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EFFECT OF SOME MINERAL NPK RATES AND HARVESTING DATES ON PRODUCTIVITY AND QUALITY OF CASSAVA YIELD

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ABSTRACT

The present study was performed in a newly reclaimed land at Ali Moubark Farm, South Tahrir Research Station, Horticulture Research Institute, during the two successive growing seasons of 2009/2010 and 2010/2011, to study the effect of four rates of mineral NPK and harvesting dates on the productivity and quality of cassava tuber roots (Indonesian cultivar). The treatments included four different levels of mineral fertilizer NPK namely 50%, 100%, 150% and 200% of the recommended NPK (50 N + 77 P_2O_5 + 96 K_2O kg/fed.) by Sherif *et al.* (2003), and four harvesting dates (8, 9, 10 and 11 months from planting). Application of NPK fertilizer at rate of 50% significantly produced the highest chlorophyll content in leaves (SPAD), tuber roots yield and average weight of tuber root. On the contrary, the highest rate of 200% NPK increased plant height, leaf area. On the other hand, using rate of 150% NPK increased dry matter yield and percentage, diameter, starch % and starch content yield of tuber roots. NPK percentage in cassava leaves at 180 day after planting, were not affected with any rate of mineral fertilizers. Concerning harvesting dates, the highest yield, dry matter yield and percentage, average weight and diameter of tuber root, percentage and the content of starch in tuber roots were obtained with harvesting at 10 months age, while the harvesting at 8 months had the reverse trend. Applying mineral fertilizer to cassava at rate of 150% NPK and harvesting at 10 months after planting, gave the highest estimated values for tuber roots yield, dry matter yield and percentage, starch yield and percentage. The mineral fertilizer of 50% kg of NPK gave the highest average tuber root weight when cassava harvesting was done at 10 months age. Also, the highest average tuber root diameter was obtained when cassava received 100% NPK and harvested at 9 months age.

INTRODUCTION

The recent introduction of cassava *(Manihot esculenta* Crantz) in the newly reclaimed land in Egypt showed very promising results. Since cassava can be mixed with wheat flour at a ratio about 15% for bread making. Further more, for animal feed, root flour can substitute maize with a ratio of 20-30% (Sherif *et al.,* 2003). In addition, starch of cassava roots can be used as a cheapest alternative raw material source for several industrial purposes (El-Fieshawy, 1986). Thus cassava crop has a tremendous future. While, it was found that low cassava yields obtained by most farmers resulted from the following factors: 1) cassava is grown mostly on low fertility soil and 2) farmers do not apply enough fertilizers (usually only N and /or farmyard manure). So, in Egypt, Sherif *et al.* (2003) indicated that using of phosphorus fertilizer at 77 kg P_2O_5/fed and/or potassium fertilizer at 96 kg K_2O/fed. plus 50 kg N/fed. reached maximum plant height and significantly increased

number of total tubers/plant, average length and diameter of tuber roots and weight of fresh tuber roots /plant and yield of tuber roots/fed. as compared to phosphorus fertilizer at 46 kg P_2O_5/fed and/or potassium fertilizer at 72 kg k_2O /fed and the same rate of N fertilizer. Suyamto and Howeler (2001) stated that application of NP-only fertilizer resulted in the lowest height plant (109 cm), the lowest yield of cassava (11.88 t/ha fresh roots) and the lowest number of roots/plant (7.5). In this area, the K content of the soil is very low and therefore, K was main limiting factor for cassava production. The same rate of N (200 Kg/ha of urea) and P (100 Kg/ha sp-36) fertilizer the application of 50 Kg of KCl/ha increased the plant height and cassava yield by 55%, (from 11.88 to 18.42 t/ha fresh roots), as compared to the application of N and P only. Increasing the rate of KCl up to 200 Kg KCl/ha with the same rate of NP increased the cassava yield almost linearly. Also, Phien and Vinh (1998) reported that application of NPK fertilizers increased cassava yields by 71-112% compared to that of the control without fertilizer. The highest response was obtained with K fertilizer, followed by P and N fertilizers.

As a perennial crop, cassava has no definite lifetime or maturity period. However, after full development of the canopy, root growth will gradually decrease and ultimately reach point zero. This moment is sometimes called the maturity period of cassava (De Vries, 1985), and is the point when maximum or near maximum yield is obtained. When cassava is harvested too early, it often leads to reduction in yield, while delayed harvest leads to development of woody and fibrous tuberous roots, and reduction in starch content. Susceptibility to loss in starch content when cassava remains in the soil after maturity appears to be a disadvantage for starch production Ngendahayo and Dixon (2001). When, Ngeve (2003) harvested cassava tuber roots at 6, 8, 10, 12, 14 and 16 months after planting, the tuber root yields were lowest (2.9 t/ha) when roots were harvested at 6 months, but continued to bulk up to 18.5 t/ha at 16 months. The greatest root increase (9.3 t/ha) was observed between 8 and 12 months.

Therefore, the present study aimed to investigate the effect of various rates of mineral fertilization and harvesting dates on the productivity and quality of cassava in newly reclaimed lands.

MATERIALS AND METHODS

The present study was performed in a newly reclaimed sandy soil area at Ali Moubark farm, South Tahrir Research Station, Horticulture Research Institute, during the two successive growing seasons of 2009/2010 and 2010/2011. The two experiments were planted on 22nd and 21st April during the two growing seasons, respectively, using Indonesian cultivar supplied by Ali Moubark farm, South Tahrir Research Station in both seasons.

This investigation included two different factors during the two growing seasons.

1) NPK rates: four rates of N: P_2O_5: K_2O kg/fed. were used as following
a) 50% (25: 38.5: 48)
b) 100% (50: 77: 96)

c) 150% (75: 115.5: 144)
d) 200% (100:154: 192)

The rate of 50: 77: 96 (100%) kg of N: P_2O_5: K_2O/fed was chosen according to application by Sherif *et al.* (2003) on cassava in sandy soil, under the Egyptian conditions.

2)Harvesting dates

Four different harvesting dates were used after eight, nine, ten and eleven months of planting date.

The physical and chemical properties of the experimental soil area are illustrated in Table 1.

Table 1. Chemical and physical analysis of the soil at the experimental site.

Soil depth (cm)		0-30		**N**	10
EC dS/m		1.93	**Macro (ppm)**	**P**	13
pH		7.6		**K**	96
	Ca^{++}	0.6		**Cu**	1.4
Soluble Cations	**Mg^{++}**	0.4	**Micro (ppm)**	**Zn**	0.82
(meq/l)	**Na^{+}**	1.35		**Fe**	0.56
	K^{+}	0.2		**Mn**	0.6
	HCo^{-}	0.8		**Sandy %**	83.3
Soluble anions	**Cl^{-}**	1	**Mechanical**	**Silt %**	4.0
(meq/l)	**SO_4^{-}**	0.73	**analysis**	**Clay %**	13.68
	CO_3^{-}	0		**Texture class**	Sandy loam

The treatments were randomly arranged in split plot design with three replicates, the rates of mineral fertilization represented the main plot, and the harvesting dates were randomized distributed in the sub one, in both planting seasons.

Stalks of similar thickness of approximately 2.5-3.0 cm in diameter were cut into stalks of 25-30 cm in length and planted vertically by inserting two thirds of cuttings into the soil, keeping one third of them over ground at a distance of one meter within rows. The area experimental of each plot was 10 m^2, and contained one row one meter width and 10 meter length. The stalks were irrigated directly after planting. In this concept, a drip irrigation system with nozzles at 100 cm apart was adapted for irrigation. The inline laterals were (GR) type with 4L hr^{-1} discharge per emitter. As for fertilization, all experimental plots received phosphorus fertilizer provided from calcium super phosphate (15.5 % P_2O_5) which was incorporated during land preparation. Nitrogen was applied during the study in the form of ammonium nitrate (33.5 % N). Potassium sulphate (48% K_2O) was used as K source, both N and K fertilizers were fastigiated with the irrigation water within the fertilization system. The total amounts of nitrogen and potassium fertilizers were divided into 4 equal doses for the former and into 6 equal portions for the later. The fertilization program started four weeks after planting, then, at a period of one month. All agricultural practices needed for growing the cassava plants were performed.

Data recorded

1. Vegetative growth parameters

Representative random samples of six plants were chosen from each plot at 180 days after planting to record the vegetative growth parameters expressed as follows:

a. Plant height (cm), measure from the ground surface to the highest point of the plant.
b. Leaf area (cm^2) of the 5^{th} top fully leaf, determined using the LI-3100 area meter (LI-COR. Inc. Lincoln, Nebraska, USA).
c. Leaf chlorophyll content, determined using the fifth top fully leaf of three plants per plot. A digital Chlorophyll meter, model Minolta Chlorophyll meter SPAD-502, which SPAD unit = 10 mg/100 g fresh weight of leaves (Netto *et al.*, 2005), manufactured by Minolta Company was used.

2. Total yield and its quality

Representative random samples of three plants were taken from each sub plot at every harvesting date (240, 270, 300 and 330 days after planting) to record the following yield traits

a. Total yield of tuber roots, as weight of fresh tuber roots (ton/feddan)
b. Total dry matter of yield (ton/feddan), calculated according the following equation: $\frac{\text{DM X fresh tuber root yield (g/plant) X 4200}}{\text{100 X 1000 X 1000}}$
c. Average diameter of tuber root (cm): measured at the maximum thickness of tubers in cm
d. Average weight of tuber root (g), recorded by weighting the tuber roots divided by their number.
e. Dry matter of tuber roots percentage.

3. Chemical composition

a. The fifth top fully expanded leaf blade was collected from five plants within each treatment, at 180 days after planting as a sample for determining N (according to method of Koch and McMeckin, 1924), P (as described by Troug and Meyer, 1939) and K (as mentioned by Brown and Lilliland, 1946) concentrations in leaves.
b. Ton uniform tuber roots were randomly chosen from each sub plot to determine starch (%) as described by Nelson (1974). Total yield of starch (kg/fed) was calculated according the following equation:

$$\frac{\text{DM X starch X fresh tuber root yield (g/plant) X 4200}}{\text{100 X 100 X 1000}}$$

Statistical analysis

Data were statistically analyzed, according to Snedecor and Cochran (1980), using MSTAT-Computer V4. The Fishers protected least significant difference (LSD) at $P \leq 0.05$ was employed to separate the treatment means.

RESULTS AND DISCUSSION

1. Vegetative growth parameters

The application of various NPK fertilization rates resulted in an obvious and substantial effects on all measured vegetative growth

parameters (Table 2). Application NPK fertilizer at rate of 50% significantly produced the lowest values of plant height, leaf area and the highest chlorophyll content in leaves in both seasons. On the contrary, the highest rate of 200% NPK increased plant height, leaf area and caused the minimum chlorophyll content in leaves in both seasons.

The increment in the vegetative growth characteristics due to NPK fertilization may be due to the physiological role of these macronutrients on the meristematic activity of plant tissues and consequently increasing of plant growth (El-Abagy, 2002 on Jerusalem artichoke).

Similar results were concluded by Mansour (1992) who mentioned that the plant height and leaf area of cassava were increased with increasing N level up to 100 kg/fed plus 40 P_2O_5 and 75 K_2O kg per feddan compared with 50 N + 40 P_2O_5 + 75 K_2O kg / feddan and the control, while, chlorophyll content in leaves was increased with increasing N level up to 50 plus 40 P_2O_5 and 75 K_2O kg per feddan. Moreover, Sherif *et al.* (2003) reported that increasing in the values of plant height was observed with increasing phosphorus or potassium rate until 77 P_2O_5: 96 K_2O kg /fed.

Table 2. Effect of NPK rates on plant height, leaf area and chlorophyll content at 180 days after planting.

Treatments	Plant height (cm)		Leaf area (cm^2)		Chlorophyll content (SPAD unit)	
NPK rates	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011
50 %*	108.70	126.55	117.43	139.73	51.25	41.00
100 %*	112.98	132.75	121.45	162.95	49.20	40.60
150 %*	119.88	137.18	134.40	174.65	48.15	39.13
200 %*	122.23	146.50	146.68	184.23	47.43	38.95
LSD at 0.05%	5.57	3.05	16.19	24.35	1.60	1.49

*50% (25: 38.5: 48), 100% (50: 77: 96), 150% (70: 115.5: 144) and 200% (100:154: 192) kg of N: P_2O_5: K_2O/fed. respectively

2. Total yield and its quality

As show in Table (3) applying of mineral fertilizers at 50% kg of N: P_2O_5: K_2O /fed. gave the maximum values of average tuber root weight, followed by mineral fertilizers at the rates 100% and 150% and then 200% kg of N: P_2O_5: K_2O /fed. in both seasons. In contrast, no significant differences in average tuber root diameter were observed among the four levels of mineral fertilization in the first season. But, data show that applying mineral fertilizers at the rates of 100%, 150 and 200% kg of NPK/fed produced a higher average tuber root diameter as comparing to 50% of NPK, in the second season.

These results are in accordance with those obtained by Attalla *et al.* (2001), who reported that average diameter and fresh weight of cassava tuber roots per plant were increased with increasing potassium fertilizer rate from 100 to 200 kg K_2O/fed. Also, it is well known that potassium is not basic component of protein, carbohydrate or fats, but it is involved in their metabolism. K, is essential for carbohydrate translocation from the tops to the roots consequently. Also, inadequate supply of NPK for cassava will thus lead to excessive top and little root production. The present results agree with those reported by El-Fieshawy (1986) who stated that diameter and weight of

cassava tuber roots was increased when N was applied at 30 and 60 kg N/fed plus 120 P_2O_5 and 120 K_2O kg/fed, then reduction with increasing N up to 90 kg N/fed with the same rate of P and K fertilizers.

Table 3. Effect of NPK rates and harvesting dates and their interaction on weight and diameter of tuber root

Treatments		Tuber root weight (g)		Tuber root diameter (cm)	
NPK rates*	Harvesting dates	2009/2010	2010/2011	2009/2010	2010/2011
50 %		223.9	482.2	2.76	3.79
100 %		199.4	456.2	2.95	4.23
150 %		179.5	455.2	3.04	4.28
200 %		150.7	428.8	2.91	4.12
LSD at 0.05		33.1	41.8	NS	0.30
	8 month	138.3	445.7	2.86	3.89
	9 month	205.9	461.8	2.98	4.04
	10 month	231.3	464.0	3.04	4.29
	11 month	177.9	450.9	2.83	4.20
LSD at 0.05		20.8	NS	NS	0.35
50 %	8 month	183.9	486.9	2.57	3.60
	9 month	216.9	488.9	2.83	3.53
	10 month	321.3	488.6	2.80	4.07
	11 month	173.5	464.5	2.83	3.97
100 %	8 month	143.3	422.9	2.90	4.07
	9 month	240.8	466.8	3.00	4.37
	10 month	243.0	481.1	3.03	4.27
	11 month	170.4	454.1	2.87	4.23
150 %	8 month	111.3	453.4	3.00	4.03
	9 month	199.1	447.1	3.17	4.27
	10 month	230.8	470.7	3.33	4.50
	11 month	177.0	449.5	2.87	4.33
200 %	8 month	114.9	419.7	2.97	3.87
	9 month	167.0	444.3	2.93	4.00
	10 month	130.0	415.5	3.00	4.33
	11 month	190.8	435.5	2.73	4.27
LSD at 0.05		41.6	NS	0.69	0.71

***50% (25: 38.5: 48), 100% (50: 77: 96), 150% (70: 115.5: 144) and 200% (100:154: 192) kg of N: P_2O_5: K_2O/fed. respectively**

Data illustrated in Table (3) show that harvesting cassava at 10 months after planting date increased average tuber root weight in the first season and diameter in the second season, as compared with harvesting time at 8 months after planting. Similar results reported by El-Fieshawy (1986) who showed that high diameter and weight of tuber roots was obtained after a growth period of 12 to 15 months. Also, this study reveal that, the photosynthetic activity in plants as well as the translocation of starch was still in action during the last three months in the delayed harvesting, leading in turn to heavier tuber weight.

The interaction between mineral fertilization and harvesting dates is presented in the same Table. It is clear in the first season that mineral fertilizer of 50% of N: P_2O_5: K_2O /fed was effective and gave the highest average tuber root weight when cassava harvested at 10 months after planting date while mineral fertilization with 100%, 150% and 200% kg of NPK/fed and harvesting at 8 months after planting gave the reverse trend. On

the other hand, no significant differences in average tuber root weight were observed between mineral fertilization and harvesting dates in the second season. Tuber root diameter was the greatest with using 150% NPK + harvesting after 10 months from planting in both seasons, and the lower value when plants received 50% NPK and harvested after 8 months in the first season, and 9 months in the second season, after planting.

Data in Table (4) indicate that mineral fertilization of cassava with 50% of NPK increased tuber roots yield in the first season as compared with other treatments, while, no significant differences in tuber roots yield were observed between the four levels of mineral fertilization in the second one. On the other hand, using rates of 50%, 100% and 150% NPK gave a significant increase in dry matter yield of tuber roots a compared to using 200% in both seasons. As reported by Sherif *et al.* (2003) the maximum weight of fresh tubers t/fed was obtained when cassava plants received the lower dose of phosphorus (46 kg) and higher dose of potassium (96 kg). Such increase, may be due to the equilibrium state between the vegetative stage and the tuber formation stage and the increment in dry matter content per plant of such treatments (El-Abagy, 2002)

Table 4. Effect of NPK rates and harvesting dates and their interaction on total yield of tuber roots and dry matter yield and percentage.

Treatments		Total yield of tuber roots (t/fed)		Dry matter yield (t/fed)		Dry matter (%)	
NPK rates*	Harvesting dates	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011
50 %		5.368	10.403	2.043	3.839	37.93	36.98
100 %		4.469	10.383	1.759	4.021	39.19	38.71
150 %		4.142	10.306	1.653	4.052	39.63	39.35
200 %		3.513	9.535	1.324	3.549	37.62	37.11
LSD at 0.05		0.798	NS	0.457	0.429	NS	1.95
	8 month	3.513	9.567	1.337	3.536	38.13	37.00
	9 month	4.563	10.517	1.778	4.054	38.96	38.58
	10 month	5.181	10.823	2.100	4.163	40.28	38.46
	11 month	4.236	9.721	1.564	3.708	36.99	38.12
LSD at 0.05		0.518	0.807	0.235	0.357	2.50	NS
50 %	8 month	3.943	10.570	1.460	3.853	36.90	36.80
	9 month	5.393	10.917	2.097	4.027	38.87	36.90
	10 month	6.113	11.153	2.427	4.150	39.50	37.17
	11 month	6.020	8.973	2.187	3.327	36.47	37.07
100 %	8 month	3.550	10.290	1.383	3.847	39.13	37.30
	9 month	4.877	10.733	1.913	4.213	39.27	39.30
	10 month	5.460	10.770	2.230	4.250	40.50	39.50
	11 month	3.990	9.740	1.510	3.773	37.87	38.73
150 %	8 month	3.290	9.077	1.280	3.397	38.97	37.67
	9 month	4.363	10.523	1.727	4.320	39.53	41.17
	10 month	5.437	11.253	2.273	4.427	41.90	39.33
	11 month	3.477	10.370	1.333	4.067	38.10	39.23
200 %	8 month	3.267	8.330	1.223	3.047	37.53	36.23
	9 month	3.617	9.893	1.377	3.657	38.17	36.93
	10 month	3.713	10.117	1.470	3.827	39.23	37.83
	11 month	3.457	9.800	1.227	3.667	35.53	37.43
LSD at 0.05		1.037	1.615	0.470	0.715	5.00	NS

*50% (25: 38.5: 48), 100% (50: 77: 96), 150% (70: 115.5: 144) and 200% (100:154: 192) kg of N: P_2O_5: K_2O/fed. respectively

Concerning harvesting dates, data presented in Table (4) reveal that the highest tuber roots yield and dry matter yield were obtained with harvesting at 10 months after planting comport to harvesting at 8 months after planting, in both seasons. In addition, dry matter yield showed higher values when cassava plants were harvested after 9 and 10 months from planting as compared to the harvest after 8 months from planting. Ngeve (2003) reported that root yields of cassava were very low (2.9 t/ha) when harvesting was done 6 months after planting, but continued to bulk up to 18.5 t/ha at 16 months. The greatest root increase (9.3 t/ha) was observed between 8 and 12 months. The same researcher mention that the delay in harvesting time after the physiological maturity of the crop may thus be done to take advantage of this additional yield increase. Also Saengthongpinit and Sajjaanantakul (2005) indicated that dry matter of Jerusalem tubers was increased with delay maturity from 16 to 20 weeks after planting and stated that 18 weeks after planting seemed to be the optimum maturity.

This is in contradiction with the report of Tougnon *et al.* (1998) observed that dry matter and starch content were low when roots were harvested earlier than 10 months. Probably, the soils and rainfall patterns and the cassava genotype evaluated had an influence on starch and dry matter production.

Regarding the interaction between mineral fertilization and harvesting dates, as a general notice that, the results in the same Table, clearly reveal that, applying mineral fertilizer to cassava at rates of 50%, 100% or 150% NPK and harvesting at 10 months after planting date gave the highest estimated values for tuber roots yield while mineral fertilization at rates of NPK 150% in the first season and NPK 200% in the second season and harvesting at 8 months after planting date reduced the produced total yield. On the other hand, applying mineral fertilizer at rates of 50%, 100% or 150% NPK and harvesting at 10 months after planting in the first and second seasons, gave the highest dry matter yield. In contrast, mineral fertilizers at rate of 200% NPK and harvesting at 8 and 11 months after planting in 2009/2010 and 2010/2011 seasons showed the lowest dry matter yield.

Data in Table (4) show that dry matter percentage was not affected by the tested mineral fertilization in the first season, while the highest value of dry matter percentage of tuber roots was significantly obtained with adding mineral fertilizers at rate of 150% N: P_2O_5: K_2O (Kg/fed) as compared to 50% and 200% of NPK, in the second season.

The same Table indicate that, when harvesting of cassava took place at 10 months after planting, in the first season the dry matter was higher as compared to harvesting at 11 months after planting. There whereas, dry matter percentage showed no significant differences with harvesting times, in the second season. Franck *et al.* (2011) indicated that the dry matter content of cassava roots did not significantly vary with the age of the cassava plant. Mean values were 38.5%, 39.1% and 39.4% at 10, 12 and 14 months, respectively.

Concerning the interaction effect, (Table 4) show that mineral fertilizers at rate of 150% NPK (kg/fed.) plus harvesting date at 10 months gave the highest dry matter in tuber roots meanwhile mineral fertilizer at rate

of 200% N: P_2O_5: K_2O (kg/fed.) plus harvesting date at 11 months gave the lowest values in the first season only.

3.Chemical composition

From Table (5), NPK percentage in cassava leaves at 180 day after planting was not affected by any rate of mineral fertilizers, in both growing seasons.

Table 5. Effect of NPK rates NPK percentage in leaves at 180 days after planting

Treatments	Nitrogen %		Phosphor %		Potassium %	
NPK rates	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011
50 %*	6.09	5.77	0.55	0.43	1.36	1.35
100 %*	6.38	6.83	0.57	0.45	1.37	1.39
150 %*	6.26	6.32	0.58	0.46	1.37	1.25
200 %*	6.18	5.47	0.59	0.45	1.36	1.24
LSD at 0.05%	NS	NS	NS	NS	NS	NS

*50% (25: 38.5: 48), 100% (50: 77: 96), 150% (70: 115.5: 144) and 200% (100:154: 192) kg of N: P_2O_5: K_2O/fed. respectively

Table 6 indicates that mineral fertilization of cassava with 150% of NPK in the first season and the using of 100%, 150% and 200% NPK in the second season gave a significant increase in starch % of tuber roots comparing to use 50% of NPK. This result may be due to the optimum NPK levels that proved to be the most important nutrient for the formation and construction of starch in tuber roots (Ezumah *et al.* 1994). Concerning starch content yield kg/feddan, it was clear applying 150% of NPK caused the best result comparing with the other rates of NPK.

Regarding harvesting dates, data presented in Table (6) reveal that percentage and the content of starch in tuber roots of cassava appeared to increase with increasing the time of harvesting till ten months. Also, cassava has been reported to show slow initial growth, and it has been observed that root bulking in cassava starts 4 months after planting. There is evidence that starch quantity and quality are low when extracted from cassava roots harvested earlier than 10 months. Apparently, starch synthesis is greatest after 10 months, thereby influencing size and the resulting root yield (Tougnon *et al.* 1998).

Regarding the interaction between mineral fertilization and harvesting dates, as a general notice, the results in the same Table, clearly reveal that cassava treated with mineral fertilizer at rate of 150% NPK with any harvesting dates after planting, gave the highest estimated values for starch % in tuber roots during the two growing seasons. Similar trend of results was obtained with using the rate of 100% NPK during the second season. On the contrary, plants received the lowest rate of 50% NPK with harvesting at 8 months after planting gave the minimum starch % in tuber roots. Also, with applying 150% of NPK and harvesting at 10 and 11 months after planting during the first and second seasons, respectively, gave the highest starch content yield (kg/fed) while mineral fertilizer at rate of 50% NPK gave the minimum results for this character when cassava harvested at 8 and 11 months after planting, in 2009/2010 and 2010/2011 seasons, respectively.

Table 6. Effect of NPK rates and harvesting dates and their interaction on starch and Sstarch content yield

Treatments		Starch (%)		Starch content yield (kg/fed)	
NPK rates	Harvesting dates	2009/2010	2010/2011	2009/2010	2010/2011
50 %		60.56	63.83	1250.7	2449.3
100 %		68.98	77.28	1206.1	3109.8
150 %		84.35	83.54	1393.8	3389.7
200 %		76.43	74.18	1011.9	2668.7
LSD at 0.05		2.42	9.65	307.9	508.1
	8 month	66.63	67.74	874.0	2399.8
	9 month	71.77	74.90	1273.2	3046.0
	10 month	74.74	73.87	1531.3	3088.5
	11 month	77.19	82.33	1184.0	3083.3
LSD at 0.05		6.30	11.03	156.7	508.1
50 %	8 month	46.29	54.31	658.4	2039.6
	9 month	68.00	75.31	1421.9	3032.7
	10 month	63.69	66.23	1516.7	2753.9
	11 month	64.27	59.48	1405.6	1970.9
100 %	8 month	60.50	69.90	835.9	2697.7
	9 month	68.63	78.55	1311.8	3310.1
	10 month	66.67	69.61	1464.4	2996.4
	11 month	80.10	91.06	1212.5	3435.2
150 %	8 month	81.31	80.39	1044.1	2743.6
	9 month	82.10	80.56	1420.0	3466.4
	10 month	84.63	81.88	1912.2	3633.4
	11 month	89.38	91.34	1199.1	3715.4
200 %	8 month	78.41	66.35	957.8	2118.2
	9 month	68.35	65.20	939.1	2374.7
	10 month	83.98	77.75	1231.9	2970.2
	11 month	75.00	87.42	918.7	3211.6
LSD at 0.05		12.61	22.06	313.4	1016.0

*50% (25: 38.5: 48), 100% (50: 77: 96), 150% (70: 115.5: 144) and 200% (100:154: 192) kg of N: P_2O_5: K_2O/fed. respectively

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تاثير بعض معدلات التسميد المعدنى NPK ومواعيد الحصاد على انتاجية وجودة محصول الكاسافا

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****قسم البطاطس والخضر خضرية التكاثر – معهد بحوث البساتين – مركز البحوث الزراعية – جيزة**

أجرى هذا البحث فى مزرعة على مبارك التابعة لمحطة بحوث البساتين بجنوب التحرير – محافظة البحيرة خلال موسمى الزراعة ٢٠٠٩/٢٠١٠ و ٢٠١٠/٢٠١١ م لدراسة تاثير بعض معدلات التسميد المعدنى (NPK) ومواعيد الحصاد على انتاجية وجودة محصول الكاسافا (صنف الاندونيسى) تحت ظروف الاراضى الرملية المستصلحه حديثا.

و قد أشتملت المعاملات على الاتى

١. التسميد المعدنى

استخدمت توليفة من NPK بمعدل ٥٠% و١٠٠% و١٥٠% و٢٠٠% من الثلاث عناصر ناتج الابحاث السابقة على الكاسافا تحت الظروف المصرية ، حيث كان المعدل ١٠٠ % من التسميد المعدنى هو ٥٠ :٧٧ : ٩٦ وحدة من النيتروجين : الفوسفور : البوتاسيوم على التوالى للفدان

٢. مواعيد الحصاد

تم حصاد النباتات عند عمر ٨ و ٩ و١٠ و١١ شهر من الزراعة

وقد أظهرت النتائج المتحصل عليها ما يلى :

١) أظهرت النتائج ان تسميد الكاسافا بمعدل ٥٠% من NPK أعطت أعلى محتوى كلوروفيل فى الاوراق وأدت الى زيادة محصول الجذور المتدرنة بالطن /فدان ومتوسط وزن الجذر. اما استخدام المعدل العالى ٢٠٠% من NPK ادى الى زيادة فى ارتفاع النبات ومساحة الورقة ولكن التسميد المعدنى ١٥٠% سجل اعلى قيم للمادة الجافة كنسبة ومحصول كلى طن/فدان والنشا كنسبة ومحصول كجم/فدان ومتوسط قطر الجذر المتدرن، أما التحليل الكيماوى فى الاوراق عند عمر ١٨٠ يوم من الزراعة للنيتروجين والفوسفور والبوتاسيوم كنسبة مئوية لم تظهر اى فروق معنوية خلال الموسمين.

٢) أدى حصاد الكسافا عند عمر ١٠ شهور من الزراعة الى زيادة محصول الجذور المتدرنة طن/فدان وكذلك كل صفات الجودة المدروسة فى الجذر المتدرن خلال موسمى النمو مقارنة بالحصاد عند عمر ٨ شهور من الزراعة وذلك خلال موسمى الزراعة.

٣) أشارت النتائج أن تسميد النباتات بمعدل ١٥٠% من NPK مع حصادها عند عمر ١٠ شهور من الزراعة أدت إلى زيادة محصول الجذور المتدرنة طن/فدان والمادة الجافة (نسبة ومحصول طن/فدان) والنشا (نسبة و محصول كجم/فدان). اما التسمد المعدنى ٥٠% من NPK مع حصاد الكاسافا عند عمر ١٠ شهور من الزراعة أعطى أعلى متوسط وزن للجذر المتدرن. وايضا فان اعلى متوسط قطر للجذر سجل عند التسميد المعدنى للكاسافا بمعدل ١٠٠% NPK والحصاد عند عمر ٩ شهور فى الموسمين.

قام بتحكيم البحث

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