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The Influence of Applying some Stimulating Agents and Humic Acid on Productivity and Quality of Cassava Plants under Loamy Sandy Soil

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ABSTRACT

The effect of using some foliar spray stimulating agents (amino acids, potassium humate, micro-nutrients), as a spray application with humic acid and mineral fertilizers on yield and quality of Cassava plants (Indonesian, cv.) was studied. Moreover, the need for installation of drainage system was also investigated to maintain both soil salinity and water table in safe limits for plants. A field experiment was carried out at Al-Kassaseen Research Station – Ismailia Governorate, Egypt. The experiment was conducted during the two summer seasons 2017 and 2018. Mineral fertilizer was used as a recommended dose with or without humic acid and with or without foliar spray stimulating agents (amino acids, potassium humate, micro-nutrients).The experiment included eight treatments. The obtained results indicated that the maximum productivity of Cassava tubers was observed with mineral fertilizer with humic acid and stimulating agents compared to control. Total yield of tuber fresh weights and dry matter % of Cassava had the following decreasing order:MHP > MHA> MHN >MP >MH> MN > MA > M. Moreover, a pronounced increase in tubers quality with (dry matter, starch, total sugar, crud protein and vitamin C) and nutrient contents (N, K, P, Zn, Mn, Fe and Cu) of Cassava tubers was noticed with the application of foliar stimulating agents under mineral fertilizer with humic acid compared to control.The results showed also a decrease in soil salinity compared with the control (M) for different treatments of the study after harvesting Cassava according to the following order :MH > MHA or MHP > MHN >MP >MA >MN. The recommended calculated drain spacing in this area according to measured field data is 100 m spacing between drains and the recommended drain depth is 1.2 m.

Keywords: humic acid, stimulation agents, dry matter, amino acid, potassium humate, tile drains .

INTRODUCTION

In recent years, much amelioration has been carried out across refinement on of quality and quantity in agriculture. The progresses and development in agriculture depend not only on mechanization and new crossbred seeds but also on the refinement on the soil characteristic which also help to increase the yield productivity. Inadequate soil conditions for the plant development generally had from the lack of organic contents in the soil. To solve this problem, humic substances are used which improve soil fertility and crop yield. The effect of organic matter on the soil characteristic physical, chemical and biological has been recognized for a long time. Soil organic matter contains residues of plants and animals and organic compounds found as a result of decomposition. Soil organic matter has not certain chemical formula due to its dynamic structure. Soil organic matter mainly consists of humic and fulvic acids which are called humic materials (Schnitzer 1982; Andriesse 1988). They are mainly produced from nitrogenous compounds containing decomposed amino acids and aromatic complexes (Andriesse 1988). Those organic complexes affect the soil properties and physiological properties of plants due to carboxyl (COOH–) and phenolic (OH–) groups; also affect physical and chemical properties of soils (Lee and Barlett 1976; Schnitzer 1992).

In many studies, suggested that uses of humic acid led to increase the uptake of mineral elements (Mackowiak *et al.* 2001), to promote the root length (Cenellas *et al.* 2002), and to increase the fresh and dry weights of crop plants (Chen *et al.* 2004a, b). Due to the positive effect of humic substances on the growth of plants, these chemicals have been widely used by the growers. In plant, amino acids have necessary roles in cell life. Amino acids are among the almost important primary metabolites within the plant cells. However, they are considering as secondary metabolites, particularly in the case of proline, Glycine. Many physiochemical properties of plant cells, tissues and organs are affected by the existence of amino acids (Rai 2002; Marschner 2011). They are the constructors units of proteins, as the main component of a live cell that has necessary roles in many cell metabolic reactions (Kielland, 1994). In addition, amino acids have several important biological functions in plant cells including detoxification of toxins and heavy metals (Hussain *et al.*, 2018;Bashir *et al.*, 2018), improve the nutrient uptake, translocation and metabolism, biosynthesis of vitamin , growth bio stimulation, make higher stamina to environmental stresses such as drought, salinity . Application of amino acids can have beneficial effects on yield and quality of leafy vegetable crops. Micronutrients are absorbed by the plant in very small quantities, but are a basic component of many enzymes and thus play an essential role in most metabolic processes. Micronutrient such as manganese, zinc, iron and copper are essential for plant maturing, crop productivity, and its quality, they play an important role in crop nutrition (Mousavi *et al.*, 2012). Manganese is one of the major

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micro-nutrients, which has an important role in plant as an element of enzymes involved in photosynthesis and else processes (Mousavi *et al*., 2011).

Foliar fertilizer application with zinc, magnesium and sulfur, it had good effects on yield and quality of Cassava root (Panitnok *et al*., 2013). Ahmed *et al*. (2011) indicated that foliar application of zinc stimulated the crop growth, improved quality of tuber and increased the productivity. Also, iron has a role function in the synthesis of chloroplast protein and with chlorophyll synthesis. Copper is essential for metabolism of carbohydrate and nitrogen, also the copper is important for lignin synthesis which is needed for cell wall strength and prevention of wilting. Copper deficiency causes dwarfing in growing plants (Allen *et al*., 2007).

Ahmad *et al*. (2015) found a significant improvement in physical properties like aggregate stability, bulk density, saturated hydraulic conductivity and soil moisture content with the application of humic acid at 150 kg ha-1 level. And this improvement was also reflected in valuable increase in wheat crop yield and improvement of soil physical and hydraulic properties by the addition of humic acid amendment. The stable carbonaceous compounds present in soil organic matter like humic acid act as binding factors for the primary soil particles, and resultantly improve the structural stability of the soil aggregates (Six *et al*., 2000). Application of organic substances in to the soil significantly affects the surface soil physical characteristics. These include stable aggregates, less bulk density and the improved hydraulic conductivity under saturated conditions (Barzegar *et al*., 2002; Zeleke *et al*., 2004). The grades of humic substances prepared from farmyard manure has shown better and long lasting stability of aggregates as compared to the application of bulky levels of farmyard manure (Piccolo *et al*., 1997).

Potassium have important role in photosynthesis, promotes the circulation of the ascending sap in the xylem and the transfer of assimilates (sugars, amino acids) to roots and storage organs (grains, fruits, tubers) according to Adjanohoun, (2006). .Also, amino total as a source of amino acids may be play an important role in plant metabolism and protein assimilation which necessary for cells formation and consequently increase fresh and dry matter. However, similar effect and findings about amino acids were reported by El-Zohiri and Asfour (2009) on potato .

Cassava is the fourth of most important source of food energy in the tropics countries (Abdullahi *et al*., 2014).Cassava is extensively cultivated as an annual crop in tropical and subtropical regions for its edible starchy tuberous root and as a major source of carbohydrates (Kenneth, 2011). The crop is a low cost production and is one of the cheapest foods (Shams, 2011). The future demand for fresh Cassava may depend on improved storage methods. The markets for Cassava as a replace for cereal flours in bakery products and as source in animal feed were likely to expand. The use of Cassava had a source of ethanol for an efficient source of energy (Cock, 1982). Cassava is one of the most drought-tolerant crops, can be successfully grown on marginal soils, and gives reasonable yields where many other crops do not grow well, also Cassava has the potential to grow in poor soils with a pH ranging from acidic to alkaline.

The aim of the present study is to evaluate the mineral fertilizer and stimulation agents (amino acids, potassium humate, micro-nutrients), as a spray application beside humic acid on yield and quality of Cassava plants (Indonesian, cv.) and to study its effect on soil properties and to verify the need for installation of drainage system to maintain both soil salinity and water table within safe limits for plants.

MATERIALS AND METHODS

A field experiment was established at El-Kassaseen Research Station ,Agric. Research Centre, Ministry of Agriculture Ismailia Governorate, Egypt, (E 31 57 37.25 N 30 31 14.17during two summer seasons 2017 and 2018 . The studied soil is characterized by a loamy sand texture, average values of ECe=3.3 dS m^{-1} ; a high hydraulic conductivity (1.56 m/day) .The main soil characteristics are presented in Table (1).

Table 1. Some chemical and physical properties of soil before planting Cassava at El Kassaseen Research Station

soil characteristics	soil depth (cm) 0-30	30-60	60-100
Chemical properties			
pH(1:2.5)	7.6	7.8	7.8
EC_e (dS/m)	3.6	3.3	2.9
Soluble cationsmeq/l			
Ca^{++}	7.7	7.3	6.5
Mg^{++}	5.2	4.5	4.4
K^{+}	0.8	0.7	0.6
Na^{+}	23.3	21.5	17.5
Soluble anions meq/l			
$HCO3^{-}$	1.2	1.1	1.1
Cl^{-}	30.4	28.7	22.7
$SO4^{--}$	5.4	4.2	5.2
Available micronutrients (mg/Kg)			
Fe	2.3	2.7	2.5
Mn	1.6	1.9	1.7
Zn	0.7	0.8	0.6
Cu	0.4	0.4	0.3
Physical properties			
Wilting point % (vol)	5.0	4.4	3.7
Field capacity % (vol)	10.6	8.7	7.6
Available water (cm/cm)	0.06	0.04	0.04
Saturation % (vol)	41	41	42
Bulk density (g/cm^3)	1.58	1.55	1.54
Total porosity %	40.4	58.5	58.1
Ks (m/day)	1.56	1.55	1.52
Particle size distribution %			
Coarse sand	37.7	40.4	40.3
Fine sand	40.4	42	44.8
Silt	14.6	12.4	10.7
Clay	7.3	5.2	4.2
Soil texture	Loamy sand	Loamy sand	Loamy sand

Cassava (Indonesian, *cv.*) is characterized with high dry matter, good maleness, ground storability and well adapted to Egyptian environmental conditions as well as can also bulk early and easy to process. Healthy Cassava stem cuttings (middle internodes) 20–25 cm length with about 5–7 nodes were chosen. To overcome stem-borne pests stem cuttings were treated by dipping them in a dilute fungicide solution (Vitavax 75%) and transplanted vertically. The used experimental layout was a split-plot in a randomized complete blocks design, with three replicates. Main plots were consisted of mineral fertilizer with or without humic acid. The application of humic acid was carried out two times, the first addition was done after two weeks from grown and the second one was applied after four weeks from grown. Sub-plots were done to apply foliar application of stimulation agents (amino acids, potassium humate, and micronutrients mixture. Each sub-plot having an area of 10 m^2.

The experiment includes eight treatments, the treatments were as followed:

T1: mineral fertilizer (recommended dose of NPK)[M] as control

T2: mineral fertilizer (recommended dose of N PK) +humic acid (6.0 Kg/feddan) [MH]

T3: mineral fertilizer + foliar spray of amino acids (1%) [MA]

T4: mineral fertilizer + humic acid +foliar spray of amino acids (1%) [MHA]

T5: mineral fertilizer + foliar spray of micronutrients (30%) as EDTA [MN]

T6: mineral fertilizer +humic acid + foliar spray of micronutrients (30%) as EDTA [MHN]

T7: mineral fertilizer + foliar spray of potassium humate (1.5%) [MP]

T8: mineral fertilizer +humic acid + foliar spray of humate potassium (1.5%) [MHP]

Four times of foliar spray application was carried out during the growing season. The applications were carried out after 30, 60, 90 and 120 days from sowing. Soil was fertilized with N, P and K with recommended rates. A set of deep wells were installed to 1.5 m depth to monitor the water table during the study period.

Analytical methods:

Physical and chemical characteristics of the studied soil were determined according to (Black, 1983). In tuber samples, Carbohydrate was extracted according to (Smith, *et al*., 1964) and determined using spectrophotometer according to (Murphy, 1958). Starch % in tuber was determined by (A.O.A.C, 2000) methods. Nitrogen, phosphorus and potassium were determined as described by (A.O.A.C, 2000, Olsen *et al*., (1954) and Jackson, 1967), respectively. Zn, Mn, Fe and Cu concentration were measured by ICP. Crude protein percentage was calculated by multiplying the nitrogen concentration by 5.75.

Drain spacing is calculated using Hooghoudt's formula (Hooghoudt, 1940), as follows:

$$L^2 = (8Kd_eh + 4Kh^2) /q$$

Where:

L = drain spacing (m)
K = hydraulic conductivity (m/day)
d_e = equivalent depth (m)
h = hydraulic head (m)
q = drain discharge rate (m/day)

RESULTS AND DISCUSSION

Effect of humic acid and some stimulation agents

Tubers yield and dry matter of Cassava plant

Data presented in Table (2) showed the effect different treatments applied in this study on Cassava tubers yield and quality parameters for average two summer seasons.

The results revealed that the highest effect in total yield of tuber fresh weights and dry matter of Cassava plant was obtained by using mineral fertilizer + humic acid + foliar spray of humate potassium (1.5%) [MHP]. The increasing in total yield of tuber fresh weights and dry matter % of Cassava plant had the following decreasing order:

MHP > MHA> MHN >MP >MH> MN > MA > M

Table 2. Effect of humic acid and some stimulation agents on Cassava tubers yield and quality parameters for average two seasons

Treatments	Tuber fresh weight ton/fed	Dry matter %	Starch %	Total sugar mg/g d. w.	Total protein %	Vitamin C mg/100g DW
M (control)	9.43	38.73	17.03	7.88	1.70	36.0
MH	11.21	42.47	18.44	8.51	1.81	38.8
MHA	12.76	45.63	19.27	9.26	1.92	38.9
MHP	13.13	46.74	22.25	10.13	1.98	39.6
MHN	12.73	44.40	20.68	9.68	1.95	39.2
MA	10.55	40.55	17.93	8.33	1.78	36.5
MP	11.27	43.71	20.05	8.76	1.80	37.1
MN	10.95	40.83	18.08	8.43	1.74	36.5

M = mineral fertilizer H= humic acid P= potassium humate N=micro-nutrients A= amino acid

The increasing percentage for the total yield of fresh weights for tubers compared with the control treatment (M) for the previous treatments (MHP , MHA, MHN ,MP ,MH, MN , MA and M treatments) were 39.2, 35.3,35.0 , 19.5, 18.9, 16.1 and 11.9% ,respectively. While the percentages of dry matter of tubers increase were 20.7,17.8,14.6, 12.9,9.7, 5.4 and 4.7 %, respectively. Also, addition of humic acid (6.4 Kg/feddan) with mineral fertilizers (recommended dose) led to superiority in both fresh tuber yield and dry matter which amounted to 18.9% and 9.7% , respectively comparing with the control treatment (mineral fertilizer without addition of humic acid-M) . It might be concluded that the addition of humic acid to the Cassava plants caused an increase of the nutrients in rhizosphere consequently the more nutrients were absorbed, so more and enhancement of growth plant which caused an increase the tubers yield. Many investigators studied the behavior of many vegetable crops to the addition of organic fertilizer and obtained a data supported that mentioned here (Belay *et al*., 2001, Amanullah *et al*., 2006 and Makinde and Ayoola 2008).

Quality parameters of Cassava tubers roots

Data presented in Table (2) showed that, the tuber roots quality characteristics (total starch, total sugar, crud protein and vitamin C) of Cassava plants increased in response to any of the tested both stimulation agents (amino acids-A , potassium humate-P , micro nutrients mixture-N) and mineral fertilizer –M mixed with humic acid –H compared to control-M. The percentages of increase for starch compared with the control were 30.7,21.4 , 17.7 ,13.2,8.3 ,6.2 and 5.3 % for MHP ,MHN , MP , MHA,,MH, MN and MA treatments, respectively . Concerning the total sugar the increase percentages were 28.6 , 22.8 , 17.5 ,11.1 , 8.1 , 7.0 and 5.7 % for MHP , MHN , MHA, MP ,MH, MN and MA treatments respectively. On the other hand, applying mineral fertilizer with humic acid and potassium humate (MHP treatment) showed the highest increase percentages in total protein and vitamin C compared to control treatment these percentages of increase were 16.5 and 10 %, respectively.

The results also emphasized that applying mineral fertilizer –M with any of stimulation agents (MHA,MHP and MHN treatments) had a positive effect on the same parameters compared to control (mineral fertilizer-M). Moreover, humic acid mixed mineral fertilizer application and spray of potassium humate was superior over on rest of treatments on the same parameters. Generally, the mineral fertilizers mixed with humic acid and spraying with stimulation agents(amino acids , potassium humate , micro nutrients mixture) gave the highest of quality parameters (total starch, total sugar, crud protein and vitamin C), then mineral fertilizers mixed with humic acid without spraying of stimulation agents and that compared to mineral fertilizer and spraying with stimulation agents except mineral fertilizers and spraying with potassium humate was higher than mineral fertilizers mixed with humic acid without spraying . The increase in the treatment of mineral fertilizers was mixed with humic acid without spraying of stimulation agents (MH treatment) was as follows 8.3, 8.0, 6.5, 7.8 % for starch , total sugar , total protein and vitamin C respectively, similar trends of such results were reported by Olasantan (2003) and Hassan *el. al.*,(2007) on Cassava. The positive effect of spraying by potassium humate on tuber quality parameters might be attributed to the role of K in assimilation and translocation of carbohydrates, as well as, in their conversion into starch (Nelson, 1970). Jansson, (1980) reported that, foliar application of micronutrient mixtures on the growth of Cassava plants led to increase in growth, tubers yield , quality of tubers , and total yield /feddan as well as tubers contents(dry matter, starch, and total sugar) of Cassava plants growing in sandy soils.

Macro and micronutrient content of Cassava tuberous roots

NPK content of Cassava tubers

The obtained results in Table 3 showed that application of mineral fertilizer with humic acid (H) and stimulation agents (amino acid-A, potassium humate-P, micro nutrients mixture-N) had an effect on the N, P and K content in tubers in average two seasons. However, MHP treatment gave highest NPK content in tubers. The results also showed that the foliar use of micro-nutrients-N with mineral fertilizer-M (MN treatment) generally, increased N and K contents but decreased P content of Cassava tubers.The results presented herein appeared to be in accordance with those found by Ali, and Abd –Elkader (2014). Some studies explain these positive effects in the ability of humic acid to hold the nutrients in rhizosphere area. Humic acids enhance the absorbance capacity of nutrients of the roots by having carboxylic and phenolic groups and increasing H+-ATP activity in the root cells (Cenellas *et al*., 2002).

Table 3. Macro and micro-nutrients contents in Cassava tubers for average two seasons

Treatments	N %	P %	K %	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cu (ppm)
M	2.21	0.69	2.30	55.8	8.55	1.63	2.25
MH	2.53	0.77	2.84	85.1	9.89	1.79	3.10
MA	2.39	0.73	2.38	69.0	8.59	1.66	2.81
MHA	2.70	0.79	2.90	92.0	9.92	1.79	3.14
M N	2.33	0.67	2.59	80.1	8.84	1.86	3.07
MHN	2.71	0.74	2.95	93.4	10.4	1.99	3.31
MP	2.46	0.80	2.68	87.6	9.22	1.85	2.99
MHP	2.81	0.89	3.17	95.7	10.62	2.10	3.40

M = mineral fertilizer H= humic acid P= potassium humate N=micro-nutrients A= amino acid

Micro-nutrients content of Cassava tubers

Data presented in Table (3) indicated that the combination between humic acid-H mixed with mineral fertilizers-M and spraying with stimulation agents (amino acids-A, potassium humate-P, and micro nutrients mixture-N), recorded the highest values in the content of micro nutrients (Fe, Mn, Zn, Cu) in Cassava tubers. However, the MHP- treatment showed the highest content of micro-nutrients in Cassava tubers .Also, application of spraying with stimulation agents led to increase in micro-nutrients content compared to the two fertilization types (mineral fertilizers, mineral fertilizers mixed with humic acid). These results are consistent with Calvo, *et al*., (2014) and Du Jardin, (2015) who reported that, stimulation agent's act by increasing plant mineral uptake and by improving the nutrients use. Amino acids are good chelating agents and act as carriers of micronutrients contained in the fertilizers or soil, the effect of stimulating agents of plant growth results from the synergism of many components at different concentrations (Popko *et al* 2014). In fertilizers, amino acids form organic connections with minerals (amino acid), which increase the availability of nutrients by plants (Johansson, 2008).

Effect of different treatments on Soil salinity

Data presented in Table (4) showed the soil reaction and soil salinity under different treatments applied in this study. The obtained results revealed clearly that a decrease in soil salinity for different treatments of the study after harvesting Cassava plant according to the following order:

MH > MHA or MHP > MHN >MP >MA >MN

The reduction percentages in soil salinity in the top 1.0 m compared to the control treatment were 40.0 , 32.2 , 32.2 , 30.0 , 18.9 , 16.7 and 14.4 % for MH , MHA , MHP ,MHN ,MP ,MA,MN and M treatments , respectively. Generally, it could be noticed that the lowest reduction in soil salinity occurred with the application of mineral fertilizer with stimulation agents (MP,MA and MN treatments) . Whereas, adding mineral fertilizer with humic acid (MH treatment) resulted the maximum reduction in soil salinity of top 1.0 m which emphasizes that humic acid play an important role in lowering soil salinity. These obtained results are in harmony with the findings found by (Ahmad et al. 2015) who found that the use of humic acid in soil as an organic source improved the physical condition of soil by improving the aggregate stability of soil and reducing the compactness of soil which result in decrease in bulk density and increase in porosity of soil and finally improved the water infiltration. Moreover, the obtained data revealed that, foliar spray application of stimulation agents with humic acid with mineral fertilizers resulted in a pronounced decrease in ECe values of studied soil.

Table 4. Soil reaction and electrical conductivity in soil after harvest of Cassava plants for average two summer seasons

Treatments	Soil depth (cm)	pH	ECe (dS/m)
	0 -30	7.81	2.7
M	30 -60	7.8	2.9
	60 -100	7.81	3.4
Average	0-100	7.81	3.0
	0 -30	7.71	1.9
MH	30 -60	7.76	1.6
	60 -100	7.76	1.9
Average	0-100	7.74	1.8
	0 -30	7.79	2.1
MA	30 -60	7.77	2.3
	60 -100	7.79	3.1
Average	0-100	7.78	2.5
	0 -30	7.73	1.9
MHA	30 -60	7.75	1.7
	60 -100	7.76	2.5
Average	0-100	7.75	2.0
	0 -30	7.78	2.1
MN	30 -60	7.8	2.4
	60 -100	7.78	3.2
Average	0-100	7.79	2.6
	0 -30	7.74	1.9
MHN	30 -60	7.8	1.8
	60 -100	7.78	2.6
Average	0-100	7.77	2.1
	0 -30	7.77	2.1
MP	30 -60	7.8	2.6
	60 -100	7.79	2.6
Average	0-100	7.79	2.4
	0 -30	7.71	1.8
MHP	30 -60	7.75	1.9
	60 -100	7.79	2.4
Average	0-100	7.75	2.0

Tile drains design

To maintain the soil salinity to the safe level and to lower water table for a better root zone aeration it is recommended to install drainage system in the study area.

The monitored water table data and the determined saturated hydraulic conductivity values were used to estimate the tile drain spacing according to Hooghoudt's equation (1940).

The fluctuation of water table is recorded during the period of the study and illustrated in Figure (1).

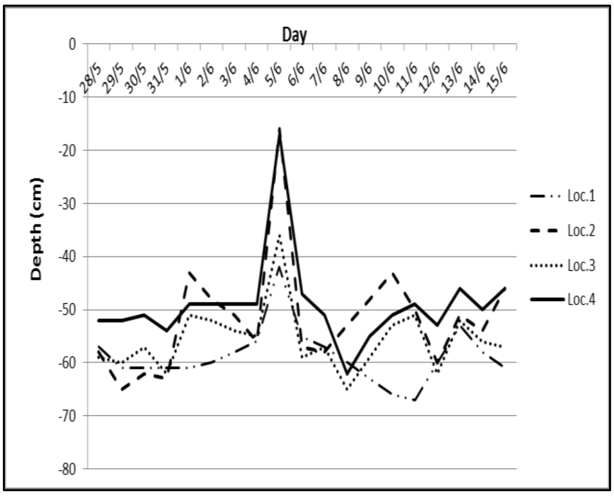

Figure 1. Water table fluctuation in El-Kassaseen Experimental Station during the study period

The recommended calculated drain spacing in this area according to measured field data is 100 m spacing between drains and the recommended drain depth is 1.2 m. Installing the drains according to these recommended values maintain both soil salinity and water table to safe limits for plants.

CONCLUSION

Sustainable agriculture requires using not only effective mineral fertilizers containing macro and micro elements, but also use of stimulating agents which are a rich source of active compounds. These very important formulations allow achieving significant increases on productivity and quality of Cassava plants, as well as improve the health of plants, improve the efficiency of nutrients uptake. The study has shown a positive effect of the use of three stimulating agents (potassium humate, amino acids and micronutrients) under mineral fertilizers with humic acid in the cultivation of Cassava plant. The increase in Cassava production reached to 39.2, 35.3 and 35.0% for MHP,MHA, MHN treatments compared to control (mineral fertilizer), respectively. Thus, the present study recommended spraying Cassava that grown under mineral fertilizers with humic acid and with potassium humate at the rate of 1.5%, to produce a higher tuber yield of good quality.

The recommended calculated drain spacing in this area according to measured field data is 100 m spacing between drains and the recommended drain depth is 1.2 m. Installing the drains according to these recommended values maintain both soil salinity and water table to safe limits for plants.

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تأثيراستعمال بعض العوامل المحفزة وحمض الهيوميك على إنتاجية ونوعية نبات الكاسافا تحت ظروف التربة الرملية الطميية

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تم دراسة تأثير رش بعض العوامل المحفزة (مثل الاحماض الامينية – هيومات البوتاسيوم – والعناصر الصغرى) وايضا استخدام حمض الهيوميك بالاضافة الى التسميد المعدنى على انتاجية وخواص درنات نبات الكاسافا ،هذا بالاضافة الى دراسة تأثير هذه الاضافات على ملوحة التربة ومدى احتياج منطقة الدراسة لشبكة صرف للمحافظة على ملوحة التربة من التدهور والمحافظه على مستوى الماء الأرضى عند الحدود الامنه المسموح بهاوالتى لا تضر النبات. أجريت الدراسة فى محطة البحوث بالقصاصين بمحافظة الأسماعيلية بمصر وذلك خلال موسمى صيف 2017 و 2018 ، وقد تم استخدام الجرعات الموصى بها من الأسمدة المعدنية مع استخدام حمض الهيوميك معها فى بعض المعاملات واخرى بدون استخدامه فى معاملات اخرى كما تم الرش بالمواد المحفزة معها او عدم رشها فى معاملات اخرى ، وقد اشتملت التجربة على ثمانية معاملات وصممت التجربة على اساس التصميم قطع منشقه كاملة العشوائية مع استخدام ثلاث مكررات لكل معاملة .وقد بينت النتائج المتحصل عليها ان اقصى انتاجية لنبات الكاسافا تم الحصول عليها عند رش النبات بالمواد الحفزة مع استخدام التسميد المعدنى واضافة حمض الهيوميك بالمعدلات الموصى بها وذلك مقارنة بامعاملة الكونترول (اضافة تسميد معدنى فقط بالمعدلات الموصى بها) وكانت الانتاجية للمعاملات المختلفة بالتجربة تتبع الترتيب التالى: MHP > MHA> MHN >MP >MH> MN > MA > MMHP , MHA, MHN كما اكدت النتائج المتحصل عليها ان اضافة التسميد المعدنى مع المواد الحفزة وحمض الهيوميك-كان لها تأثير ايجابى على خواص وجودة درنات نبات الكاسافا (المادةالجافة- النشا – السكر الكلى – البروتين – فيتامين سى) ، علاوة على حدوث زيادة ملموسة فى المحتوى من العناصر الكبرى والصغرى . اما بالنسبة لملوحة التربة فلوحظ انخفاض فى ملوحة التربة مقارنة بمعاملة الكنترول (تسميد معدنى فقط) و قد اخذ الانخفاض فى ملوحة التربة الترتيب التالى طبقا للمعاملات المستخدمة فى التجربة كما يلى : MH > MHA or MHP > MHN >MP >MA >MN حيث اوضحت النتائج ان اضافة حمض الهيوميك بالمعدلات الموصى بها مع اضافة الأسمدة المعدنية أدى الى خفض ملوحة التربة بدرجة كبيرة مقارنة بمعاملة الكونترول . وبناء على النتائج المتحصل عليها والخاصة بقياسات عمق الماء الأرضى وكذلك نفاذية التربة تم تصميم شبكة صرف مغطى يوصى بتنفيذها بمنطقة الدراسة بحيث تكون المسافات بين المصارف 100 متر وعمق المصرف 1.2 متر وذلك بهدف المحافظة على ملوحة التربة من التدهور والمحافظة على مستوى الماء الأرضى عند الحد الامن المسموح به والذى لا يضر النبات المنزرع .