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Effect of Feldspar and Bio- Fertilization on Growth, Productivity and Fruit Quality of Banana cv. Grande Naine

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ABSTRACT

This study was undertaken during the two successive seasons of 2013 (first Ratoon plants) and 2014 (second Ratoon plants) to increase growth, productivity and improving fruit quality of banana cv. Grande Naine grown under sandy soil conditions at El-Khatatba region, using different levels of feldspar and bio-fertilization in combination. The obtained results showed that all vegetative growth parameters of Grande Naine banana plants i.e., pseudostem high and circumference, green leaves number, leaf area and assimilation area were greatly affected by the studied feldspar and bio-fertilizers treatments in both seasons. However, the tallest and thickest pseudostem were scored by the treatment of 8Kg feldspar +10 ml potassin " two doses" (T9) in the two seasons. Moreover, the highest number of green leaves /plant was recorded by 8Kg feldspar +10 ml potassin " two doses" (T9) followed by control treatment "recommended dose" (T1) in the first and second seasons. Whereas, the highest leaf area and assimilation area were registered by T1 plants, followed in descending order by 8Kg feldspar +10 ml potassin at " one dose" T5 and at two doses T9 treatments in both seasons. The highest leaf N, P and K contents were recorded by T9 plants, in the first and second seasons. The highest bunch weight, yield, bunch height and the bunch circumference were recorded by T9-fertilized plants, followed by T5-fertilizered plants. T5-fertilized plants showed to be the most effective treatment for producing the highest number of hands /bunch. Furthermore, the heaviest hand, the highest number of fingers/hand and the heaviest finger were registered by T9-fertilized plants. Moreover, T9-treated plants is being the most effective treatment for improving the studied fruit physical parameters of banana cv. Grande Naine i.e., finger length, finger diameter, pulp weight, peel weight and pulp/peel ratio. Additionally, the highest values of total soluble solids, total sugar and TSS/acidity were scored by T9-fertilized plants, whereas the lowest values of total acidity were registered by T9 and T5 treatments.

Key words: Banana cv. Grande Naine, feldspar, bio- fertilization, growth, leaf mineral content, yield and fruit quality.

Introduction

One of goals of Egyptian authorities is to increase the production of fruits to satisfy the requirements for local consumptions and export to foreign markets. The increase could be achieved in two ways: the fruit is the horizontal expansion by planting more land, and the second is the vertical expansion by improving cultural practices such as fertilization to raise the production of the same area of land. Thus, the aim of this work was to study the effect of different levels of feldspar and bio-fertilization on the growth and yield of banana plants.

Banana is the common name for herbaceous plants of the genus Musa and for the fruit they produce. It is one of the oldest cultivated plants. It is well known that banana needs large amounts of fertilizers especially potassium and nitrogen. So, the major problems facing banana growers are the high costs of excessive manufactured fertilizers needs for banana plants. Besides, these chemical fertilizers are considered as air, soil and water polluting agents during their production and utilization. Consequently, it has drowned the attention of researchers and banana growers to use another sources of fertilizers which are safe for human, animal and environment as a partial substitute for mineral source. Thus, it is preferred to use these natural fertilizers to avoid pollution and to reduce the costs of chemical fertilizers (Palmer, 1971 and El-Mahmoudy, 1975)

As is well known the importance of potassium fertilization of banana plants, potassium major elements, which plays an important role in plants and significantly influence on many human-health related quality compounds in fruits and vegetables (Usherwood 1985). It is involved in numerous biochemical and physiological processes vital to plant growth, yield, quality and stress (Marschner, 1995 and Cakmak, 2005). It resulted also in improving the fruit quality parameters i.e. total soluble solids, total sugars and coloration (Dutta, 2011 and Eliwa, 2003) These effects might be dedicated to the potassium role in increasing tolerance to stresses and improving the formation and accumulation rates of sugars (Saleh and Abd El-Moneim, 2003 and Wahdan *et al.,* 2011).

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Initial application of natural rocks (rock phosphate and feldspar) caused the release of the macro-elements and converted them to soluble from of phosphorus, potassium, calcium and magnesium in comparison with the compost without natural rocks (Fayed, 2005).

Feldspar rock contains potassium in ranges from 10 to 13 % and not easily suitable for direct application where Feldspar structure is Aluminum silicate combined with potassium to make Orthoclase ($KAlSi_3O_8$). It is a slow release fertilizer, so several laboratory studies have shown that microbes can increase the dissolution rate of silicate and aluminum silicate minerals, primarily by generating organic and inorganic acids (Barker *et al.,* 1997 and Aisha and Taalab, 2008). Also, the direct contact between bacteria and minerals may be important in mineral alteration and can enhance K mineral dissolution rate by producing and excreting metabolic by-products that elevate carbonic acid concentration at mineral surfaces (Chapelle *et al.,* 1987 and Paris *et al.,* 1996). So, the silicate dissolving bacteria (*Bacillus circulans*) are generally used to release potassium from rock-feldspar (Balabel, Naglaa, 1997 and Sheng and Huang, 2002).

Recently, biofertilization is considered an important tool to enhance the yield and fruit quality of fruits trees and it becomes, as positive alternative to chemical fertilizers. It is safe for human and environmental and using them was accompanied with reducing the great pollution occurred on our environment as well as for producing organic foods for export. Application of bio fertilizers in fruit trees orchard is a production system avoids or largely excludes (Abdelaal, *et al.,* 2010).

Therefore, this experiment was carried out to increase growth, productivity and improving fruit quality of banana cv. Grande Naine grown under sandy soil of El-Khatatba region, Minofia Governorate, using different levels of feldspar and bio-fertilization in combination.

Materials and Methods

This work was carried out at the sandy soil of El-Khatatba region, Minofia Governorate, Egypt, through the two successive seasons 2013 (first Ratoon plants) and 2014 (second Ratoon plants) of Grande Naine cultivar, Giant Cavendish AAA sub-group. Mother plants were planted at 3.0X3.5 m. apart in March 2012 and three suckers were selected per each (hole) and the others were removed. The experimental soil in texture and deficient in fertility according to mechanical and chemical analysis (Table, 1).

Table 1: Soil characteristics of the banana plantation at the start of the experiment.

Properties	Value	Properties	Value
Clay %	8.00	Na mg/L	2.91
Silt %	6.00	K mg/L	0.10
Fine sand %	30.50	Ca mg/L	1.24
Coarse sand %	55.50	Mg mg/L	0.86
Texture	Sandy	HCO_3 mg/L	2.01
PH	8.2	Cl mg/L	1.53
EC	0.84	SO_4 mg/L	0.63
Ca CO_3%	0.63		

The experimental plants received all the agricultural practices usually used in banana plantation except for the purpose of this study. The plants were received compost at the rate of 60m^3/fed./year with the soil root zone during the first week of December and the recommended fertilizer NPK (800, 100, 1000 N, P_2O_5, K_2O actual g/plant) in the forms (ammonium nitrate 33.5% N, phosphoric acid 80% P_2O_5 and potassium sulphate 48% (K_2O) (Ibrahim, 2003). The main source of water supply was well water with drip irrigation. The selected plants received all agriculture practices usually used in banana plantation.

Feldspar treatments:

Banana plants were received feldspar (Feldspar rock contains potassium in ranges from 10 to 13 %) at the rate of 2, 4, 6 and 8 Kg/plant in the two seasons in early March of both seasons, one trench (40×40×40cm) was excavated on one side of the plant, then the given amount of feldspar as a part of surface soil was mixed together and added to the chuck hole followed by the irrigation.

Bio-fertilization treatments:

Grande Naine banana plants were inoculated with potassin containing efficient strains of soluble potassium namely *Bacillus circulans* which supplied by Department of Microbiology, Agric. Res. Inst., Giza was used in this study as biological activators. The strain is characterized by a good ability to infect its specific host plant and by its high efficiency in potassium solublizing. Banana plants were received potassin at 10ml/plant one time at March or two times during March and April at the two seasons.

The experiment consisted of nine treatments as follow:

1- T1: Control (recommended doses)
2- T2: 2 Kg Feldspar + 10 ml potassin (one dose)
3- T3: 4 Kg Feldspar + 10 ml potassin (one dose)
4- T4: 6 Kg Feldspar + 10 ml potassin (one dose)
5- T5: 8 Kg Feldspar + 10 ml potassin (one dose)
6- T6: 2 Kg Feldspar + 10 ml potassin (two dose)
7- T7: 4 Kg Feldspar + 10 ml potassin (two dose)
8- T8: 6 Kg Feldspar + 10 ml potassin (two dose)
9- T9: 8 Kg Feldspar + 10 ml potassin (two dose)

Vegetative growth:

Morphological measurements were done at bunch shooting stage via the following parameters: pseudostem height (cm.), pseudostem circumference (cm.), number of green leaves per plant, leaf length (cm), leaf width (cm) then leaf area (m^2) of the third full sized leaf (from the top) was calculated using the equation =leaf length (cm) X leaf width (cm) X 0.8 (Murry, 1960) and assimilation area per plant (m^2). Assimilation area was determined using the equation = leaf area X number of green leaves (Ibrahim, 1993).

Bunch characteristics:

Bunch length and circumference (cm), bunch weight (kg), number of hands/bunch and number of fingers/hand were counted and recorded.

Finger parameters (physical and chemical):

Finger weight (g), finger length and diameter (cm), pulp weight (g), peel weight (g), pulp /peel ratio, total soluble solids (%), total sugars (%), starch, titratable acidity and T.S.S/acidity ratio were estimated from samples of ripened fruits taken from the middle portion (5^{th} and 6^{th}) of two hands for each bunch. Total sugar and titratable acidity were determined according to A.O.A.C (1995). T.S.S was estimated by hand refractometer as Brix.

Yield was calculated according to the following equations:

Yield = Bunch weight (kg) X Number of plants (1200 plants) /fed.

Leaf mineral content of N, P and K were also determined as follow:

Samples of leaves were taken from the third upper leaf in the descending foliar succession of the plant at bunch shooting as recommended by (Hewitt 1955) and adopted by (Saad and Attaweya 1999). Total nitrogen was determined by using micro-kjeldehl method as described by (Pregl 1945). Phosphorus was determined according to Evenhuis and Dewaored (1980). Potassium was determined according to photometric method described by (Brown and Lilleland, 1946).

Statistical analysis:

The obtained data in both seasons were statistically analyzed using analysis of variance method according to Snedecor and Cochran (1980). However, means were distinguished by the Duncan's multiple range tested Duncan (1955).

Results and Discussion

Effect of some feldspar levels and bio-fertilization on vegetative growth of Grande Naine banana plants.

Table (2) shows that all vegetative growth of Grande Naine banana plants i.e., pseudostem height and circumference, green leaves number, leaf area and assimilation area were greatly affected by the studied feldspar and bio-fertilizers treatments in both seasons .On the other hand, there was positive correlation between the values of studied vegetative growth and the levels of feldspar and bio-fertilizers, hence the values of vegetative growth increased as the levels of feldspar and bio-fertilizer increased until reach to the maximum increasing at the high level of feldspar and bio-fertilizer in the two seasons. However, the tallest plant (296.33 and 299.33cm) as well as the thickest pseudostem (89.33 and 88.00cm) were scored by the treatment of 8Kg feldspar + 10 ml potassin" one dose" (T9), followed in descending order by 8Kg feldspar+10ml potassin "one dose" treatment (T5) and control (recommended dose) (T1) in the first and second seasons, respectively. Moreover, the highest number of green leaves /plant (12.67 and 12.00) was recorded by T8 treatment, followed by T1 treatment which gave (11.67 and 11.33 leaves) in the first and second seasons, respectively. Whereas, the highest leaf area (2.13 and 2.10 m^2) and assimilation area (24.86 and 23.79m^2) were registered by T1 treatment, followed in

descending order by T5 and T9 treatments in both seasons. On contrary, the lowest values of these parameters were gained by 2 Kg feldspar + 10 ml potassin "one dose" (T2) and 2Kg feldspar + 10ml potassin "two doses" (T6) in the two seasons of this study. The remained treatments occupied an intermediate position between the aforementioned treatments in both seasons.

These results are confirmed by those obtained by Abd El-Naby and Gomaa (2000) on banana, Abou El-Khashab (2003) on olive, Abd-Rabou (2006) on avocado and mango, Baiea *et al.,* (2015) on mango Abd El-Migeed *et al.,* (2007) on Washington navel orange, Abd El-Moneim, Eman *et al.,* (2008) on Washington navel orange trees, Aseri *et al*., (2008) on Pomegranate, Dheware and Waghmare (2009) on sweet orange, Abdelaal *et al*., (2010) on orange, Rivera-Cruz *et al.,* (2010) in Sour orange, Barakat *et al*., (2011) on Williams banana, Abdel-Salam and Shams (2012) on Potato, Barakat *et al.,* (2012) on orange, Petry *et al.,* (2012) on Valencia oranges, Vazquez-Ovando and Andrino-Lopez (2012) on banana fruits (Grande Naine). Abdallah Dina, (2013) on Peach, Slim (2014) on Valencia orange.

Table 2: Effect of different levels of feldspar and potassin on some vegetative growth characteristics of Grande Naine banana plants during 2013 and 2014 seasons.

Parameters / Treatments	Pseudostem height (cm)		Pseudostem circumference (cm)		No. of green leaves\plant		Leaf area (m^2)		Assimilation area (m^2/plant)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
T1: Control (recommended doses)	281.33	282.33	82.33	83.67	11.67	11.33	2.13	2.10	24.86	23.79
T2: 2 Kg Feldspar + 10 ml potassin (one dose)	252.33	250.33	70.00	68.00	9.33	9.67	1.30	1.25	12.13	12.08
T3: 4 Kg Feldspar + 10 ml potassin (one dose)	274.33	277.33	80.00	81.00	10.67	10.33	1.75	1.71	18.67	17.66
T4: 6 Kg Feldspar + 10 ml potassin (one dose)	277.67	280.00	82.00	82.33	10.67	10.33	1.82	1.85	19.42	19.11
T5: 8 Kg Feldspar + 10 ml potassin (one dose)	282.00	288.00	84.33	84.67	10.33	10.67	1.97	1.99	20.35	21.23
T6: 2 Kg Feldspar + 10 ml potassin (two dose)	253.00	260.33	79.00	79.33	10.33	10.00	1.74	1.76	17.97	17.60
T7: 4 Kg Feldspar + 10 ml potassin (two dose)	277.00	278.33	81.67	81.00	10.33	10.67	1.87	1.79	19.31	19.10
T8: 6 Kg Feldspar + 10 ml potassin (two dose)	278.67	280.33	82.00	83.00	10.67	10.67	1.87	1.82	19.95	19.41
T9: 8 Kg Feldspar + 10 ml potassin (two dose)	296.33	299.33	89.33	88.00	12.67	12.00	1.92	1.93	24.32	23.16
LSD at 5%	6.315	6.452	4.016	4.550	1.143	1.320	0.969	1.527	2.407	2.902

Effect of some feldspar levels and bio-fertilization on some leaf chemical composition contents of Grande Naine banana plants.

Data in Tables (3) revealed that leaf N, P and K contents were responded for the tested feldspar and bio-fertilizer treatments in both seasons. However, the highest leaf N (3.110 and 3.113%), P (0.247 and 0.236 %) and K (3.900 and 3.847%) contents were recorded by T9 treatment, in the first and second seasons, respectively. Also, T5 and T1 treatments gave highly significant increments in this regard in the two seasons. On the reverse, the lowest values of these parameters were scored by T2 and T6 treatments in the two seasons. The rest treatments came in-between the aforementioned treatments in both seasons.

Table 3. Effect of different levels of feldspar and potassin on leaves contents of N, P and K of Grande Naine banana plants during 2013 and 2014 seasons.

Parameters / Treatments	N (%)		P (%)		K (%)	
	2013	2014	2013	2014	2013	2014
T1: Control (recommended doses)	3.020	3.073	0.227	0.216	3.613	3.723
T2: 2 Kg Feldspar + 10 ml potassin (one dose)	2.750	2.790	0.197	0.200	3.287	3.373
T3: 4 Kg Feldspar + 10 ml potassin (one dose)	2.820	2.853	0.200	0.213	3.397	3.483
T4: 6 Kg Feldspar + 10 ml potassin (one dose)	2.933	2.876	0.213	0.207	3.520	3.503
T5: 8 Kg Feldspar + 10 ml potassin (one dose)	3.090	3.070	0.243	0.220	3.803	3.820
T6: 2 Kg Feldspar + 10 ml potassin (two dose)	2.807	2.843	0.200	0.200	3.363	3.450
T7: 4 Kg Feldspar + 10 ml potassin (two dose)	2.877	2.883	0.207	0.207	3.450	3.493
T8: 6 Kg Feldspar + 10 ml potassin (two dose)	2.980	3.010	0.217	0.207	3.577	3.590
T9: 8 Kg Feldspar + 10 ml potassin (two dose)	3.110	3.113	0.247	0.236	3.900	3.847
LSD at 5%	0.065	0.147	0.014	0.021	0.077	0.155

The obtained results regarding leaf chemical contents of banana plants were supported by the findings of many investigators Gomaa and Abd El-Naby (2000) on banana, Abou El-Khashab (2003) on olive, Abd-Rabou (2006) on avocado and mango, Baiea *et al.,* (2015) on mango, Abd El-Migeed *et al.,* (2007) on Washington

navel orange, Abd El-Moneim, Eman *et al.,* (2008) on Washington Navel orange trees, Aseri *et al*., (2008) on Pomegranate, Dheware and Waghmare (2009) on sweet orange, Abdelaal *et al*., (2010) on orange, Rivera-Cruz *et al.,* (2010) in sour orange, Barakat *et al*., (2011) on Williams banana, Abdel-Salam and Shams (2012) on Potato, Barakat *et al.,* (2012) on orange, Petry *et al.,* (2012) on Valencia oranges, Vazquez-Ovando and Andrino-Lopez (2012) on banana fruits (Grande Naine). Abdallah Dina, (2013) on Peach, Slim (2014) on Valencia orange.

Effect of some feldspar levels and bio-fertilizer treatment on yield parameters of Grande Naine banana plants.

Data in Table (4) declared that yield parameters of Grande Naine banana plants were positively responded for the studied treatments in the both seasons. However, the highest bunch weight (35.47 and 32.16 Kg), yield (42.57 and 38.60 ton/fed.), bunch length (119.00 and 113.00 cm) and the bunch circumference (121.33 and 115.33cm) were recorded by T9-fertilized plants, followed by T5-fertilizered plants which recorded (34.29 and 31.33Kg), (41.15 and 37.60 ton/fed.), (113.00 and 109.00cm) and (116.33 and 114.67cm) for bunch weight, yield, bunch length and bunch circumference, in the first and second seasons, respectively. Moreover, T1-fertilized plant induced high significant increases in these parameters in the two seasons. On the reverse, the lowest values of these parameters were recorded by T2 and T6 treatments in the two seasons. The rest treatments occupied an intermediate position between the aforementioned treatments in both seasons. However, the differences between the above-mentioned two treatments did not reach to the level of significant in most cases in the two seasons.

These results go in parallel with those of Abou El-Khashab (2003) on olive, Abd-Rabou (2006) on avocado and mango, Baiea *et al.,* (2015) on mango, Abd El-Migeed *et al.,* (2007) on Washington navel orange, Abd El-Moneim, Eman *et al.,* (2008) on Washington Navel orange trees, Aseri *et al*., (2008) on Pomegranate, Dheware and Waghmare (2009) on sweet orange, Abdelaal *et al*., (2010) on orange, Rivera-Cruz *et al.,* (2010) in sour orange, Barakat *et al*., (2011) on Williams banana, Abdel-Salam and Shams (2012) on Potato, Barakat *et al.,* (2012) on orange, Petry *et al.,* (2012) on Valencia oranges, Vazquez-Ovando and Andrino-Lopez (2012) on banana fruits (Grande Naine). Abdallah Dina, (2013) on Peach, Slim (2014) on Valencia orange.

Table 4: Effect of different levels of feldspar and potassin on yield and bunch characteristics of Grande Naine banana plants during 2013 and 2014 seasons.

Parameters / Treatments	Bunch weight (Kg)		Yield (ton/feddan)		Bunch length (cm)		Bunch circumference (cm)	
	2013	2014	2013	2014	2013	2014	2013	2014
T1: Control (recommended doses)	27.96	28.29	33.55	33.95	111.00	109.33	115.33	114.33
T2: 2 Kg Feldspar + 10 ml potassin (one dose)	18.15	13.78	21.78	16.53	89.00	88.33	93.33	92.67
T3: 4 Kg Feldspar + 10 ml potassin (one dose)	20.20	19.74	24.24	23.69	102.67	105.33	104.33	109.67
T4: 6 Kg Feldspar + 10 ml potassin (one dose)	23.72	22.89	28.47	27.47	107.00	106.67	110.00	111.67
T5: 8 Kg Feldspar + 10 ml potassin (one dose)	34.29	31.33	41.15	37.60	113.00	109.00	116.33	114.67
T6: 2 Kg Feldspar + 10 ml potassin (two dose)	15.96	19.31	19.15	23.18	101.67	103.33	105.00	106.00
T7: 4 Kg Feldspar + 10 ml potassin (two dose)	23.39	22.26	28.01	26.71	104.33	107.00	109.00	111.33
T8: 6 Kg Feldspar + 10 ml potassin (two dose)	25.59	24.38	30.71	29.26	109.67	111.33	113.33	113.67
T9: 8 Kg Feldspar + 10 ml potassin (two dose)	35.47	32.16	42.57	38.60	119.00	113.00	121.33	115.33
LSD at 5%	5.000	5.789	5.505	6.370	5.343	6.493	4.984	7.293

Effect of some feldspar levels and bio-fertilizer treatments on bunch parameters of Grande Naine banana plants.

Data presented in Table (5) pointed out that the heaviest hand (1.98 and 1.97 kg), the highest number of fingers/hand (18.00 and 18.00) and the heaviest finger (109.67 and 109.33g) were registered by T9-fertilized plants, followed by T5-fertilized plants in the two seasons. The differences between T9 and T5 were not significant in most cases in the two assigned seasons. Besides, T1-treated plants gave high values in this concern in the two seasons. On contrary, the lowest values of these parameters were scored by T2 and T6-treated plants in the two seasons. The remained treatments came in-between the aforementioned treatments in the two seasons.

These results are confirmed by those obtained Abou El-Khashab (2003) on olive, Abd-Rabou (2006) on avocado and mango, Abd El-Migeed *et al.,* (2007) on Washington navel orange, Abd El-Moneim, Eman *et al.,* (2008) on Washington Navel orange trees, Aseri *et al*., (2008) on Pomegranate, Dheware and Waghmare

(2009) on sweet orange, Abdelaal *et al*., (2010) on orange, Rivera-Cruz *et al.,* (2010) in sour orange, Barakat *et al*., (2011) on Williams banana, Abdel-Salam and Shams (2012) on Potato, Barakat *et al.,* (2012) on orange, Petry *et al.,* (2012) on Valencia oranges, Vazquez-Ovando and Andrino-Lopez (2012) on banana fruits (Grande Naine). Abdallah Dina, (2013) on Peach, Slim (2014) on Valencia orange.

Table 5: Effect of different levels of feldspar and potassin on physical characteristics of bunch and fingers of Grande Naine banana plants during 2013 and 2014 seasons.

Parameters / Treatments	Hand weight (Kg)		No. of Fingers\hand		Finger weight (g)	
	2013	2014	2013	2014	2013	2014
T1: Control (recommended doses)	1.72	1.78	16.67	16.33	103.00	109.67
T2: 2 Kg Feldspar + 10 ml potassin (one dose)	1.18	1.14	13.33	12.33	88.33	86.67
T3: 4 Kg Feldspar + 10 ml potassin (one dose)	1.35	1.40	14.67	15.00	92.00	93.00
T4: 6 Kg Feldspar + 10 ml potassin (one dose)	1.51	1.58	15.67	16.33	96.00	96.67
T5: 8 Kg Feldspar + 10 ml potassin (one dose)	1.91	1.87	17.67	17.67	108.00	110.00
T6: 2 Kg Feldspar + 10 ml potassin (two dose)	1.23	1.29	13.00	14.33	94.33	89.67
T7: 4 Kg Feldspar + 10 ml potassin (two dose)	1.41	1.41	15.00	14.67	94.00	95.67
T8: 6 Kg Feldspar + 10 ml potassin (two dose)	1.77	1.64	16.00	16.33	110.67	100.00
T9: 8 Kg Feldspar + 10 ml potassin (two dose)	1.98	1.97	18.00	18.00	109.67	109.33
LSD at 5%	0.202	0.183	2.113	2.311	3.676	6.105

Effect of some feldspar levels and bio-fertilizer treatments on physical characteristics of Grande Naine banana fruits.

Data presented in Table (6) showed that T9-treated plants showed to be the most effective treatment for improving the studied fruit physical parameters of banana cv. Grande Naine *i.e.,* finger length, finger diameter, pulp weight, peel weight and pulp/peel ratio. Also, T4 and T7 treatments statistically recorded some high increments in these parameters. This trend was true in the two seasons. On contrary, the lowest values of these parameters were recorded by T2-fertilized plant in the both seasons. The remained treatments occupied an intermediate position between the above-mentioned treatments in the two seasons of this study.

Table 6: Effect of different levels of feldspar and potassin on some fruit physical characteristics of Grande Naine banana plants during 2013 and 2014 seasons.

Parameters / Treatments	Finger length (cm)		Finger diameter (cm)		Pulp weight (g)		Peel weight (g)		pulp\peel ratio	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
T1: Control (recommended doses)	17.83	17.37	3.55	3.53	64.65	70.85	38.35	38.48	1.69	1.84
T2: 2 Kg Feldspar + 10 ml potassin (one dose)	14.47	14.13	3.38	3.39	52.90	51.59	35.43	35.07	1.49	1.47
T3: 4 Kg Feldspar + 10 ml potassin (one dose)	16.93	16.97	3.42	3.43	54.83	58.48	37.17	34.52	1.48	1.69
T4: 6 Kg Feldspar + 10 ml potassin (one dose)	15.73	17.61	3.48	3.62	58.87	61.21	37.13	35.46	1.59	1.73
T5: 8 Kg Feldspar + 10 ml potassin (one dose)	18.73	18.53	3.63	3.63	68.58	70.23	39.75	39.78	1.73	1.77
T6: 2 Kg Feldspar + 10 ml potassin (two dose)	16.93	16.23	3.38	3.42	48.26	56.26	36.40	33.40	1.33	1.68
T7: 4 Kg Feldspar + 10 ml potassin (two dose)	16.40	16.00	3.47	3.50	57.69	61.58	36.31	34.09	1.58	1.81
T8: 6 Kg Feldspar + 10 ml potassin (two dose)	16.23	16.23	3.50	3.53	71.42	64.92	39.25	35.08	1.82	1.85
T9: 8 Kg Feldspar + 10 ml potassin (two dose)	18.98	18.70	3.64	3.65	70.85	70.57	38.82	39.10	1.82	1.80
LSD at 5%	0.264	0.807	0.134	0.145	3.20	5.018	0.810	1.672	0.130	0.116

These results are confirmed by those obtained by Abou El-Khashab (2003) on olive, Abd-Rabou (2006) on avocado and mango, Baiea *et al.,* (2015) on mango, Abd El-Migeed *et al.,* (2007) on Washington navel orange, Abd El-Moneim, Eman *et al.,* (2008) on Washington Navel orange trees, Aseri *et al*., (2008) on Pomegranate, Dheware and Waghmare (2009) on sweet orange, Abdelaal *et al*., (2010) on orange, Rivera-Cruz *et al.,* (2010) in sour orange, Barakat *et al*., (2011) on Williams banana, Abdel-Salam and Shams (2012) on Potato, Barakat *et al.,* (2012) on orange, Petry *et al.,* (2012) on Valencia oranges, Vazquez-Ovando and Andrino-Lopez (2012) on banana fruits (Grande Naine). Abdallah Dina, (2013) on Peach, Slim (2014) on Valencia orange.

Effect of some feldspar levels and bio-fertilizer treatments on fruit quality of Grande Naine banana plants.

Data in Table (7) demonstrated that the highest values of total soluble solids (21.99 and 21.91%), total sugar (17.69 and 17.70%) and TSS/acidity (67.97 and 69.79) were scored by T9-fertilized plants, followed in descending order by T5 and T1treatments in the two seasons. Whereas, the lowest values of total acidity were registered by T9 and T5 treatments as they gave not only non-significant differences, but also gave the same exact values in the two seasons. In addition, T1-fertilized plants recorded low values in this concern in both seasons. On the other hand, the richest fruits starch content was gained by T2-treated plants, followed by T6-treated plants in the two seasons. On contrary, the lowest values of fruits starch content were registered by T9 and T1 treatments in the two seasons.

These results are coincided by those obtained by Abou El-Khashab (2003) on olive, Abd-Rabou (2006) on avocado and mango, Abd El-Migeed *et al.,* (2007) on Washington navel orange, Abd El-Moneim, Eman *et al.,* (2008) on Washington navel orange trees, Aseri *et al*., (2008) on Pomegranate, Dheware and Waghmare (2009) on sweet orange, Abdelaal *et al*., (2010) on orange, Rivera-Cruz *et al.,* (2010) in sour orange, Barakat *et al*., (2011) on Williams banana, Abdel-Salam and Shams (2012) on Potato, Barakat *et al.,* (2012) on orange, Petry *et al.,* (2012) on Valencia oranges, Vazquez-Ovando and Andrino-Lopez (2012) on banana fruits (Grande Naine). Abdallah Dina, (2013) on Peach, Slim (2014) on Valencia orange.

Table 7: Effect of different levels of feldspar and potassin on some fruit chemical characteristics of Grande Naine banana plants during 2013 and 2014 seasons.

Parameters / Treatments	Total soluble solids (TSS) (%)		Total acidity (TA) (%)		TSS\Acidity		Total sugar (%)		Starch (%)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
T1: Control (recommended doses)	21.52	21.53	0.33	0.33	65.21	65.24	17.55	16.97	1.88	1.87
T2: 2 Kg Feldspar + 10 ml potassin (one dose)	18.94	18.86	0.40	0.40	47.35	47.15	15.00	15.13	2.31	2.34
T3: 4 Kg Feldspar + 10 ml potassin (one dose)	19.84	20.03	0.37	0.38	53.62	54.71	16.05	16.15	2.08	2.12
T4: 6 Kg Feldspar + 10 ml potassin (one dose)	20.99	21.32	0.34	0.36	61.73	59.22	16.86	16.88	2.01	2.02
T5: 8 Kg Feldspar + 10 ml potassin (one dose)	21.97	21.64	0.32	0.32	68.66	51.52	17.68	17.31	1.83	1.87
T6: 2 Kg Feldspar + 10 ml potassin (two dose)	19.49	19.58	0.39	0.38	49.97	54.19	15.98	15.80	2.22	2.20
T7: 4 Kg Feldspar + 10 ml potassin (two dose)	19.95	20.05	0.36	0.37	55.42	56.69	16.14	16.51	2.02	2.08
T8: 6 Kg Feldspar + 10 ml potassin (two dose)	21.05	21.44	0.33	0.35	63.79	61.26	17.13	16.95	1.89	1.95
T9: 8 Kg Feldspar + 10 ml potassin (two dose)	21.99	21.91	0.32	0.32	68.71	68.49	17.69	17.70	1.80	1.82
LSD at 5%	1.27	1.14	0.029	0.048	5.402	8.881	0.304	0.435	0.050	0.055

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