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# Cassava Cultivars Response to Different Levels of Potassium Fertilization under Drip Irrigation and Sandy Soil Conditions

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TWO FIELD experiments were conducted at Nubaria region (Behira Governorate), Egypt, during the two successive seasons of 2016/2017 and 2017/2018 to study the response of vegetative growth, yield and quality of cassava crop. Three cassava cultivars (*i.e.,* American, Brazilian and Indonesian cultivars) and three levels of potassium fertilizers (*i.e.,* 75, 150 and 250kg $K_2O$ fed$^{-1}$) were investigated. The results indicated that, American cassava cultivar with 250 kg $K_2O$ fed$^{-1}$ recorded the highest vegetative growth, yield and its quality as well as higher chemical composition plants except for total fiber and N (%) was found by treatment ofBrazilian cassava cultivar with 75 kg $K_2O$ fed$^{-1}$. This study also confirmed that the optimum K- nutrition for cassava under sandy soils might support the cultivated cassava plants in their growth, yield and yield quality. This work also could present more details about the suitability of some cassava cultivars to cultivate under sandy soils and drip irrigation and which dose of K-nutrient should be applied. Further investigations are needed to carry out to make a complete program for the fertilization and irrigation of different cassava cultivars under arid conditions in Egypt.

**Key words:** Cassava, Chlorophyll, Fertilizer, Growth, Yield, Soil fertility, Macro-nutrient.

## Introduction

Cassava (*Manihot esculenta* Crantz) is considered one of the oldest tuber and root crops used in human foods and animal feeding, which belongs to the Euphorbiaceae family (De Souza et al. 2017).Cassava also represents the 5$^{th}$most important staple crop worldwide (after maize, rice, wheat and potato) and based on the food production and consumed quantities is the 2$^{nd}$ after rice in the least developed countries (Bechoff et al. 2018). More than 800 million people can consume the roots and leaves of this crop in the world (Njankouo Ndam et al. 2019). The global production of cassava recorded about 282 million tons (FAO 2018), which cultivated on nearly 25 million ha worldwide (Parma et al. 2017). Cassava plant is drought-tolerant and could be grown in tropical and sub-tropical areas in Latin America (*e.g.,* Brazil), Africa (e.g., Nigeria, Ghana and Congo) and Asia like Indonesia and Thailand (Tappiban*et al*. 2018). This crop also has a high nutritional value because it is rich in the content of carotenoids, minerals and vitamin C as well as very high content of starch (800-900 g kg$^{-1}$ dry weight; Li et al. 2017). Cassava leaves are common vegetable among some countries in Africa while the stem is used as planting material during cassava production (Hawashi et al. 2019). Cassava plants also have a distinguished list of industrial applications including the medicine, biopolymers, cosmetics food and feed as well as the production of ethanol and biofuel (Adekunle and Raghavan2017; Li et al. 2017; James et al. 2019). The wastes derived-cassava could be used

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also in the biorefinery and industrial applications (Zhang et al. 2016 and de Carvalho et al. 2018), which could mitigate the carbon emission and save the energy (Jiang et al. 2019). Cassava crop has some problems including the short postharvest shelf-life about 1-3 days (Uchechukwu-Agua et al. 2015; Djabou et al. 2017), the low protein content and the high content of cyanogenic compounds (Tshala-Katumbay et al. 2016), and existence of anti-nutrients in its tissues like tannins, polyphenols andphytic acid (Hawashi et al. 2019). Otherwise, this crop may be favor under small- and large-scale cultivation (Li et al. 2017).

Although potassium is an essential element in plant nutrition, this crucial nutrient does not exist in any plant components like chlorophyll or mitochondria. The plants need potassium in a huge amounts and this nutrient activates more than 60 enzymes in plants. The biosynthesis of protein in every step and starch forming in plants cannot achieve without potassium (Lanzerstorfer 2019). Potassium also has a crucial role in the plant dense system under abiotic stress (*i.e.,* metal toxicity, chilling, drought, and salinity) by regulation a lot of plant physiological and metabolic processes like photosynthesis (Hasanuzzaman et al. 2018 and Lanzerstorfer, 2019). Potassium has several roles in plants including the regulation of energy transfer, osmoregulation,water movement, and cation-anion balance (Wang and Wu 2017 and Hasanuzzaman et al. 2018). The cultivated plants uptake a large amounts of potassium for their growth and development. So, there is urgent need to supply plants with potassium through the fertilizers in particular under sandy soils and intensive agricultural systems (Sattar et al. 2019). The most common K-fertilizers include $K_2SO_4$, KCl and $KNO_3$ (Prakash and Verma 2016). According to FAO, the global K-demand of fertilizers increased during the period from 2014 to 2018 to 34 million Mg (FAO 2017 and Sattar et al. 2019). The production of cassava crop might request application of K-fertilizers in particular in poor or sandy soils. Potassium fertilizers have the ability to stimulate the leaf photosynthetic activity, increase the translocation rate of photosynthates and storing in the roots (Ezui et al. 2017). The yield of cassava could be decreased under the K-deficiency due to the decline in the stored starch in the roots, whereas the content of hydrogen cyanide might be increased in the cassava roots (Ezui et al. 2017). It is worth to mention that, the bioavailability of K- fertilizer or from soils mainly depends on soil pH, soil moisture content and the soil texture (Hasanuzzaman et al. 2018) and the common K-form of plant uptake is $K^+$ using the HAK/KUP/KT family transports (Li et al. 2018).

During the last decade, a considerable literature has grown up around the production of cassava under the Egyptian conditions such as fertilization cassava with bio- organic fertilizers (Shafeek et al. 2012), production under water deficit (Helal et al. 2013), application of K-fertilizer and micronutrient mixtures (Ali and Abd-Elkader 2014), foliar applied bio-fertilizers and bio stimulators (Marzouk et al. 2016) and (Hassan et al. 2020), but based on our information, the production of different cassava cultivars in presence of K-fertilizations under the Egyptian conditions did not yet investigated.

The sandy soils are common infertile soils containing low organic matter and low nutrients contents beside the problem of water retention. So, the cultivation of sandy soils is considered a great challenge, which needs a particular management to get the desirable crop production. Intensive investigations were carried out concerning the management of sandy soils including application of biochar (El-Shony et al. 2019), growth regulators (Rashad et al. 2020), bio-mineral fertilization (Khalifa 2020), and compost (Hammoudaet al. 2019; Mohamed and Rashad, 2020).Therefore, the aim of this study was to investigate the response of three cultivars of cassava to different levels of potassium fertilizer under sandy soil conditions. The productivity and quality of cassava roots also was evaluated.

## Materials and Methods

A field experiment was conducted in newly reclaimed lands during two successive seasons of 2016/2017 and 2017/2018 at the Experimental Station of National Research Centre in Nubaria region, Behira Governorate, north of Egypt. This study was carried out to investigate the response of some cassava cultivars to different potassium levels on growth, yield and chemical contents of these plants. The soil texture was sandy, where the sand, silt and clay values were 78.6, 13.9 and 7.5%, respectively. The soil pH was 7.5 and soil salinity or EC recorded 2.2 dS $m^{-1}$. This experiment included 9 treatments which were the combinations of three cassava cultivars(i.e., American, Brazilian and Indonesian) and three levels of potassium fertilizer (*i.e.,* 75, 150 and 250 kg $K_2O$ $fed^{-1}$ as potassium sulphate; fed = 4200 $m^2$). The design of this experiment was split plot with three replications. The cultivars were the main plots and the fertilizer treatments of potassium were the sub plots. Cassava was planted on 22nd April during the two growing seasons. Cassava stalks of similar thickness of approximately 2.5 – 3.0 cm in diameter were cut into stalk cuttings of 25 – 30 cm in length and planted vertically by burring two-thirds of the cuttings into the soil and keeping one third of them over ground, then irrigated directly after planting. The recommended agricultural practices were carried out uniformly in all treatment plots as recommended.

Before sowing, 20 $m^3$ poultry manure was added and 500 kg calcium super phosphate per fed (15.5% $P_2O_5$) was also applied during land preparation through the ditches. The recommended doses for cassava included 250 kg N-fertilizer as an ammonium sulphate (20.5% N) and 200 kg potassium-fertilizer as a potassium sulphate (50 % $K_2O$) were added. Drip irrigation lines were built and spread over the ditches and the irrigation frequented every day throughout drip irrigation system, which were used and spread over the ditches. The experiments included 9 treatments which were the combinations of three cassava cultivars (American, Brazilian and Indonesian**)** and three different levels of potassium (*i.e.* 75, 150 and 250 kg $K_2O$ $fed^{-1}$). The design of the experiments was split plot with three replications. The cultivars were designed into the main plots and the fertilizer treatments of potassium were the sub plots. The plot area was 9.6 $m^2$ consisted of four inner rows of 3 m in length and 80 cm in width and was used for irrigation drip irrigation system. The total amounts of nitrogen fertilizers were divided into 4 equal doses, where fertilization program started at the fourth week after planting and then other doses were monthly applied.

*Vegetative growth parameters*

Representative random samples of 8 plants were labeled in each replicate for every treatment after 180 days from planting and the following parameters were recorded: plant height, number of leaves per plant, number of main stems and number of lateral branches, leaf area, total chlorophyll content, number of roots per plant and root fresh weight. The root/shoot ratio was calculated according to the following equation: weight of roots (g per plant) / weight of shoots (g per plant).The length of root and diameter of root, dry matter percentage of roots were also recorded. The total chlorophyll content in cassava leaves was measured using portable photosynthesis system (Li-Cor Inc. USA).

*Chemical composition of roots*

Starch percent was determined as described by Smith and Zeeman (2006). Total carbohydrates percent was determined colorimetrically as gram of glucose /100 g dry weight of roots according to the method of James (1995). Total fibers percent of root was determined as described by A.O.A.C. (1990). Nitrogen was determined in cassava roots according to method of Horneck and Miller (1998). Phosphorus was determined colorimetrically, whereas potassium was determined using flame photometer according to the method of Page et al. (1982).

*Statistical analyses*

The treatment effects were evaluated by analysis of variance. The differences among treatments mean values were compared using Duncans's multiple range test at $P<5\%$ as reported by Gomez and Gomez (1984).

## Results and Discussion

*Vegetative growth of cassava*

Data presented in Table 1 indicated that cultivars significantly differed in vegetative growth parameters, *i.e.,* plant height, leaves number, main stems,lateral branches, leaf area, and chlorophyll content in bothgrowing seasons. TheIndonesian cultivar was the lowest in vegetative growth, whereasAmerican cultivar was the superior in vegetative growth parameters comparison to others cultivars.

*Effect of potassium levels application*

Reponses of cassava cultivars to different level of potassium presented in Table 1 significantly differ data show the effect of potassium application on vegetative growth of cassava plants. Results clear that vegetative growth was gradually significantly increased by increasing levels of potassium application from 75, 150 up to250 Kg $K_2O$/fed. As shown in both growing seasons.

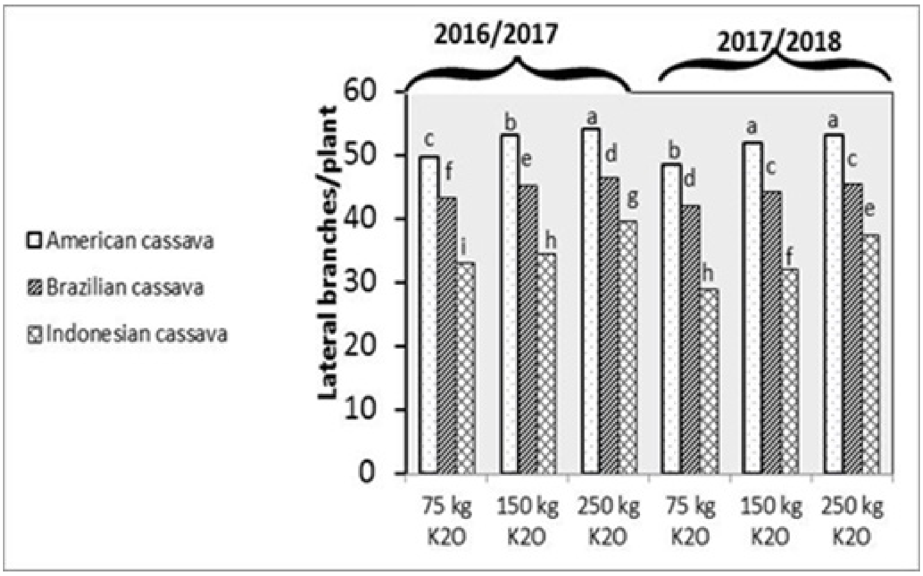
*The interaction between cultivars and different applied K-levels*

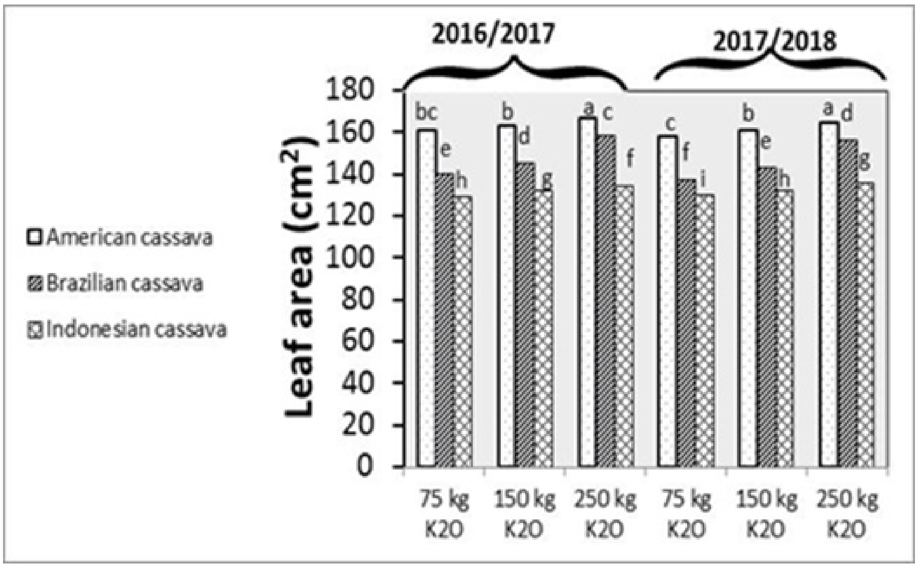
Data presented in Fig. 1 show the effect of interaction between cassava cultivars and potassium levels application showed that American cultivar of cassava was treated by 250 Kg $K_2Ofed^{-1}$gave the highest value of vegetative growth. On the other hand, the lowest values of vegetative growth recorded by Indonesian cultivar of cassava which was treated by 75 Kg $K_2Ofed^{-1}$ and there were significant differences among them in both years.

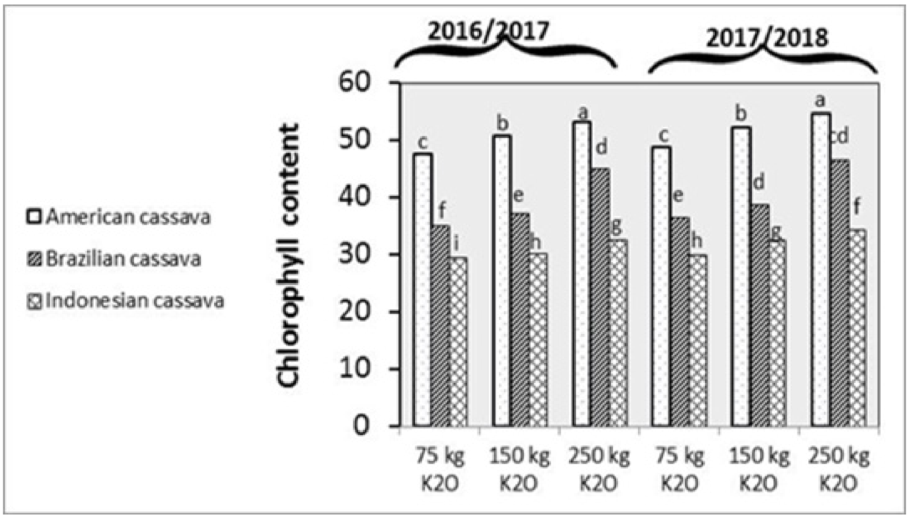
**TABLE 1. Effect of different cultivars and levels of potassium on vegetative growth characters of cassava plants in (2016/2017) and (2017/2018) seasons**

| Treatments | First season (2016/2017) | | | | | | Second season (2017/2018) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plant height (cm) | Leaves no. plant$^{-1}$ | Main stem no. plant$^{-1}$ | Lateral branches plant$^{-1}$ | Leaf area (cm$^2$) | Chlorophyll content (SPAD) | Plant height (cm) | Leaves no. plant$^{-1}$ | Main stem no. plant$^{-1}$ | Lateral branches plant$^{-1}$ | Leaf area (cm$^2$) | Chlorophyll content (SPAD) |
| Effect of cultivars | | | | | | | | | | | | |
| American Cassava | 175 a | 158 a | 4.77 a | 6.2 a | 163 a | 51.9 a | 176 a | 157 a | 3.9 a | 173 a | 161 a | 50.5 a |
| Brazilian Cassava | 141 b | 137 b | 3.53 b | 5.1 b | 147 b | 40.5 b | 143 b | 136 b | 2.6 b | 139 b | 145 b | 39.1 b |
| Indonesian Cassava | 118 c | 119 c | 2.87 c | 4.3 c | 132 c | 32.2 c | 122 c | 123 c | 2.1 c | 119 c | 132 c | 30.7 c |
| Effect of potassium fertilizer level | | | | | | | | | | | | |
| 250 kg $K_2O$ | 155 a | 147 a | 4.10 a | 5.5 a | 153 a | 45.1 a | 156 a | 146 a | 3.2 a | 153 a | 152 a | 43.6 a |
| 150 kg $K_2O$ | 145 b | 136 b | 3.73 b | 5.2 b | 147 b | 41.1 b | 147 b | 137 b | 2.9 b | 144 b | 145 b | 39.3 b |
| 75 kg $K_2O$ | 134 c | 131 c | 3.33 c | 4.9 c | 143 c | 38.4 c | 137 c | 133 c | 2.5 c | 134 c | 141 c | 37.3 c |

Values followed by the same letter (s) are not significantly different at 5%


2016/2017
2017/2018
Lateral branches/plant
American cassava
Brazilian cassava
Indonesian cassava
75 kg K2O
150 kg K2O
250 kg K2O


2016/2017
2017/2018
Leaf area (cm²)
American cassava
Brazilian cassava
Indonesian cassava
75 kg K2O
150 kg K2O
250 kg K2O


2016/2017
2017/2018
Chlorophyll content
American cassava
Brazilian cassava
Indonesian cassava
75 kg K2O
150 kg K2O
250 kg K2O

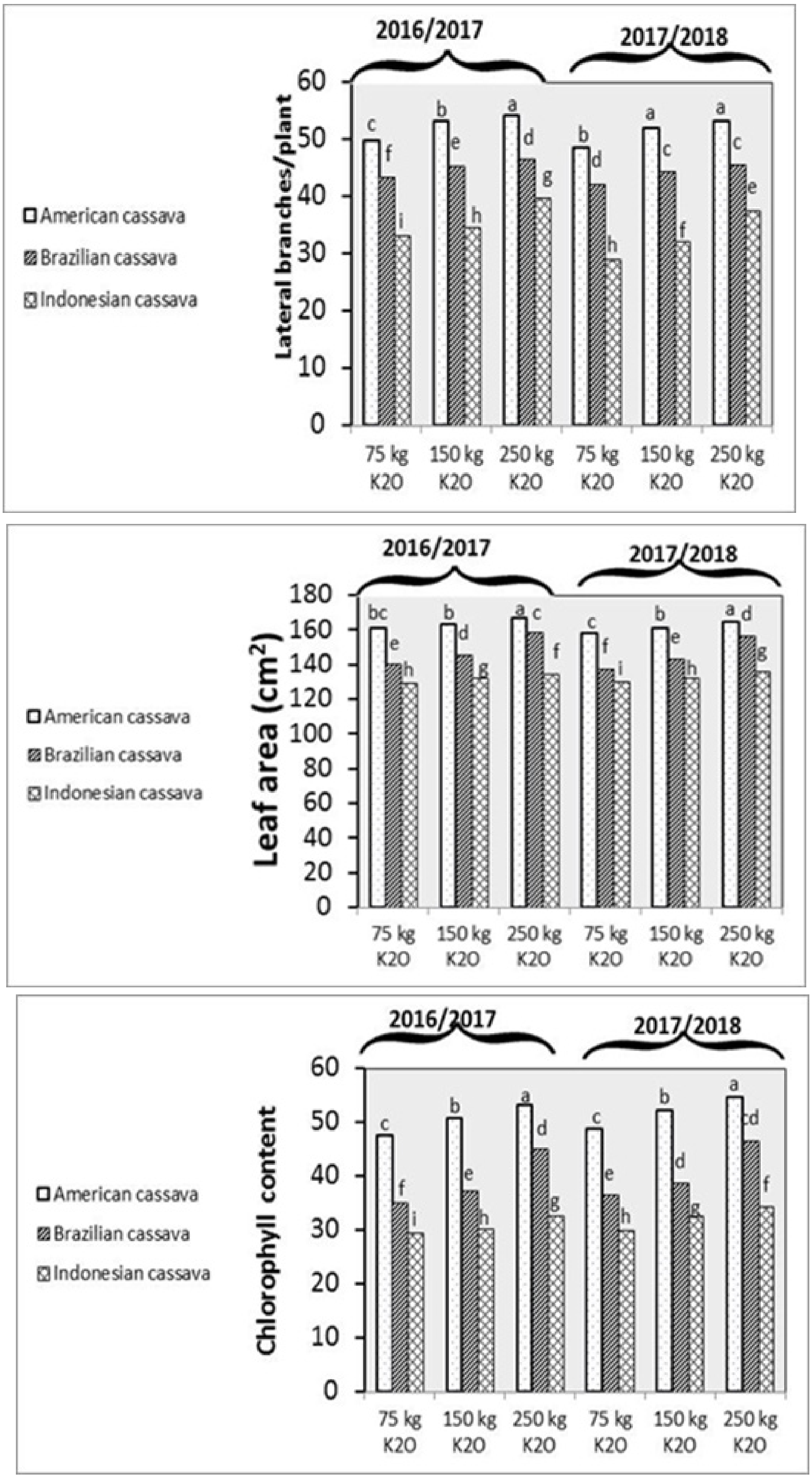



**Fig. 1. Effects of interaction between the two studied factors (cultivars and potassium rates) on the vegetative growth characters of cassava plants in (2016/2017) and (2017/2018) seasons**

The productivity of a crop mainly influences with the soil fertility, which may be reduced at poor or sandy soils. Cassava could be cultivated under such infertile soils giving an acceptable production like the soil low availability of nutrients (Imakumbili et al. 2019; Njankouo Ndam et al. 2019). Therefore, under sandy soils the supply of enough and proper nutrients for cultivated cassava is a vital issue to get the optimal cassava growth, which needs the adequate supply of soil nutrients (Munyahali et al. 2017; Biratu et al. 2018). These results might be correlated with the gene action of the tested cultivars and the morphological characteristic as well as the chemical content of these cultivars (Njankouo Ndam et al. 2019).

The potassium fertilizer has a significant effect on these previous vegetative growth parameters in the two growing seasons. Translocation of metabolites and their movement from cassava leaves to roots (Natarajan et al. 2019). Potassium also has the ability to regulate the synthesis and accumulation of starch in the storage roots due to its controlling some enzymes of these processes (Fernandes et al. 2017). In this study, the highest vegetative growth characters were recorded by plants which supplied with 250 kg $K_2O$ $fed^{-1}$, whereas the lowest values were recorded by 75 kg $K_2O$ $fed^{-1}$. These findings had the same trend in both seasons of study as a result of the potassium effects on the studied growth parameters. It could be noticed that, the American is more suitable for production under the Egyptian conditions and under the sandy soils, whereas the Indonesian one is not recommended for production under the current experimental conditions.

The chlorophyll units represent the factory, in which the plants manufacture their metabolites. The total chlorophyll includes*a* and *b* and the efficiency of these units mainly depends on nitrogen, magnesium as well as all enzymes, which regulate the work of these chlorophyll units. Potassium as cofactor regulates the forming of chlorophyll and photosynthesis process (Hou et al. 2018). In this study, the total chlorophyll increased by increasing K-doses up to 250 kg $K_2O$ $fed^{-1}$ recording the American cultivar the height content .This result also confirmed that the American cultivar could be adapted according to the Egyptian cultivating conditions.

*Tuber roots yield and its parameters*

*Effect of cultivars*

As shown in Table 2 there were significant differences among cassava cultivars on tuber roots yield and tuber parameters, *i.e.,* tubers number per plant, tuber shoots ratio, tuber length, tuber diameter, total yield and dry matterAmerican cultivar followed by Brazilin cultivarsshowed the highest mean value of tuber roots yield and tuber roots parameters while Indonesian cultivar gave the lowest mean value of tuber roots yield and tuber roots parameters in two seasons.

*Effect of appliedK-levels*

Data in Table 2 shows that tuber roots yield and tuber roots parametersvaried widely under different rates of potassium and registered significantly higher tuber roots yield and tuber roots parameters at high potassium rate compared to low potassium rate.

*The interaction between cultivars and different applied K-levels*

Regarding the interaction between cassava cultivars and potassium application, the results indicated that 250 kg/$K_2O$/fed. treatment was the most effective in encouraging tuber roots yield and tuber roots parameterswith American cultivar of cassava whereas, the lowest value root diameter was obtained by Indonesian cultivar of cassava which received 70kg/$K_2O$/fed. During the two growing seasons was presented in Figure (2).Concerning the importance of potassium in cassava production, it is confirmed the potential of applied K-fertilizer for the productivity of root and tuber crops (*e.g.,* cassava) in many studies like Ezui et al. (2017) and Omondi et al. (2019). Data in Fig. 2 show clearly that, the highest yield values and their quality (*i.e.,* tuber number per plant, tuber shoot ratio, tuber length and diameter as well as dry matter) were recorded by American cassava cultivar compared with other cultivars during the two successive seasons. Meanwhile, the lowest yield and its quality characters were recorded by Indonesian cassava cultivar.

*Chemical composition of cassava tuber roots*

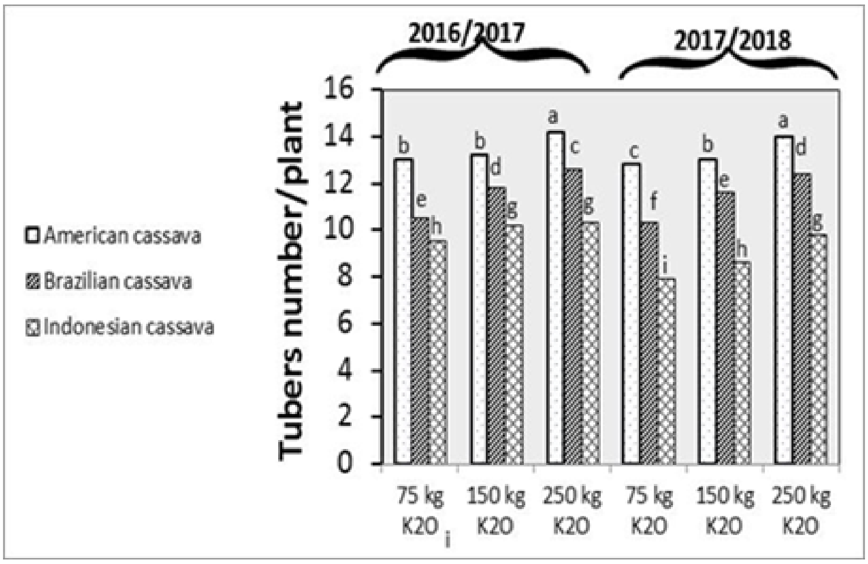
*Effect of cultivars*

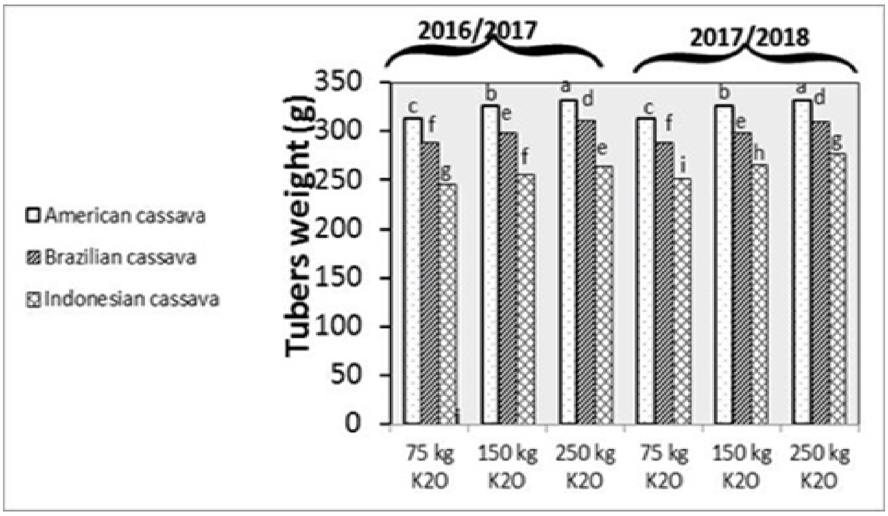
It is obvious from Table 3 that chemical compositionof cassava tuber roots (*i.e.*, starch, total carbohydrates, total fibers, N, P and K) of cassava roots significantly affected by cassava cultivars in both seasons. The highestcassava tuber roots ( starch, total carbohydrates, total fibers, N, P and K (%) except total fibers of cassava tubersproduced in the two seasons by American cultivarof cassava .whereas, the lowest chemical composition recorded by Indonesian cassava cultivar in the two studied seasons.

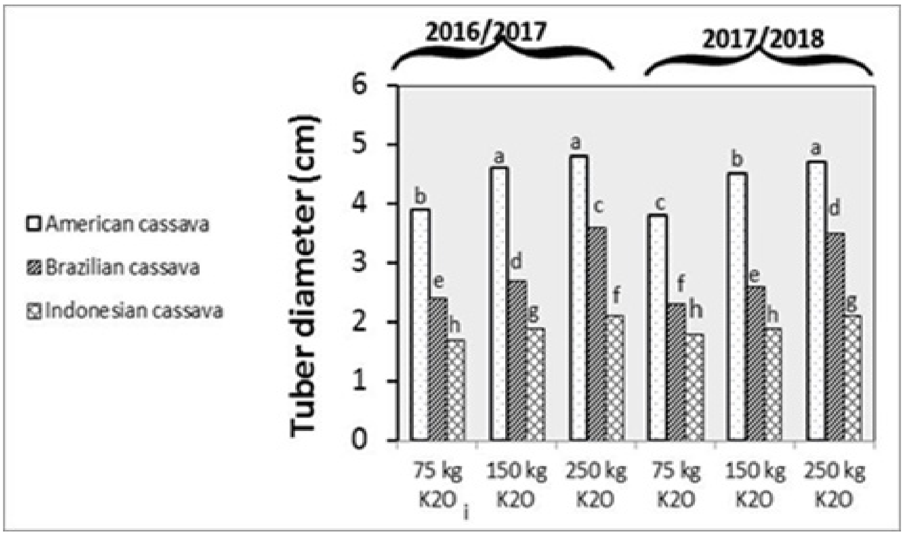
TABLE 2. Effect of different cultivars and levels of potassium Tuber roots yield and tuber parameters of cassava plants in (2016/2017) and (2017/2018) seasons

| Treatments | First season (2016/2017) | | | | | | | Second season (2017/2018) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tuber no. per plant | Tuber weight (g) | Tuber/ shootratio | Tuber length (cm) | Tuber diameter (cm) | Total yield | Dry matter (%) | Tuber no. per plant | Tuber weight (g) | Tuber/ shoot ratio | Tuber length (cm) | Tuber diameter (cm) | Total yield | Drymatter (%) |
| Effect of cultivars | | | | | | | | | | | | | | |
| American cassava | 13.5 a | 323 a | 1.59 a | 36.1 a | 4.4 a | 12.4 a | 36.9 a | 13.3 a | 323 a | 1.7 a | 39.0 a | 4.3 a | 11.5 a | 35.8 a |
| Brazilian cassava | 11.6 b | 299 b | 1.25 b | 30.1 b | 2.9 b | 9.5 b | 32.2 b | 11.4 b | 298 b | 1.4 b | 33.5 b | 2.8 b | 9.3 b | 31.1 b |
| Indonesian cassava | 10.0 c | 254 c | 1.07 c | 21.7 c | 1.9 c | 6.3 c | 26.7 c | 8.8 c | 264 c | 1.2 c | 27.8 c | 1.9 c | 7.1 c | 26.8 c |
| Effect of potassium fertilizer level | | | | | | | | | | | | | | |
| 250 kg $K_2O$ | 12.3 a | 302 a | 1.39 a | 32.0 a | 3.5 a | 11.2 a | 33.8 a | 12.1 a | 305 a | 1.5 a | 35.3 a | 3.4 a | 10.2 a | 32.7 a |
| 150 kg $K_2O$ | 11.7 b | 293 b | 1.31 b | 28.6 b | 3.1 b | 8.6 b | 31.9 b | 11.1 b | 296 b | 1.4 b | 33.8 b | 3.0 b | 8.6 b | 31.5 b |
| 75 kg $K_2O$ | 11.0 c | 282 c | 1.22 c | 27.2 c | 2.7 c | 7.4 c | 30.2 c | 10.3 c | 283 c | 1.3 c | 31.1 c | 2.6 c | 6.9 c | 29.5 c |

Values followed by the same letter (s) are not significantly different at 5%


2016/2017
2017/2018
Tubers number/plant
American cassava
Brazilian cassava
Indonesian cassava
75 kg K2O
150 kg K2O
250 kg K2O
75 kg K2O
150 kg K2O
250 kg K2O


2016/2017
2017/2018
Tubers weight (g)
American cassava
Brazilian cassava
Indonesian cassava
75 kg K2O
150 kg K2O
250 kg K2O
75 kg K2O
150 kg K2O
250 kg K2O


2016/2017
2017/2018
Tuber diameter (cm)
American cassava
Brazilian cassava
Indonesian cassava
75 kg K2O
150 kg K2O
250 kg K2O
75 kg K2O
150 kg K2O
250 kg K2O

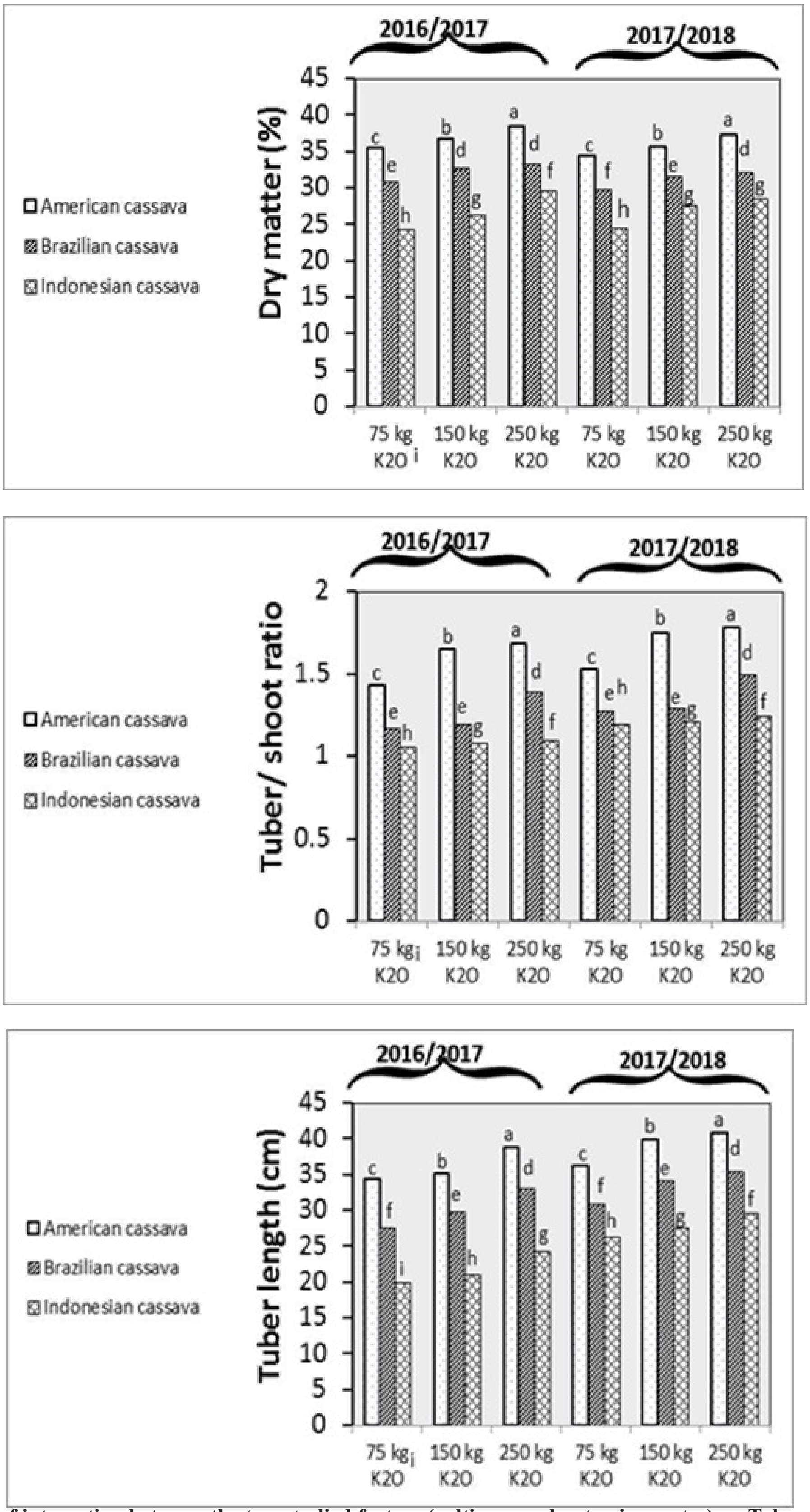



**Fig. 2. Effects of interaction between the two studied factors (cultivars and potassium rates) on Tuber roots yield and tuber parameters of Cassava plants in (2016/2017) and (2017/2018) seasons**

*Effect of applied K-levels*

Data tabulated in Table 3 that cassava tuber roots except total fibers of cassava tubers was increased due to the application of 250kg/$K_2O$/fed. and was higher than 75 and 150 kg$K_2O$fed$^{-1}$ Raising potassium applications rates caused a significant increase cassava tuber root of cassava.

*The interaction between cultivars and different applied K-levels*

As shown in Fig. 3 the effect of interaction between cassava cultivars and potassium application was significant. American cultivar treated with 250kg/$K_2O$/fed. gave the highest value of cassava tuber roots except total fibers of cassava whereas, the lowest root length was recorded by Indonesian cassava cultivar which received 75 kg/$K_2O$/fed in the two growing seasons.It is well known that, the K-supply in adequate amounts for cassava production is the guarantee to increase the yield of roots and the quality of starch of these roots (Fernandes et al. 2017). Potassium can play a crucial role in many physiological and biochemical processes of cultivated plants as well as K may involve in N-metabolism, support the increase of leaf area and improve the crop yield (Fernandes et al. 2017).The highest values of the chemical contents of tuber roots including starch, total carbohydrates, total fiber and NPK contents were recorded by the American cultivar comparing with other cultivars (Fig. 3). However, the lowest values of the chemical characters were recorded by the Indonesian cultivar. These results were similar in the two seasons of study.

Results in Fig. 3 show clearly that, the potassium fertilizer have a significant effect on chemical contents of tuber roots starch, total carbohydrates, total fiber and NPK contents in the two seasons of study. The highest mean values of the chemical contents of tuber roots starch, total carbohydrates, total fiber and NPK contents were recorded by plants which supplied with 250 kg $K_2O$ fed$^{-1}$ of potassium fertilizer except for total fiber and N (%) were found by treatment of 75 kg $K_2O$ fed$^{-1}$. These findings were similar in both seasons of study. On the contrary, the lowest values of chemical contents of tuber roots including starch, total carbohydrates, total fiber and NPK content characters were recorded by 75 kg $K_2O$ fed$^{-1}$ treatment except for total fiber and N (%) were found by treatment of 250 kg $K_2O$ fed$^{-1}$. These results held well in the two experimental seasons.

The obtained data demonstrated that, the interaction between treatments significantly affected all growth parameters in the two experimental seasons. Generally, it could be concluded that, the highest values of yield and itsquality includingtuber number of plant, tuber shoot ratio, tuber length and diameter as well as dry matter were obtained by the American cultivar with 250 kg $K_2O$ fed$^{-1}$ of potassium fertilizer. On the other hand, the lowest valuesof vegetative growth characters werefound by using the Indonesian cultivar with 75 kg $K_2O$ fed$^{-1}$ of potassium fertilizer.

## Conclusion

In this study, the production of cassava was investigated using three cultivars and different K-doses under drip irrigation and infertile sandy soils in arid conditions in Egypt. This work confirmed that the American cultivar is the most suitable to grow in Egypt recording the highest values in the growth parameters and yield as well as the yield quality. The K-dose 250 kg $K_2O$ fed$^{-1}$ achieved the highest values in all studied parameters of the American cultivar, whereas the dose of 70 kg $K_2O$ fed$^{-1}$ recorded the lowest values for the Indonesian cultivar. The importance of this study represents in determination the suitable K-fertilization program for different cultivars in Egypt. Further studies are needed to include more trails of this important crop. Cassava crop should handle in Egypt with much more cares and from different points of view including the agricultural, industrial and nutritional sides. This crop should be investigated based on its tolerance to the arid conditions, infertile soils and scarcity of water.

## Acknowledgment

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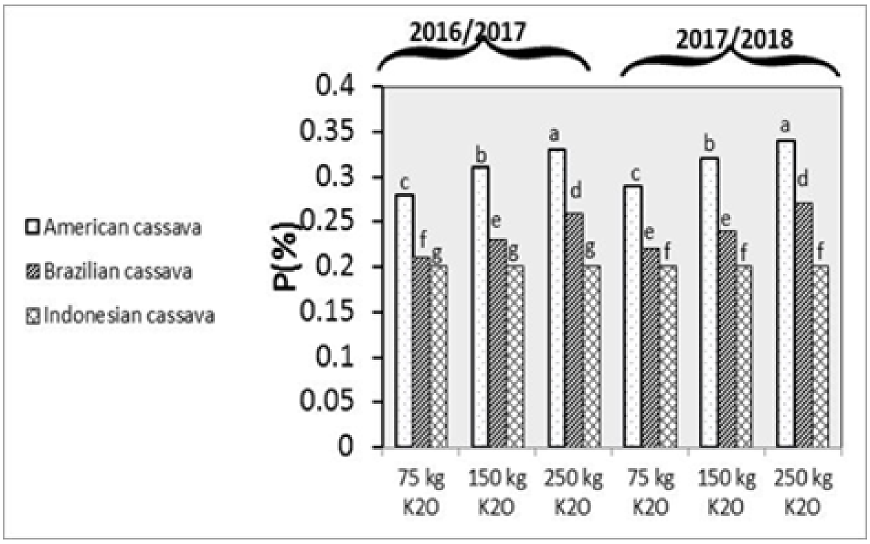
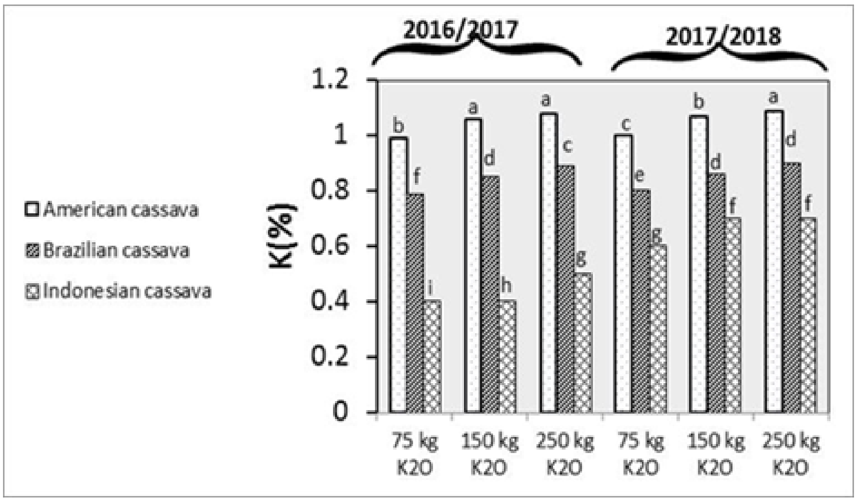
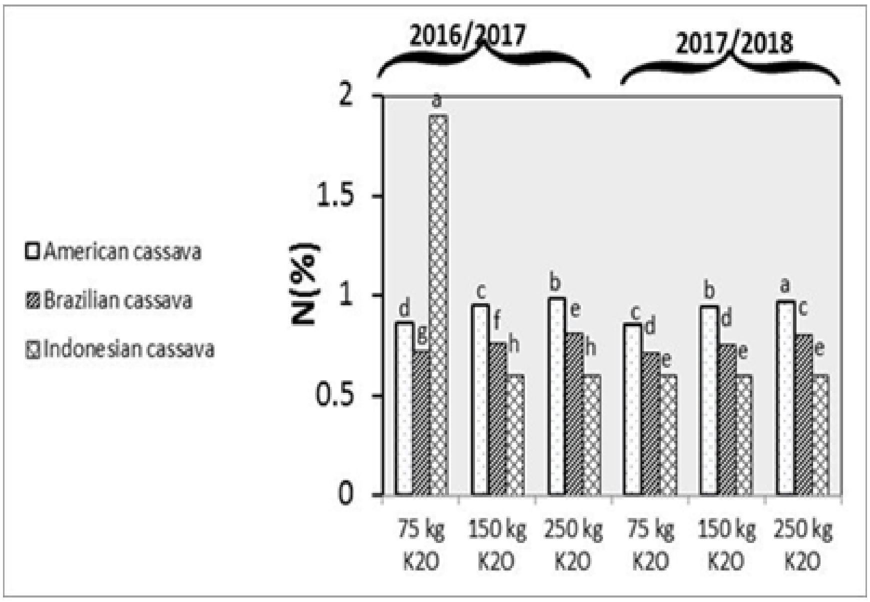
**TABLE 3. Effect of different cultivars and levels of potassium on chemical contents of tuber roots of cassava in (2016/2017) and (2017/2018) seasons**

| Treatments | First season (2016/2017) | | | | | | Second season (2017/2018) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Starch (%) | Total carbohydrates (%) | Total fibers (%) | N(%) | P(%) | K(%) | Starch (%) | Total carbohydrates (%) | Total fibers (%) | N (%) | P (%) | K (%) |
| Effect of cultivars | | | | | | | | | | | | |
| American cassava | 52.3 a | 63.1 a | 2.26 c | 0.9 a | 0.3 a | 1.0 a | 51.2 a | 60.4 a | 2.4 b | 0.90 a | 0.3 a | 1.1 a |
| Brazilian cassava | 45.0 b | 59.1 b | 2.72 b | 0.8 b | 0.2 b | 0.8 b | 43.9 b | 51.9 b | 2.6 a | 0.80 b | 0.2 b | 0.9 b |
| Indonesian cassava | 35.7 c | 53.9 c | 2.90 a | 1.0 c | 0.2 b | 0.5 c | 32.9 c | 43.2 c | 2.3 c | 0.60 c | 0.2 b | 0.7 c |
| Effect of potassium fertilizer level | | | | | | | | | | | | |
| 250 kg $K_2O$ | 46.8 a | 60.6 a | 2.29 c | 0.8 b | 0.3 a | 0.8 a | 45.3 a | 54.3 a | 2.4 a | 0.80 a | 0.3 a | 0.9 a |
| 150 kg $K_2O$ | 44.3 b | 58.9 b | 2.37 b | 0.8 b | 0.2 b | 0.8 a | 42.8 b | 51.6 b | 2.4 a | 0.80 a | 0.2 b | 0.9 a |
| 75 kg $K_2O$ | 42.0 c | 56.5 c | 3.22 a | 1.2 a | 0.2 b | 0.7 b | 39.9 c | 49.7 c | 2.4 a | 0.70 b | 0.2 b | 0.8 b |

Values followed by the same letter (s) are not significantly different at 5%.


2016/2017
2017/2018
P(%)
American cassava
Brazilian cassava
Indonesian cassava
75 kg K2O
150 kg K2O
250 kg K2O


2016/2017
2017/2018
K(%)
American cassava
Brazilian cassava
Indonesian cassava
75 kg K2O
150 kg K2O
250 kg K2O


2016/2017
2017/2018
N(%)
American cassava
Brazilian cassava
Indonesian cassava
75 kg K2O
150 kg K2O
250 kg K2O

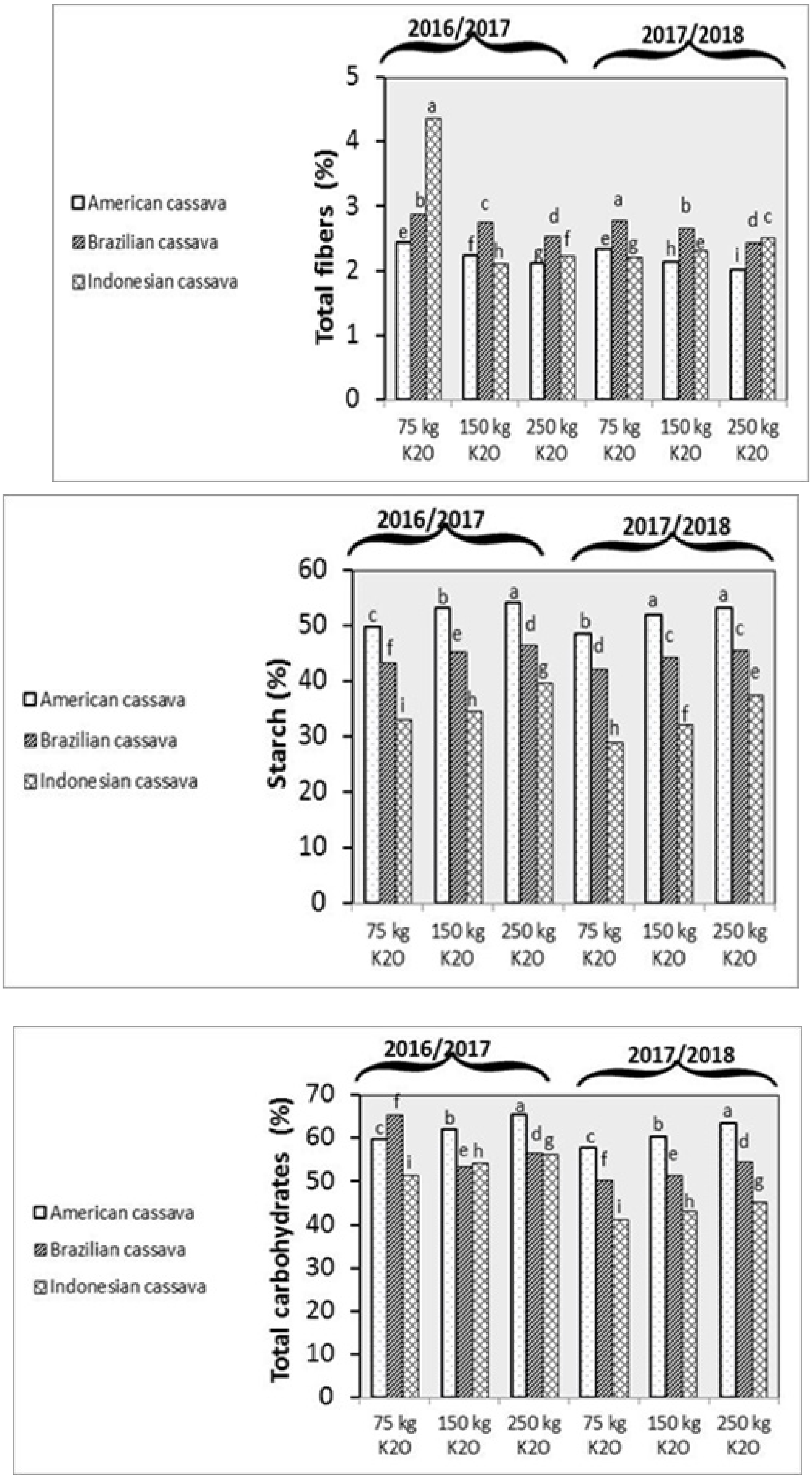



**Fig. 3. Effects of interaction between the two studied factors (cultivars and potassium rates) on the chemical composition of cassava of cassava plants in (2016/2017) and (2017/2018) seasons**

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## استجابة بعض أصناف محصول الكسافا لمستويات مختلفة من التسميد البوتاسي تحت نظام الري بالتنقيط وظروف التربة الرملية

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أجريت تجربتان حقليتان بمزرعة المركز القومى للبحوث في منطقة النوبارية (محافظة البحيرة) ، مصر ، خلال الموسمين المتتاليين ٢٠١٧/٢٠١٦ و ٢٠١٨/٢٠١٧ لدراسة إستجابة النمو الخضري والمحصول و جودتة لنباتات الكسافا لبعض أصناف الكسافا مع بعض معدلات سمادية للتسميد البوتاسى . تم إستخدام ثلاثة أصناف من الكسافا (الصنف الأمريكي و الصنف البرازيلي و الصنف الإندونيسي) وثلاثة مستويات من السماد البوتاسى (٧٥ و ١٥٠ و ٢٥٠ كجم /فدان). أوضحت النتائج أن صنف الكسافا الأمريكي مع التسميد البوتاسى بمعدل ٢٥٠ كجم/فدان سجل أعلى معدلات للنمو الخضري والمحصول وجودتة بالإضافة إلى المركبات الكيمائية باستثناء نسبة الألياف ومعدل النتيروجينالذى كان أعلى معدل لهما عند إستخدام الصنف البرازيلى مع التسميد البوتاسى بمعدل ٧٥ كجم/ فدان. كما أكدت هذه الدراسة أن التسميد البوتاسى للكسافا في التربة الرملية يدعم نباتات الكسافا المزروعة في نموها وإنتاجها وجودة المحصول الناتج.و فى هذا البحث أيضًا مزيدًا من التفاصيل حول مدى ملاءمة بعض أصناف الكسافا للزراعة تحت ظروف التربة الرملية والري بالتنقيط و جرعات التسميد البوتاسى التى يجب تطبيقها. هناك حاجة لمزيد من الأبحاث لإجراء برنامج كامل لتسميد وري أصناف الكسافا المختلفة في ظل ظروف الأراضى الرملية و القاحلة في مصر.