Sciences2: 242-246.

Pavlov A, Georgiev V, Ilieva M. 2005 Betalain biosynthesis by red beet (Beta vulgaris L.) hairy root culture. Process Biochem.; 40:1531–1533

Petek M, Herak Ćustić M, Čoga L, Toth N, Pecina M (2008). Phosphorus content in soil and in fresh and cooked red beet in dependence on different fertilization. Cereal Res Commun 36(Suppl 1:435-438.

Petrov P., (2014): Effects of soil fertility and foliar fertilization of beetroot (Beta vulgaris L. var. cicla) in Gevgelija region. Ss. Cyril and Methodius University in Skopje, Faculty of Agricultural Sciences and Food, Skopje. (MA thesis).

Pettigrew, W.T. (2008) Potassium influences on yield and quality production for maize, wheat, soybean and cotton. Physiol. Plantarum, 133, 670–681.

Prakash P, Rajab Kumari P , Aishwarya V, ThanujaPolani , Archana PriyaVenugopal, Thirumurugan A. (2012). The influence of potassium humate on Stevia rebaudiana. International Journal of Agricultural and Food Science. 2, 30-31

Prakash P, Samundeeswari R, Vivek C, and Chitradevi A.(2011). The influence of potassium humate on Pleurotusflorida. World Journal of Science and Technology. 1, 28-31.

Ranade-Malvi U. 2011 Interaction of micronutrients with major nutrients with special reference to potassium.Karnataka J Agric Sci.; 24(1):106–109.

Rey, A. I., A. Hopia, R. Kivikari and M. Kahkonen (2005). Use of natural food/plant extracts: Cloudberry (Rubus chamaemorus), beetroot (Beta vulgaris “Vulgaris”) or willow herb (Epilobium angustifolium) to reduce oxidation of cooked park patlies. Food Science and Technology, 38: 363-370.

Rivoira, L., Studzinska, S., Szultka-MLynska, M., Bruzzoniti, M.C. and Buszewski, B. (2017) New Approaches for Extraction and Determination of Betaine from Beta vulgaris Samples by Hydrophilic Interaction Liquid Chromatography-Tandem Mass Spectrometry. Analytical and Bioanalytical Chemistry, 409, 533-541

Sabzevari, S., Khazaie, H.R. and Kafi, M. Effect of humic acid on root and shoot growth of two wheat cultivars (Triticum aestivum L.). J. Water Soil, 2009; 23: 87-94.

Salami M, Saadat S (2013). Study of potassium and nitrogen fertilizer levels on the yield of sugar beet in jolge cultivar. Journal of Novel Applied Sciences, 2(4):94–100

Saud, S., j. Chun, M. Razaq, M. Luqman, S. fahad, M. Abdullah, and A. Sadiq,(2013) Effect of potash levels and row spacing on onion yield. Journal of Biology, Agriculture and Healthcare, Vol.3, No.16: 118-127.

Sediyama, M.A.N., Santos, M.R., Vidigal, S.M. and Salgado, L.T (2011) Produtividade E exportacao de nutrientes beterraba cultivada com cobertura morta adubacaoorganica. Revista Brasileira Engenharia Agricola Ambiental 15, 883-889.

Shahabifar J, Panahpour E, Moshiri F, Gholami A, Mostashari M. (2019)The quantity/intensity relation is affected by chemical and organic P fertilization in calcareous soils. Ecotox Environ Safe.; 172:144–151.

Sikora M., Klonowska K., Hallmann E., Rembiałkow-ska E.(2010) Nutritive quality of red beet roots from organic and conventional production. In: Rembiałkowska E. (ed.), The impact of organic production methods on the vegetable product quality Published by SGGW, Warszawa, Poland, pp. 209-220

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

Szalaty, M. (2008) Physiological roles and bioavailability of betacyanins.nPost.Fit.1, 20 25.

Szura A., Kowalska I., Sady W. 2008. Biological value of red beets in relation to nitrogen fertilization. Veget. Crops Res. Bull. 68: 145-153.

Tripura, P. Kumar, S. and Verma, R. (2017) Effect of potassium humate and bio-inoculants on nutrient content, uptake and quality of cowpea (Vigna unguiculata L.) Walp. In International Journal of Current Microbiology and Applied Sciences, vol. 6, no. 2, pp. 1735 – 1741.

Vali, L., E. Stefamouits – Banyai, K. Szentmihalyi, H. Febel, E. Sardi, A. Lugasi, I. Kocsis and A. Blazouics (2007). Liver – protecting effects of table beet (Beta vulgaris var. Rubra) during ischemia reperfusion. Nutrition, 23: 172-178

Zahoor, R. – Dong, H. – Abid, M. – Zhao, W. – Wang, Y. – Zhou, Z. (2017) Potassium fertilizer improves drought stress alleviation potential in cotton by enhancing photosynthesis and carbohydrate metabolism.InEnvironmental and Experimental Botany, vol. 137, pp. 73 – 83.

Zörb, C.; Senbayramb, M.; Peiter, E. (2014) Potassium in Agriculture - Status and Perspectives. Journal of Plant Physiology, Jena, V. 171, N. 9, P. 656-669

Zujko M. E., Witkowska A. 2009. Antioxidant activity popular species fruits, vegetables, mushrooms and pulsem. Bromat. Chem. Toksykol. 3: 895-899