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Effect of sugar industrial wastes on sweet potato (*Ipomoea batatas* L.) yield and roots quality

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Abstract

Two field experiments were conducted at a private farm in Malawi city, El-Minya, Egypt during two successive seasons of 2018 and 2019 respectively, to study the effect of organic, inorganic and its combination fertilizers on sweet potato yield and quality in a sandy clay loam soil, Treatments were (T1) 100% of inorganic fertilizer (NPK at mineral form), (T2) 100% organic fertilizer (sugarcane bagasse ash plus sugarcane vinasse), (T3) 75% organic fertilizer + 25% inorganic, (T4) 50% organic fertilizer + 50% inorganic, (T5) 25% organic fertilizer + 75% inorganic. A random complete block design (RCBD) with three replications was used. The data showed a high response to the full dose of organic fertilization treatments (5 ton /feddan of sugarcane bagasse ash plus 80 L /feddan of sugarcane vinasse (feddan = 4200 m² = 0.420 hectares = 1.037 acres)) at all vegetative growth and tuberous roots yield and quality. Meanwhile, the lowest values of sweet potato characters were obtained with full dose of inorganic fertilizers (NPK).

Keywords: sugarcane bagasse ash, sugarcane vinasse, sweet potato, *Ipomoea batatas*.

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1. Introduction

Sweet potato (*Ipomoea batatas* L.) is a dicotyledonous plant belonging to the *Convolvulaceae* family (Woolfe, 1992). The plant is an herbaceous perennial vine with alternate heart-shaped leaves. Sweet potato ranked as the seventh economic crop after wheat, rice, maize, potato, barley, and cassava (FAO 2009). Sweet potato is one of the important root crops in Egypt and many other countries in the world especially the Eastern and Southern parts of the African continent (Tumwegamire *et al.*, 2004). Sweet potato requires low inputs and less management and is an important food security crop grown in many of the poorest regions of the world mainly by women for food and as a source of food and family cash income (Woolfe, 1992). Sweet potato is valued for its roots which can be boiled, fried, baked, or roasted for humans or boiled and fed to livestock as a source of energy (Boru, 2017). Orange-fleshed varieties are rich in beta-carotene, while purple-fleshed varieties are high in anthocyanins, two important antioxidants thought to prevent chronic heart diseases and cancer (Drapal *et al.*, 2019; Teow *et al.*, 2007). Significant amounts of essential minerals are found in sweet potato, including manganese, copper, iron, and potassium, which are the most prevalent mineral (Huang, 1982). The total cultivated area in the year of 2017 reached about 18590 feddan with a total production of about 287244 tons and a mean of 9-17 tons /feddan (feddan = 4200 m² = 0.420 hectares = 1.037 acres). According to Department of Agricultural Economic Statistics, Egyptian Ministry of

Agriculture and Land Reclamation, sweet potato cultivated areas were in El-Behera, Kafr–Elsheikh, and Damietta governorates (Anonymous, 2013). Sweet potato may be adapted to grow on poor soils; as such most farmers do not apply fertilizer to their crops, resulting in poor yield. Small-holder farmers apply little or no fertilizer, often citing high cost or non-availability of inorganic fertilizers as reasons for not applying recommended dosage. Though inorganic fertilizers have been the conventional method of soil mineral input in sweet potato production, these fertilizers may pose danger to the environment especially if inappropriately applied. According to Buresh *et al.* (1997) and Palm *et al.* (1997), it has generally been accepted that both inorganic and organic inputs are needed to increase crop production. The concept of ‘integrated nutrient management’ utilizing all available organic and inorganic resources has become a dominant paradigm for improved or increased yields in smallholder agriculture system of sub-Saharan Africa (SSA) to ensure both efficient and economic use of scarce nutrient resources (Smaling *et al.*, 1997; Vanluawe *et al.*, 2001). Sugar industry waste is one of the alternative organic sources to improve soil quality and plant growth. Bagasse ash and vinasse is a by-product of distillery industries produced mostly from raw materials of sugarcane. Bagasse is the fibrous material remaining after removing the sucrose, water, and other extraneous material impurities (e.g. sediment) from the delivered sugarcane. Bagasse on a dry weight basis is composed of 40-50% cellulose, 30-35% hemicellulose, 20-30% lignin, and a small

percentage of other materials (Amin, 2011; Cardona *et al.*, 2010; Drummond and Drummond, 1996; Martin *et al.*, 2007; Pandey *et al.*, 2000; Sales and Lima, 2010). On the other hand, sugarcane vinasse is produced from juice and often with molasses, has more concentration of carbon, potassium, phosphate, sulphate, calcium, iron, sodium and other micronutrient than former (Gopal and Kammen, 2009) and has lot of organic compounds such as glycerol, lactic acid and acetic acid (Decloux *et al.*, 2002). Therefore, the use of organic materials to supplement inorganic fertilizer use, as an integrated management strategy, is of paramount importance to reducing the cost of soil mineral input, maximizing yields and sustaining sweet potato as well as other food crops production. Accordingly, the present study was carried out to achieve the following goals: Determination of the suitable rates of vinasse and bagasse ash

as an organic fertilizer under different concentrations to obtain high yield with good root quality. Minimizing the added inorganic fertilization rates and, thereby, lowering the total production cost. Trying to find the right combination of organic and inorganic fertilizers to obtain high yield with good root quality.

2. Materials and methods

2.1 Experimental site

The experiments were performed on the sweet potato (*Ipomoea batatas* L.) at an a private farm in, Malawi, City, El-Minya, Egypt located at 28.0871° N, 30.7618° E during two successive summer seasons of 2018 and 2019 respectively, to study the effect of organic, inorganic and its combination fertilizers on sweet potato yield and quality in a sandy clay loam soil as presented in Table (1).

Table (1): The physical and chemical properties of the samples taken from experimental soil during the two cultivated seasons.

Characteristic	Value	Characteristic	Value
O.M. (%)	0.0062	Mg ⁺² (%)	0.036
CaCO ₃ (%)	1.62	Na ⁺ (%)	6.5
Sand (%)	55.2	K ⁺ (%)	0.035
Silt (%)	20.8	Available (ppm)	---
Clay (%)	24	NH ₄ (%)	48.0
Texture class	Sand clay loam	N (%)	0.032
pH	7.4	P (%)	0.0054
EC (dS/m)	2.4	Zn (%)	2.5
Cl	0.355	Ca ⁺² (%)	0.03

2.2 Experimental materials

Sugarcane bagasse ash and vinasse were obtained from Qus Sugarcane Company, Qus, City, Qena, Egypt and was used as

an organic fertilizer. In addition, mineral forms of NPK was used as an inorganic fertilizer. Chemical analysis of bagasse ash and vinasse are presented in Tables (2) and (3).

Table (2): Sugarcane vinasse chemical composition.

Parameter	Vinasse
pH	4.1
EC (dS/m) (electrical conductivity)	22 dS/m
BOD (mg/L) (biochemical oxygen demand)	50000
COD (mg/L) (chemical oxygen demand)	96000
N (%)	0.13
P (%)	0.00
K (%)	0.79
Ca (ppm)	0.0
Na (ppm)	0.0
Fe (ppm)	12.07
Mn (ppm)	0.42
Zn (ppm)	0.7
Cu (ppm)	0.27

Mabroka and Abis sweet potato varieties which used in this thesis were obtained from Arab El-Awamer Station, Agriculture Research Center. Vines cuttings of 25 cm length from apical sections and other actively growing sections were planted in rows, 0.75 m apart, and at spacing of 0.50 m within rows under a drip irrigation system.

Table (3): Sugarcane bagasse ash chemical composition.

Mineral	Percentage (%)
SiO ₂	73
Al ₂ O ₃	6.7
Fe ₂ O ₃	6.3
CaO	2.8
MgO	3.2
P ₂ O ₅	4.0
Na ₂ O	1.1
K ₂ O	2.4

2.3 Experimental design and treatments

A random complete block design (RCBD) with three replications was used. Vines cuttings of 25 cm length from apical sections and other actively growing sections were planted on ridges at a spacing of 1 m between ridges and

0.3 m within rows, under a drip irrigation system. Two-thirds of each vines (with 4 to 6 nodes) was buried into the soil (about 15 to 20 cm deep) leaving one-third above the soil. Each plot size consisted of three ridges with each ridge being 3.5 m long. Treatments were (T₁) 100% of inorganic fertilizer (NPK at mineral form), (T₂) 100% organic fertilizer (bagasse ash plus vinasse), (T₃) 75% inorganic fertilizer + 25% organic, (T₄) 50% organic fertilizer + 50% inorganic, (T₅) 25% organic fertilizer + 75% inorganic (Table 4). The mineral form of the inorganic fertilizer used in this study was mono calcium superphosphate (15.5% P₂O₅), potassium sulphate (48% K₂O) and ammonium nitrate (33.5 % N).

2.4 Agricultural operations

At soil preparation time, the full dose of mono calcium superphosphate (P₂O₅) and bagasse ash with their different levels were added. Meanwhile, ammonium nitrate (33.5 % N), potassium sulphate (48% K₂O) and vinasse fertilizer with their different levels was added to the soil throughout the drip irrigation system. All the agricultural practices used for commercial sweet potato production were carried out in this experiment (Hassan, 1991).

2.5 Data collected

Final harvesting was done when the leaves had turned brown to determine the

influence of the treatments on plant height (cm), tuberous root number per plant, average weight of a single tuber root (g), average diameter of tuberous root (cm), tuberous root yield per plant (kg) and tuberous root yield per feddan (ton) as well as total carbohydrate percentage (%).

Table (4): Total amount of inorganic and organic fertilizers.

Treatment code	Treatments (%)	Inorganic	Organic
		NPK (Kg/feddan)	Bagasse (Kg/feddan) + Vinasse (L/feddan)
T ₁	100	150 – 400 – 160	0.0 + 0.0
T ₂	100	0.0 – 0.0 0.0	5 ton/feddan + 80 L/feddan
T ₃	75 + 25	112.5 – 300 – 120	1.25 ton/feddan + 20 L/feddan
T ₄	50 + 50	75 – 200 – 80	2.5 ton/feddan + 40 L/feddan
T ₅	25 + 75	37.5 – 100 – 40	3.75 ton/feddan + 60 L/feddan

Sample preparation for chemical content analyses were performed on sweet potato tubers at 3 days after harvesting. The sample was comprised of 7 tubers taken randomly from each treatment, which were then washed, peeled, and cut to a size of 2 3 mm using a grated knife. The tubers were then heated in an oven at 60°C for 5 hours. After the sliced tubers were removed from the oven, they were milled and sieved with a size 80 mesh sieve. The samples used for chemical testing were measured on a dry weight base and stored in plastic bags at 4 °C (Dako *et al.*, 2016). The chemical analysis of carbohydrate levels and crude protein percentage (%) were process according to Bach *et al.* (2018).

2.6 Statistical analysis

The analysis of variance of the data was carried out on the mean values of the tested treatments according to the procedures described by Gomez and Gomez (1984). The least significant

differences (LSD) at 5% levels was used for testing the significance of the differences among the mean values of the tested treatments for each character.

3. Results

Response of sweet potato cultivars to organic and inorganic fertilizer treatments are presented in the following chapter. Data of sweet potato height in cm are presented in Table (5). Results revealed that, significantly effect of fertilizer treatments and cultivars on sweet potato plant height. Mabroka cv. recorded the shortest plants (132.90 and 130.68 cm) than the Abis cv. (166.17 and 166.20 cm) in the first and second season, respectively. Full dos of organic treatment (T₂) and the combined with fifty percent of organic and inorganic fertilizer treatment (T₄) scored the highest values of sweet potato length cm in the tow cultivated seasons. Significant interactions were detected between sweet

potato cultivars and the fertilizer treatments. Sweet potato cv. at T₂ and T₄ recorded the longest plants than the other fertilizer treatments in both seasons, respectively. Meanwhile, 25% organic + 75% inorganic fertilizer treatment (T₅) scored the shortest plants in both seasons, respectively.

Table (5): Effect of organic and inorganic fertilizer on plant height of sweet potato (cm).

Treatment code	2018			2019		
	Mabroka	Abis	Means (a)	Mabroka	Abis	Means (a)
T ₁	132.17	165.67	148.92	130.13	166.00	147.89
T ₂	139.80	172.00	155.90	135.93	169.33	152.63
T ₃	135.18	166.68	150.93	131.23	161.00	146.12
T ₄	136.67	170.17	153.42	135.13	170.68	152.90
T ₅	130.68	156.33	143.51	127.00	164.00	145.67
Means (b)	132.90	166.17	---	130.68	166.20	---
LSD	a= 2.18 b= 3.44 ab= 4.86			a= 3.58 b= 5.67 ab= 8.02		

Significant affect was obtained from the data which, presented in Table (6) for the number of tuberous roots affected by cultivars, fertilizer treatments and the combined effect. In both cultivated seasons of 2018 and 2019, Mabroka cv. scored the maximum tuberous roots number. Maximum values of tuberous roots number were detected by add 5 ton /feddan of bagasse ash plus 80 L /feddan

of vinasse (treatment T₂) followed by 50% of NPK plus 50% of bagasse ash and vinasse (treatment T₄) in both seasons. The interaction effect showed that, highly effect of fertilizer treatment on tuberous roots number. T₂ and T₄ scored the maximum number of sweet potato tuberous roots at the cultivars in both seasons of 2018 and 2019, respectively.

Table (6): Effect of organic and inorganic fertilizer on number of tuberous root per plant of sweet potato.

Treatment code	2018			2019		
	Mabroka	Abis	Means (a)	Mabroka	Abis	Means (a)
T ₁	4.70	4.00	4.35	4.40	4.20	4.30
T ₂	5.80	4.90	5.35	5.40	4.60	5.00
T ₃	4.90	4.70	4.80	4.85	4.46	4.74
T ₄	5.20	4.80	5.00	5.20	4.55	4.87
T ₅	4.80	4.60	4.70	4.76	4.33	4.54
Means (b)	5.08	4.60	---	4.92	4.42	---
LSD	a= 0.24 b= 0.37 ab= 0.53			a= 0.24 b= 0.39 ab= 0.55		

On the other hand, full dos of inorganic fertilizer (T₁) scored the lowest values of

tuberous roots number in both seasons. Data presented in Table (7) showed that,

significantly effect of sweet potato cultivars, organic and inorganic fertilizer treatments and the interaction effect on tuberous root diameter in both cultivated seasons of 2018 and 2019. Abis cv. recorded the lowest tuberous root diameter than the Mabroka cv. in both seasons, respectively. Also, T₁ fertilizer scored the lowest diameter of sweet potato tuberous root in the two successive seasons of 2018 and 2019,

respectively. While, T₂ fertilizer treatment followed by T₄ obtained the maximum diameter of sweet potato tuberous root in the two successive seasons of 2017 and 2018, respectively. The combined effect of sweet potato cultivars and fertilizer treatments shoed that, T₂ and T₁ at the two cultivars of sweet potato recorded the highest and lowest values of tuberous roots diameter, respectively, in both seasons.

Table (7): Effect of organic and inorganic fertilizer on mean of tuberous root diameter (cm) of sweet potato.

Treatment code	2018			2019		
	Mabroka	Abis	Means (a)	Mabroka	Abis	Means (a)
T ₁	6.87	6.10	6.48	6.10	6.22	6.16
T ₂	7.21	6.85	7.03	7.00	6.93	6.96
T ₃	6.80	6.66	6.73	6.75	6.71	6.73
T ₄	7.00	6.96	6.84	6.91	6.88	6.89
T ₅	6.80	6.22	6.51	6.00	6.65	6.32
Means (b)	6.93	6.55	---	6.55	6.67	---
LSD	a= 1.51	b= 2.40	ab= 3.39	a= 1.35	b= 2.14	ab=3.03

There was significant difference between the weight of tuberous root in the study. Application of full dos of bagasse ash and vinasse (T₂) produced higher mean value of 355.45 and 387.74 g in first and second seasons, respectively. Also, Abis cv. gave the highest tuberous root value 331.53 and 365.07 g in the first and second seasons of 2018 and 2019 respectively. While, Mabroka cv. scored the lowest value of tuberous root as weight in g. The combined effect of fertilizer treatment and sweet potato cultivars showed positively values of pure amount of bagasse ash and vinasse (T₂) on weight of tuberous roots than the

other fertilizer treatments in both seasons respectively. On the other hand, pure dose of NPK fertilizer (T₂) scored the lowest means of tuberous roots weight in both seasons (Table 8). Data presented in Tables (9) exhibit the effect of five proportions of inorganic and organic fertilizer treatments on tuberous roots yield of sweet potato per plants (kg). Application of 100% organic fertilizer (T₂) resulted in the highest yield weight (kg) per plant in both seasons. There was no significant difference between the sweet potato cv. tuberous roots yield per plant in the study. The combined treatment of 50% inorganic plus 50%

organic fertilizer produced the highest total yield as weight kg per plant in the both seasons. In contrast, the application of 100% inorganic fertilizer source (T1) was always inferior compared to other four proportion treatments regarding to tuberous roots yield during the two growing seasons.

Table (8): Effect of organic and inorganic fertilizer on average weight of single sweet potato tuber root (g).

Treatment code	2018			2019		
	Mabroka	Abis	Means (a)	Mabroka	Abis	Means (a)
T ₁	260.50	320.33	290.42	250.70	342.67	296.68
T ₂	370.57	340.33	355.45	380.30	395.17	387.74
T ₃	336.00	335.76	335.83	335.533	360.50	348.017
T ₄	351.17	338.33	344.75	350.800	377.00	363.9
T ₅	266.66	323.33	294.99	241.900	350.00	295.95
Means (b)	316.98	331.53	---	311.85	365.07	---
LSD	a= 8.75 b= 13.80 ab= 19.51			a= 10.19 b= 16.11 ab= 22.78		

Table (9): Effect of organic and inorganic fertilizer on tuberous root yield per plant of sweet potato (kg).

Treatment code	2018			2019		
	Mabroka	Abis	Means (a)	Mabroka	Abis	Means (a)
T ₁	1.22	1.18	1.25	1.44	1.40	1.42
T ₂	1.95	1.87	1.91	1.56	1.77	1.67
T ₃	1.56	1.51	1.53	1.54	1.52	1.53
T ₄	1.82	1.63	1.73	1.76	1.54	1.65
T ₅	1.34	1.36	1.35	1.46	1.45	1.45
Means (b)	1.60	1.45	---	1.55	1.53	---
LSD	a= 0.10 b= ns ab=0.22			a= 0.08 b= ns ab= 0.17		

There was significant difference between the fertilizer applied with the respect to tuberous roots yield per feddan of sweet potato. Full levels of organic fertilizer (T₂) produced the highest means value of yields as ton per feddan (30.12 and 30.58 ton /feddan) in the first and second seasons, respectively, which was followed by fifty percent of organic and inorganic fertilizer (T₄) and the last mean value of tuberous yield (26.53 and 25.79 ton /feddan) from the pure dose of NPK fertilizer treatment in the first and second

seasons, respectively (Table 10). There was no significant difference between the sweet potato cv. tuberous roots yield per feddan in the study. Concerning the interaction effects between different proportion of chemical and organic sources and different sweet potato cv., the highest values of tuberous roots yield per feddan were obtained from bagasse ash and vinasse at 100% levels (T₂) combined with mabroka cv. followed by Abis cv. at same fertilizer treatment. In the same context Mabroka and Abis cv.

at the full dose of inorganic fertilizer roots yield as ton per feddan in both treatment (T₁) scored the lowest tuberous seasons of 2018 and 2019.

Table (10): Effect of organic and inorganic fertilizer on tuberous root yield per feddan of sweet potato (ton /feddan).

Treatment code	2018			2019		
	Mabroka	Abis	Means (a)	Mabroka	Abis	Means (a)
T ₁	26.01	27.06	26.53	25.27	26.30	25.79
T ₂	30.34	29.90	30.12	31.22	29.95	30.58
T ₃	28.07	28.90	28.48	29.08	29.17	29.85
T ₄	28.90	29.00	28.95	29.80	29.90	29.85
T ₅	27.88	25.36	26.62	27.46	26.60	27.03
Means (b)	28.24	28.04	---	28.57	28.38	---
LSD	a= 0.42 b= ns ab= 2.78			a= 1.19 b= ns ab= 2.66		

The highest carbohydrate percentage in the tuberous roots of sweet potato was from organic fertilizer treated (T₂) and the least from the 25% inorganic plus 75% organic fertilizer treated (T₅). There was no significant difference between the sweet potato cv. carbohydrate percent in the study (Table 11). Regarding the interaction effects between different sweet potato cultivars and different fertilizer application treatments, Mabroka cultivar which fertilized with full dose of bagasse ash and vinasse (T₂) resulted in the highest carbohydrate percentage, while Abis cv. which fertilized with 25% inorganic and 75% organic fertilizer (T₅) resulted in the lowest carbohydrate percentage.

Table (11): Effect of organic and inorganic fertilizer on carbohydrate and crude protein (%) of sweet potato.

Treatment code	2018			2019		
	Mabroka	Abis	Means (a)	Mabroka	Abis	Means (a)
T ₁	32.33	32.01	32.17	3.20	3.27	3.24
T ₂	34.30	34.02	34.16	5.25	5.32	5.24
T ₃	31.13	31.05	31.09	3.17	3.13	3.15
T ₄	31.69	31.52	31.60	5.18	5.11	5.15
T ₅	30.56	30.46	30.51	4.21	4.15	4.18
Means (b)	32.00	31.81	---	4.20	4.19	---
LSD	a= 0.63 b= ns ab= 1.02			a=0.65 b= ns ab= 1.13		

In crude protein production, the highest percentage was realized from organic fertilizer treated (T₂), followed by 50 % organic plus 50% inorganic fertilizer treated (T₂), while the lowest percentage were recorded at 25% inorganic plus 75% organic fertilizer treated (T₅). There was no significant difference between the sweet potato cv. carbohydrate percent in the study (Table 11). Regarding the interaction effects between different sweet potato cultivars and different

fertilizer application treatments, Abis cultivar which fertilized with full dose of bagasse ash and vinasse (T₂) resulted in the highest amount of crude protein percentage, while Abis cultivar which fertilized with 75% inorganic and 25% organic fertilizer (T₃) resulted in the lowest amount of crude protein percentage.

4. Discussion

The present study aimed to reduce chemical fertilizers for sweet potato plants without reducing tuberous roots yield and also to improve tuberous roots quality through partial replacement of inorganic NPK with organic sources i.e. sugarcane bagasse ash and vinasse. Organic and inorganic fertilization treatments showed that, the highest values of growth characters, yield and tuberous roots quality were related to the application of 100% organic sources (bagasse ash and vinasse). Conversely, the lowest productivity was related to the application of 100% inorganic materials. On the other hand, the overlap between organic and inorganic fertilizers led to varying responses in all vegetative, yield and quality characters. Therefore, fertilization mode is ought to play an important role in sweet potato productivity. Whereas, sweet potato productivity is strongly affected by the different doses and sources of fertilizers. The highest growth and tuberous roots yield were related to the sufficient availability of NPK and other essential

nutrients. Under this condition, plants developed the best growth indices so they could produce the highest yield. Although inorganic fertilizer when applied to crop usually has a quick-released formula making nutrient rapidly available to plants, but because of the high cost and its long time adverse effect on soil chemical properties, organic fertilizer are recommended for use, organic fertilizer are environmentally friendly and it supply both macro and micro nutrients to the soil (Negassa *et al.*, 2001; Tirol-padre *et al.*, 2007) and also improve the physio-chemical properties of the soil. Calculated data of sweet potato characters under our studies pointed to the important role of organic fertilizer in form of sugarcane bagasse ash and vinasse for improving sweet potato traits, this results support the work of Webber *et al.* (2017) reported that, increasing the sugarcane bagasse ash percentage significantly influenced total exchange capacity, pH, organic matter, estimated nitrogen release, and all other nutrients measured, except for sodium. At the same trend, Mwita *et al.* (2019) reported that, application of different levels of sugarcane bagasse positively influenced most of the yield parameters of Chinese cabbage (*Brassica rapa* subsp. *pekinensis*). Crop improved in response to its favorable effects on the soil characteristics. Utilization of sugarcane bagasse as organic fertilizer can save chemical fertilizers along with minimizing environmental pollution. By comparing the levels of sugarcane

bagasse application they reported that, 10% was suggested to be the standard dose due to best yield parameters such as the root and shoot length of plant, root and shoot dry weight of plant, number of leaves and relative water content of Chinese cabbage (*Brassica rapa pekinensis*) crop in the soil amended with SCB. Also, In Greece, wheat production was increased by vinasse application, confirming the beneficial effects of the residue in agriculture. In Spain (Madejon *et al.*, 2001), yields of beets and maize were compared after treatments with an organic compound based on vinasse or a mineral fertilizer. Crop production was similar in both treatments indicating that the utilization of vinasse is a viable alternative for mineral fertilizers. Rajagopal *et al.* (2014) reported that, rate of vinasse application in agriculture has added significant amount of nutrients, improved the soil quality of degraded land and increased of crop yields. In Mauritius, vinasse application of 100 m³ ha⁻¹ for 10 years to sugarcane crops produces additionally cane yield of 80 to 90 tonnes that is equivalent to one more crop season (Soobadar and KeeKwong, 2012). The vinasse application increased significantly N, P, K, S and Ca uptake as well as yield of sugarcane, wheat, pigeon pea and maize yield over the countries (Komdorfer and Anderson, 1993). Vegetable crops are sensitive to vinasse and irrigation by 33% dilution increased the fruit size and weight (Chidankumar *et al.*, 2009). The lowest values of growth characters, yield and tuberous roots

quality were related to the application of 100% inorganic fertilizer source. This might be due to that available minerals in inorganic source was not sufficient for optimum sweet potato growth or it may be due to its loss by washing in sandy soil. This is line with the work of Errebhi *et al.* (1998) that potato is highly responsive to N-fertilization and that N is usually the most limiting essential nutrient for potatoes growth and development. Although urea application effect was not different significantly from the poultry manure, poultry manure is preferred to urea in the study because of its ability to improve soil structure through the increased activities of microorganism in the soil. It is therefore concluded that poultry manure application wherever is available is the best for the production of sweet potato. The influence of fertilization to achieve a high yield and generally good quality of vegetable crops is well known. Good sweet potato yield is the result of integrated effects of many factors that influence plant growth during different growth stages. This is due to the fact that plants received much available NPK enhanced their vegetative growth and they could be reflected as more productivity for tuberous roots yield. The best proportion of NPK source depending on the available NO₃-N, P₂O₅ and K₂O in organic source and in cultivated soli.

5. Conclusion

It may be concluded on the basis of

present investigation that, organic fertilizer treatment which included sugarcane bagasse ash and vinasse with 5 ton and 80 liters per feddan respectively were more positively effects on vegetative growth characters and tuberous roots yield and quality of sweet potato crops than, the inorganic fertilizer treatment (NPK) or the different mixing ratios of them. on the other side, there is no significant differences between sweet potato cultivars under study in tuberous roots yield and quality.

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